De Novo Synthesis of α-Ketoamides via Pd/TBD Synergistic Catalysis

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Supporting Information

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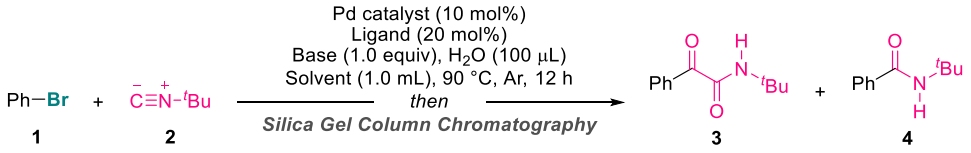
1. General information

Unless otherwise noted, all commercially available reagents were used without further purification. All of the solvents were treated according to known methods. Column chromatography was performed on silica gel (300-400 mesh). ^{1}H-NMR (400 MHz) chemical shifts were reported in ppm (δ) relative to tetramethylsilane (TMS) with the solvent resonance employed as the internal standard. ^{13}C-NMR (101 MHz) chemical shifts were reported in ppm (δ) from tetramethylsilane (TMS) with the solvent resonance as the internal standard. Data were reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, td = triplet of doublets, m = multiplet, br s = broad single), coupling constants (Hz) and integration. HRMS measurements were obtained on a Orbitrap analyzer. High-resolution mass spectra were recorded on a Waters Xevo G2-XS QTof spectrometer and Thermo Q Exactive Focus. Melting points were uncorrected. X-ray crystallographic data were collected by a diffractometer Rigaku Oxford Diffraction Supernova Dual Source.

2. Optimization of reaction conditions

2.1 Synthesis of 3 from bromobenzene

Table S1. Screening of ligands, Pd catalysts, solvents and base[a]

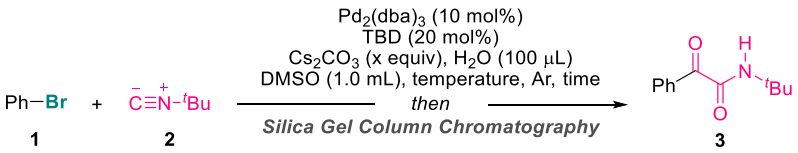


Entry	Ligand	Pd catalyst	Solvent	Base	Yield (%)[b]	
					3	**4**
1	L1	$PdCl_2$	DMSO	Cs_2CO_3	36	trace
2	L2	$PdCl_2$	DMSO	Cs_2CO_3	NR	—
3	L3	$PdCl_2$	DMSO	Cs_2CO_3	NR	—
4	L4	$PdCl_2$	DMSO	Cs_2CO_3	NR	—
5	L5	$PdCl_2$	DMSO	Cs_2CO_3	NR	—
6	L6	$PdCl_2$	DMSO	Cs_2CO_3	NR	—
7	L7	$PdCl_2$	DMSO	Cs_2CO_3	49	trace
8[c]	L8	$PdCl_2$	DMSO	Cs_2CO_3	0	74
9	L9	$PdCl_2$	DMSO	Cs_2CO_3	24	trace
10	L10	$PdCl_2$	DMSO	Cs_2CO_3	38	trace
11	L11	$PdCl_2$	DMSO	Cs_2CO_3	NR	—
12	L12	$PdCl_2$	DMSO	Cs_2CO_3	27	trace
13	L7	$Pd(OAc)_2$	DMSO	Cs_2CO_3	32	trace
14	L7	PdI_2	DMSO	Cs_2CO_3	40	—
15	L7	$Pd(TFA)_2$	DMSO	Cs_2CO_3	37	trace
16	L7	$PdCl_2$(dppb)	DMSO	Cs_2CO_3	32	—
17	L7	$PdCl_2$(nbd)	DMSO	Cs_2CO_3	34	—
18	L7	[(π-cinnamyl)PdCl]$_2$	DMSO	Cs_2CO_3	trace	—
19	L7	$PdCl_2$(dippp)	DMSO	Cs_2CO_3	28	—
20	L7	$Pd(OTF)_2$(dippp)	DMSO	Cs_2CO_3	35	—
21	L7	Pd-117	DMSO	Cs_2CO_3	41	—
22	L7	[Pd(allyl)Cl]$_2$	DMSO	Cs_2CO_3	trace	—
23	**L7**	**$Pd_2(dba)_3$**	**DMSO**	**Cs_2CO_3**	**63**	**trace**
24	L7	$PdCl_2(CH_3CN)_2$	DMSO	Cs_2CO_3	trace	—
25	L7	$PdCl_2(CH_2CN)_4(BF_4$	DMSO	Cs_2CO_3	33	—
26	L7	$Pd(PPh_3)_4$	DMSO	Cs_2CO_3	34	trace

27	L7	$Pd(OPiv)_2$	DMSO	Cs_2CO_3	41	trace
28	L7	$Pd_2(dba)_3$	DMF	Cs_2CO_3	16	trace
29	L7	$Pd_2(dba)_3$	DMA	Cs_2CO_3	19	—
30	L7	$Pd_2(dba)_3$	1,4-dioxane	Cs_2CO_3	trace	—
31	L7	$Pd_2(dba)_3$	PhMe	Cs_2CO_3	trace	—
32	L7	$Pd_2(dba)_3$	mesitylene	Cs_2CO_3	trace	—
33	L7	$Pd_2(dba)_3$	MeCN	Cs_2CO_3	trace	—
34	L7	$Pd_2(dba)_3$	DCE	Cs_2CO_3	trace	—
35	L7	$Pd_2(dba)_3$	DMSO	CsF	18	trace
36	L7	$Pd_2(dba)_3$	DMSO	KOH	19	—
37	L7	$Pd_2(dba)_3$	DMSO	K_2CO_3	32	trace
38	L7	$Pd_2(dba)_3$	DMSO	^{t}BuOK	22	trace
39	L7	$Pd_2(dba)_3$	DMSO	HCOON	trace	—
40	L7	$Pd_2(dba)_3$	DMSO	Et_3N	trace	—

[a]Reaction conditions: Bromobenzene (**1**, 0.2 mmol), *tert*-butyl isocyanide (**2**, 3.0 equiv, 0.6 mmol), ligand (20 mol%), Pd catalyst (10 mol%), base (1.0 equiv, 0.2 mmol), and H_2O (100 μL) in 1.0 mL of dry solvent under an Ar atmosphere at 90 ºC for 12 h. [b]Isolated yield of **3** and **4** based on bromobenzene is given. [c]Performed with 5 mol% of $PdCl_2$ and 10 mol% of PPh_3. DMSO = dimethyl sulfoxide. DMF = *N*,*N*-dimethylformamide. DMA = *N,N*-Dimethylacetamide. DCE = 1,2-dichloroethane. NR = no reaction.

Table S2. Screening of other reaction parameters[a]

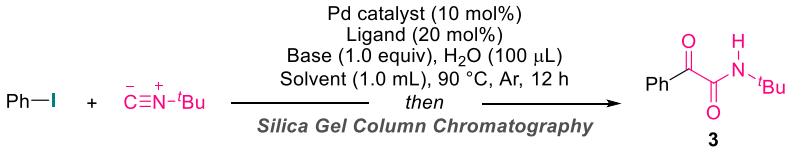


Entry	Cs_2CO_3 (x equiv)	**2** (y equiv)	Temperature (ºC)	Time	Yield (%)[b]
1	1.0	3.0	90	12	63
2	2.0	3.0	90	12	77
3	3.0	3.0	90	12	60
4	2.0	2.0	90	12	56
5	**2.0**	**2.5**	**90**	**12**	**81**
6	2.0	3.5	90	12	69
7	2.0	4.0	90	12	65
8	2.0	2.5	120	12	37
9	2.0	2.5	90	3	49
10	2.0	2.5	90	6	70
11	2.0	2.5	90	18	76
12[c]	2.0	2.5	90	12	63

[a]Reaction conditions: Bromobenzene (**1**, 0.2 mmol), *tert*-butyl isocyanide (**2**, y equiv, 0.2y mmol), TBD (20 mol%), $Pd_2(dba)_3$ (10 mol%), Cs_2CO_3 (x equiv, 0.2x mmol), and H_2O (100 µL) in dry DMSO (1.0 mL) under an Ar atmosphere at 90−120 ºC for 3−18 h. [b]Isolated yield of **3** based on bromobenzene is given. [c]Performed with 5 mol% of $Pd_2(dba)_3$.

2.2 Synthesis of 3 from iodobenzene

Table S3. Screening of ligands, Pd-catalysts, solvents and base[a]

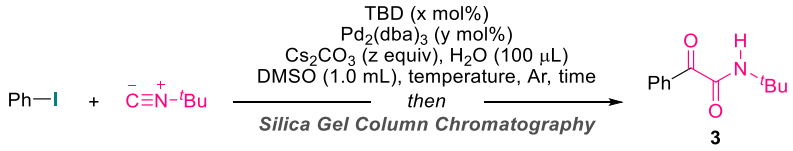


Entry	Ligand	Pd catalyst	Solvent	Base	Yield (%)[b]
1	L1	$PdCl_2$	DMSO	Cs_2CO_3	31
2	L2	$PdCl_2$	DMSO	Cs_2CO_3	trace
3	L3	$PdCl_2$	DMSO	Cs_2CO_3	NR
4	L4	$PdCl_2$	DMSO	Cs_2CO_3	NR
5	L5	$PdCl_2$	DMSO	Cs_2CO_3	NR
6	L6	$PdCl_2$	DMSO	Cs_2CO_3	NR
7	L7	$PdCl_2$	DMSO	Cs_2CO_3	62
8	L8	$PdCl_2$	DMSO	Cs_2CO_3	NR
9	L9	$PdCl_2$	DMSO	Cs_2CO_3	53
10	L10	$PdCl_2$	DMSO	Cs_2CO_3	44
11	L11	$PdCl_2$	DMSO	Cs_2CO_3	NR
12	L12	$PdCl_2$	DMSO	Cs_2CO_3	43
13	L13	$PdCl_2$	DMSO	Cs_2CO_3	43
14	L14	$PdCl_2$	DMSO	Cs_2CO_3	trace
15	L15	$PdCl_2$	DMSO	Cs_2CO_3	trace
16	L16	$PdCl_2$	DMSO	Cs_2CO_3	NR
17	L17	$PdCl_2$	DMSO	Cs_2CO_3	trace
18	L7	$Pd(OAc)_2$	DMSO	Cs_2CO_3	36
19	L7	$PdBr_2$	DMSO	Cs_2CO_3	37
20	L7	$PdCl_2(PPh_3)_2$	DMSO	Cs_2CO_3	49
21	L7	$Pd(TFA)_2$	DMSO	Cs_2CO_3	53
22	L7	$PdCl_2$(nbd)	DMSO	Cs_2CO_3	65
23	L7	[(π-cinnamyl)$PdCl]_2$	DMSO	Cs_2CO_3	29
24	L7	$PdCl_2$(dppb)	DMSO	Cs_2CO_3	36
25	L7	$Pd(dppf)_2Cl_2$	DMSO	Cs_2CO_3	39
26	L7	$PdCl_2$(dippp)	DMSO	Cs_2CO_3	trace
27	L7	PdI_2	DMSO	Cs_2CO_3	30
28	L7	$PdCl_2(CH_3CN)_2$	DMSO	Cs_2CO_3	50

29	L7	$PdCl_2(CH_2CN)_4(BF_4)_2$	DMSO	Cs_2CO_3	51
30	L7	Pd-117	DMSO	Cs_2CO_3	51
31	L7	$Pd(PPh_3)_4$	DMSO	Cs_2CO_3	52
32	**L7**	**$Pd_2(dba)_3$**	**DMSO**	**Cs_2CO_3**	70
33	L7	$Pd(OPiv)_2$	DMSO	Cs_2CO_3	25
34	L7	$Pd(OTf)_2$(dippp)	DMSO	Cs_2CO_3	26
35	L7	1,3-bis[2,6-bis(1-methyl ethyl)phenyl]-1,3-dihydro-2*H*-imid azol-2-ylidene]chloro (η3-2-propen-1-yl)palladium	DMSO	Cs_2CO_3	52
36	L7	dichloro[1,3-bis(diisopropylphenyl)-2-imidazolidinylide ne]palladium(II)dimer	DMSO	Cs_2CO_3	trace
37	L7	$[PdCl(2\text{-}(dimethyl amino)methylphenyl)]_2$	DMSO	Cs_2CO_3	67
38	L7	$Pd_2(dba)_3$	DMF	Cs_2CO_3	23
39	L7	$Pd_2(dba)_3$	DMA	Cs_2CO_3	24
40	L7	$Pd_2(dba)_3$	1,4-dioxane	Cs_2CO_3	trace
41	L7	$Pd_2(dba)_3$	NMP	Cs_2CO_3	24
42	L7	$Pd_2(dba)_3$	HMPA	Cs_2CO_3	22
43	L7	$Pd_2(dba)_3$	toluene	Cs_2CO_3	trace
44	L7	$Pd_2(dba)_3$	benzotrifluoride	Cs_2CO_3	trace
45	L7	$Pd_2(dba)_3$	mesitylene	Cs_2CO_3	trace
46	L7	$Pd_2(dba)_3$	MeCN	Cs_2CO_3	trace
47	L7	$Pd_2(dba)_3$	DCE	Cs_2CO_3	trace
48	L7	$Pd_2(dba)_3$	cyclohexane	Cs_2CO_3	NR
49	L7	$Pd_2(dba)_3$	DMSO	CsF	12
50	L7	$Pd_2(dba)_3$	DMSO	KOH	24
51	L7	$Pd_2(dba)_3$	DMSO	K_2CO_3	21
52	L7	$Pd_2(dba)_3$	DMSO	^{t}BuOK	17

[a]Reaction conditions: Iodobenzene (0.2 mmol), *tert*-butyl isocyanide (3.0 equiv, 0.6 mmol), Pd catalyst (10 mol%), base (1.0 equiv, 0.2 mmol), and H_2O (100 μL) in 1.0 mL of dry solvent under an Ar atmosphere at 90 ºC for 12 h. [b]Isolated yield of **3** based on iodobenzene is given. DMSO = dimethyl sulfoxide. DMF = *N*,*N*-dimethylformamide. DMA = *N,N*-Dimethylacetamide. NMP = *N*-methylpyrrolidone. HMPA = Hexamethylphosphoramide. DCE = 1,2-dichloroethane. NR = no reaction.

Table S4. Screening of other reaction parameters[a]



Entry	Time	Isocyanide (w equiv)	Cs_2CO_3 (z equiv)	$Pd_2(dba)_3$ (y mol%)	TBD (x mol%)	Temperature (ºC)	Yield (%)[b]
1	12 h	3.0	1.0	10	20	90	70
2	4 h	3.0	1.0	10	20	90	64
3	1 h	3.0	1.0	10	20	90	74
4	50 min	3.0	1.0	10	20	90	65
5	30 min	3.0	1.0	10	20	90	58
6	20 min	3.0	1.0	10	20	90	33
7	10 min	3.0	1.0	10	20	90	21
8	1 h	2.0	1.0	10	20	90	70
9	1 h	2.5	1.0	10	20	90	75
10	1 h	3.0	1.0	10	20	90	77
11	1 h	3.5	1.0	10	20	90	77
12	1 h	2.5	1.5	10	20	90	84
13	**1 h**	**2.5**	**2.0**	**10**	**20**	**90**	**93**
14	1 h	2.5	2.5	10	20	90	84
15	1 h	2.5	2.0	5	20	90	54
16	1 h	2.5	2.0	10	10	90	46

17	1 h	2.5	2.0	10	20	80	72
18	1 h	2.5	2.0	10	20	70	34

[a]Reaction conditions: Iodobenzene (0.2 mmol), *tert*-butyl isocyanide (w equiv, 0.2w mmol), TBD (x mol%), $Pd_2(dba)_3$ (y mol%), Cs_2CO_3 (z equiv, 0.2z mmol), and H_2O (100 μL) in dry DMSO (1.0 mL) under an Ar atmosphere at 70−90 ºC for 10 min−12 h. [b]Isolated yield of **3** based on iodobenzene is given.

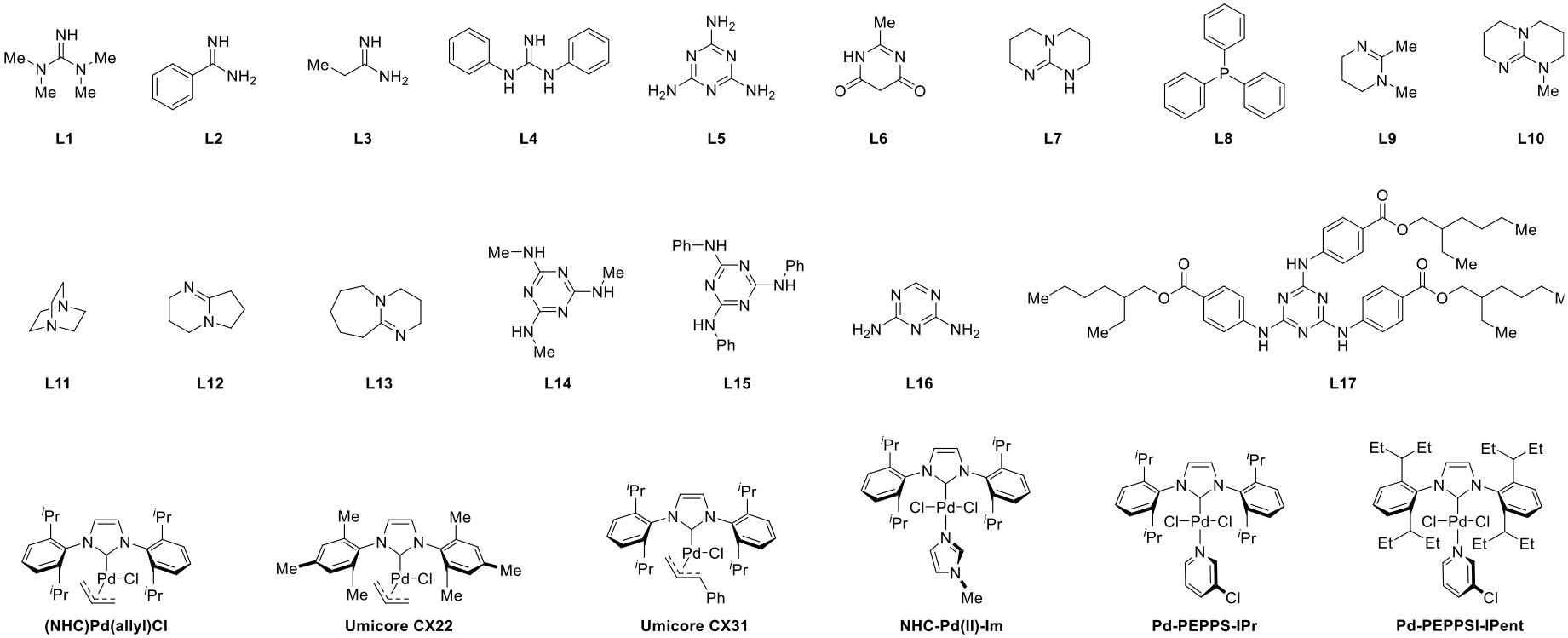
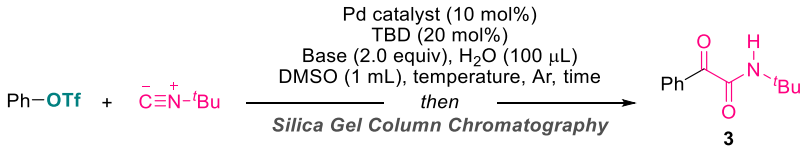


Fig. S1 Ligands and palladium complexes examined in the optimization of reaction conditions for the synthesis of **3**

2.3 Synthesis of 3 from phenyl trifluoromethanesulfonate

Table S5. Screening of temperature, time, Pd-catalysts and base[a]

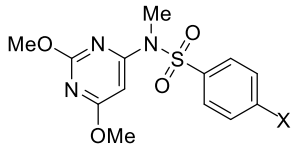


Entry	Temperature (ºC)	Time (h)	Pd catalyst	Base	Yield (%)[b]
1	90	6	$Pd_2(dba)_3$	Cs_2CO_3	8
2	90	12	$Pd_2(dba)_3$	Cs_2CO_3	9
3	120	6	$Pd_2(dba)_3$	Cs_2CO_3	13
4	120	12	$Pd_2(dba)_3$	Cs_2CO_3	13
5	150	6	$Pd_2(dba)_3$	Cs_2CO_3	11
6	150	12	$Pd_2(dba)_3$	Cs_2CO_3	10
7	120	6	$Pd(dba)_2$	Cs_2CO_3	13
8	120	6	$PdCl_2$	Cs_2CO_3	25
9	120	6	$Pd(OAc)_2$	Cs_2CO_3	12
10	120	6	$PdBr_2$	Cs_2CO_3	8
11	120	6	$PdCl_2(PPh_3)_2$	Cs_2CO_3	trace
12	120	6	$Pd(TFA)_2$	Cs_2CO_3	trace
13	120	6	$PdCl_2$(nbd)	Cs_2CO_3	9
14	120	6	[(π-cinnamyl)PdCl]$_2$	Cs_2CO_3	20
15	120	6	$PdCl_2$(dppb)	Cs_2CO_3	trace
16	120	6	$Pd(dppf)_2Cl_2$	Cs_2CO_3	trace
17	120	6	$PdCl_2$(dippp)	Cs_2CO_3	trace
18	120	6	PdI_2	Cs_2CO_3	18
19	120	6	$PdCl_2(CH_3CN)_2$	Cs_2CO_3	trace
20	120	6	$PdCl_2(CH_2CN)_4(BF_4)_2$	Cs_2CO_3	trace
21	**120**	**6**	**Pd-117**	**Cs_2CO_3**	**36**
22	120	6	$Pd(PPh_3)_4$	Cs_2CO_3	trace
23	120	6	$Pd(OPiv)_2$	Cs_2CO_3	trace
24	120	6	$Pd(OTF)_2$(dippp)	Cs_2CO_3	16
25	120	6	(NHC)Pd(allyl)Cl	Cs_2CO_3	trace
26	120	6	Umicore CX22	Cs_2CO_3	trace
27	120	6	Umicore CX31	Cs_2CO_3	trace
28	120	6	NHC-Pd(II)-Im	Cs_2CO_3	trace

29	120	6	Pd-PEPPS-IPr	Cs_2CO_3	trace
30	120	6	Pd-PEPPSI-IPent	Cs_2CO_3	trace
31	120	6	Pd-117	CsF	trace
32	120	6	Pd-117	KOH	trace
33	120	6	Pd-117	K_2CO_3	trace
34	120	6	Pd-117	^{t}BuOK	trace
35	120	6	Pd-117	Et_3N	trace
36	120	6	Pd-117	$NaOCH_3$	trace
37	120	6	Pd-117	CsOPiv	trace
38	120	6	Pd-117	K_3PO_4	trace
39	120	6	Pd-117	NaCNO	trace
40	120	6	Pd-117	DBU	trace
41	120	6	Pd-117	BABCO	trace
42	120	6	Pd-117	CsOH	trace
43	120	6	Pd-117	CsF	trace
44	120	6	Pd-117	KOH	trace
45	120	6	Pd-117	K_2CO_3	trace
46	120	6	Pd-117	^{t}BuOK	trace

[a]Reaction conditions: Phenyl trifluoromethanesulfonate (0.2 mmol), *tert*-butyl isocyanide (2.5 equiv, 0.5 mmol), TBD (20 mol%), Pd catalyst (10 mol%), base (2.0 equiv, 0.4 mmol), and H_2O (100 μL) in dry DMSO (1.0 mL) under an Ar atmosphere at 90−150 ºC for 6−12 h. [b]Isolated yield of **3** based on phenyl trifluoromethanesulfonate is given.

3. Procedures for the preparation of substrates



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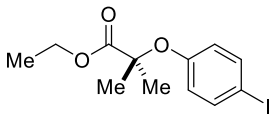

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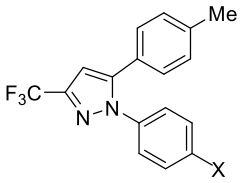

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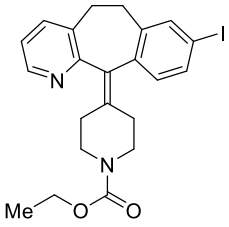

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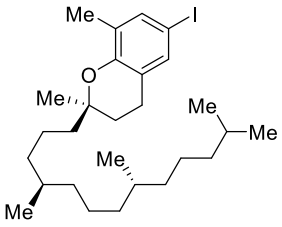

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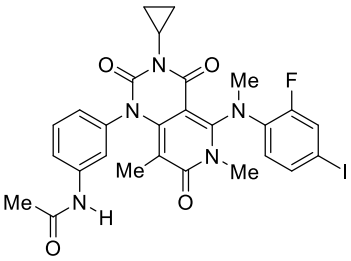
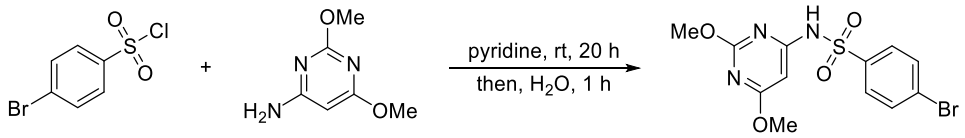
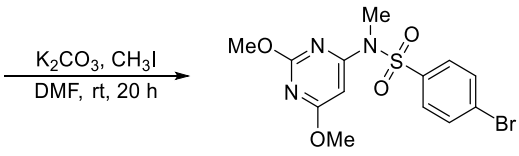


1h

3.1 Preparation of **1a**





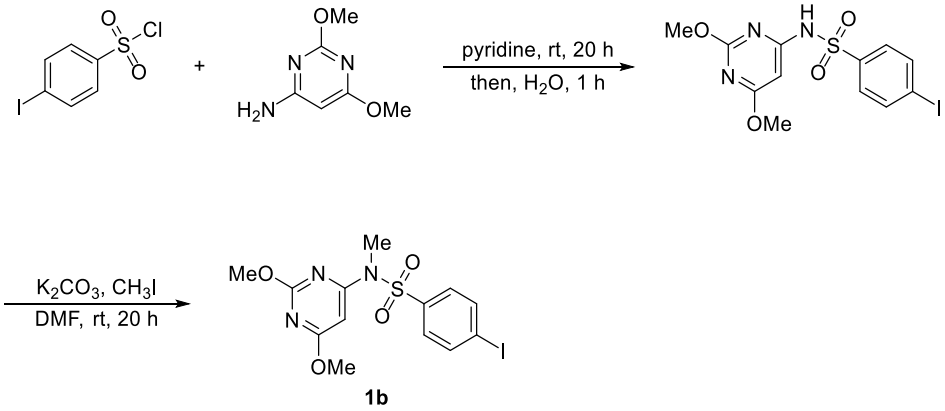
1a

A mixture of 4-bromobenzenesulfonyl chloride (2.55 g, 10.0 mmol, 1.0 equiv) and 2,6-dimethoxypyrimidin-4-amine (1.62 g, 10.5 mmol, 1.05 equiv) in pyridine (25 mL) was stirred for 20 hours at room temperature. To the solution was then added H_2O (50 mL) to produce a slurry. After stirring for 1 hour, the slurry was filtered, and the filter cake was washed with water (25 mL), after which the solid was dried in vacuo to yield the compound as a white solid (2.61 g, 70% yield).

A mixture of 4-bromo-*N*-(2,6-dimethoxypyrimidin-4-yl)benzenesulfonamide (1.86 g, 5.0 mmol, 1.0 equiv), K_2CO_3 (0.69 g, 5.0 mmol, 1.0 equiv), and iodomethane (0.47 mL, 7.5 mmol, 1.5 equiv) in DMF (15 mL) was stirred for 20 hours at room temperature. Afterwards,

the reaction mixture was diluted with EtOAc (30 mL) and washed with water (30 mL). The aqueous layer was back-extracted with EtOAc (3 × 30 mL). The combined organic layers were then dried over Na_2SO_4, filtered, and concentrated in vacuo.[1] Purification by petroleum ether/ethyl acetate (10:1) provided the compound **1a** as a white solid (1.18 g, 61% yield).

3.2 Preparation of **1b**

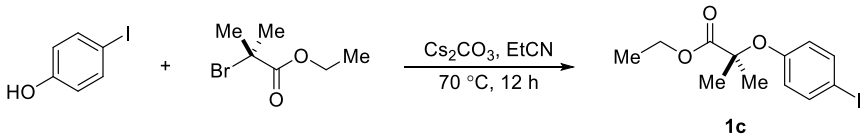


1b

A mixture of 4-Iodobenzenesulfonyl chloride (3.03 g, 10.0 mmol, 1.0 equiv) and 2,6-dimethoxypyrimidin-4-amine (1.62 g, 10.5 mmol, 1.05 equiv) in pyridine (25 mL) was stirred for 20 hours at room temperature. To the solution was then added H_2O (50 mL) to produce a slurry. After stirring for 1 hour, the slurry was filtered, and the filter cake was washed with water (25 mL), after which the solid was dried in vacuo to yield the compound as a white solid (3.07 g, 73% yield).

A mixture of 4-bromo-*N*-(2,6-dimethoxypyrimidin-4-yl)benzenesulfonamide (2.11 g, 5.0 mmol, 1.0 equiv), K_2CO_3 (0.69 g, 5.0 mmol, 1.0 equiv), and iodomethane (0.47 mL, 7.5 mmol, 1.5 equiv) in DMF (15 mL) was stirred for 20 hours at room temperature. Afterwards, the reaction mixture was diluted with EtOAc (30 mL) and washed with water (30 mL). The aqueous layer was back-extracted with EtOAc (3 × 30 mL). The combined organic layers were then dried over Na_2SO_4, filtered, and concentrated in vacuo.[1] Purification by petroleum ether/ethyl acetate (10:1) provided the compound **1b** as a white solid (1.41 g, 65% yield).

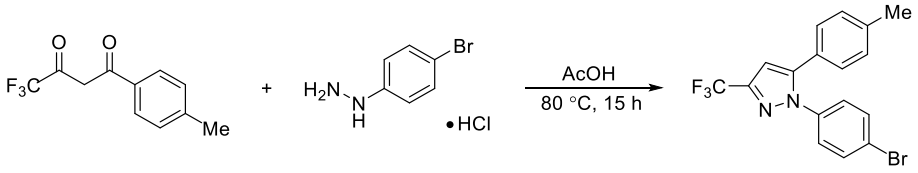
3.3 Preparation of **1c**



1c

A flame-dried 100-mL round-bottom flask, equipped with a stir bar, was charged with 4-iodophenol (440.0 mg, 2.0 mmol, 1.0 equiv), ethyl 2-bromo-2-methylpropanoate (390.1 mg, 2.0 mmol, 1.0 equiv), cesium carbonate (390.1 mg, 4.0 mmol, 2.0 equiv), and MeCN (10 mL). The mixture was allowed to stir for 12 h at 70 ºC. The mixture was then allowed to cool to room temperature and diluted with water (15 mL). The aqueous solution was then washed with ethyl acetate (10 mL x 3). The combined organic layers were dried over Na_2SO_4 and filtered.[2] The solvent was removed by rotary evaporation and the residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to give the compound **1c** as a colorless oil (621.3 mg, 93% yield).

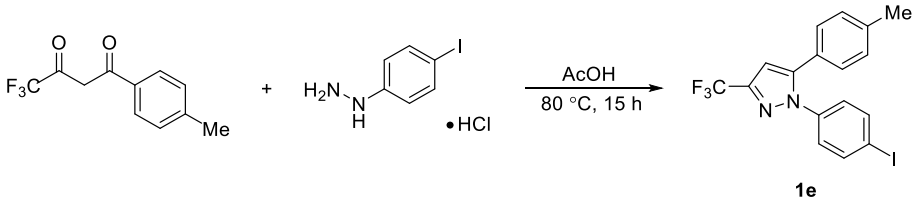
3.4 Preparation of **1d**



1d

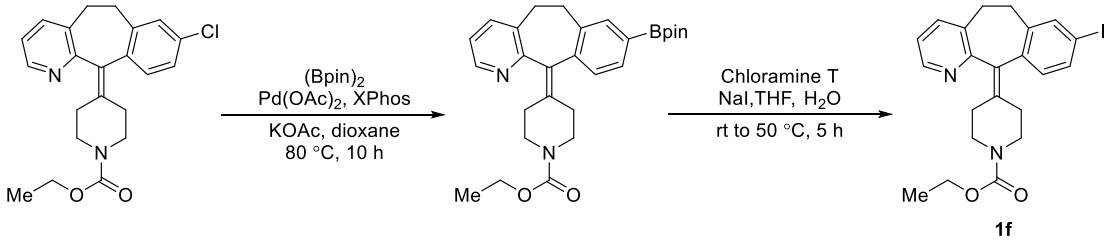
A Schlenk tube containing (4-iodophenyl)hydrazine hydrochloride (443.9 mg, 2.0 mmol, 1.0 equiv) and 4,4,4-trifluoro-1-(p-tolyl)butane-1,3-dione (460.4 mg, 2.0 mmol, 1.0 equiv) was evacuated and back-filled with anhydrous dinitrogen three times. Degassed acetic acid (10 mL) was added and the reaction mixture was stirred at 80 °C for 15 h. After cooling to room temperature, the reaction mixture was concentrated in vacuo.[3] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (20:1 – 10:1) to give the compound **1d** as a yellow solid (653.6 mg, 86% yield).

3.5 Preparation of **1e**



A Schlenk tube containing (4-iodophenyl)hydrazine hydrochloride (541.0 mg, 2.0 mmol, 1.0 equiv) and 4,4,4-trifluoro-1-(p-tolyl)butane-1,3-dione (460.4 mg, 2.0 mmol, 1.0 equiv) was evacuated and back-filled with anhydrous dinitrogen three times. Degassed acetic acid (10 mL) was added and the reaction mixture was stirred at 80 °C for 15 h. After cooling to room temperature, the reaction mixture was concentrated in vacuo.[3] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (20:1 – 10:1) to give the compound **1e** as a white solid (721.8 mg, 84% yield).

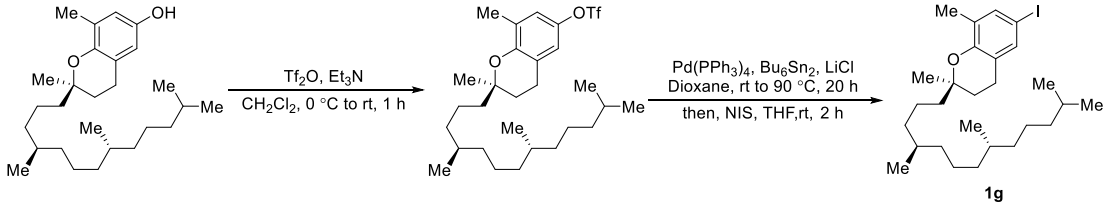
3.6 Preparation of **1f**



An oven dried 40 mL flask was charged with Loratadine (1.15 g, 3.0 mmol, 1.0 equiv), bis(pinacolato)diboron (0.91 g, 4.5 mmol, 1.2 equiv), KOAc (0.59 g, 6.0 mmol, 2.0 equiv), $Pd(OAc)_2$ (33.7 mg, 0.15 mmol, 5 mol%), XPhos (143.0 mg, 0.3 mmol, 10 mol%). They were transferred into a nitrogen-filled glovebox. Freshly distilled 1,4-dioxane (15 mL) was added to the flask in the glovebox.The flask was tightly sealed, transferred out of glovebox and stirred on a pie-block preheated to 80 °C for 10 h. The reaction mixture was filtered through Celite and taken up in 100 mL 2N HCl/ ethyl acetate. The layers were separated and the organic phase was discarded. The aqueous phase was then washed with ethyl acetate (15 mL × 3). After careful adjustment of pH to basic by adding 10N KOH (in the ice bath), the resulting slurry was extracted with ethyl acetate (25 mL × 3).[4] The combined organic phase was washed with brine, dried over Na_2SO_4, and concentrated to give a white solid (1.00 g, 70% yield).

The product (0.95 g 2.1 mmol) from the last step was dissolved in tetrahydrofuran (10 mL) and water (10 mL), and stirred at room temperature for 15 min. NaI (0.98 g, 4.3 mmol, 2.05 equiv) and Chloramine T (0.61 g, 4.1 mmol, 1.95 equiv) were then added at room temperature. After heating at 50°C for 5 h, yellow solid precipitated from the solution. The reaction mixture was then diluted with water (20 mL) and extracted with CH_2Cl_2 (20 mL × 3). The combined organic phase was washed with brine, dried over Na_2SO_4, and concentrated to give a yellowish solid.[5] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (20:1) to give the compound **2f** as a white solid (811.9 mg, 82% yield).

3.7 Preparation of **1g**

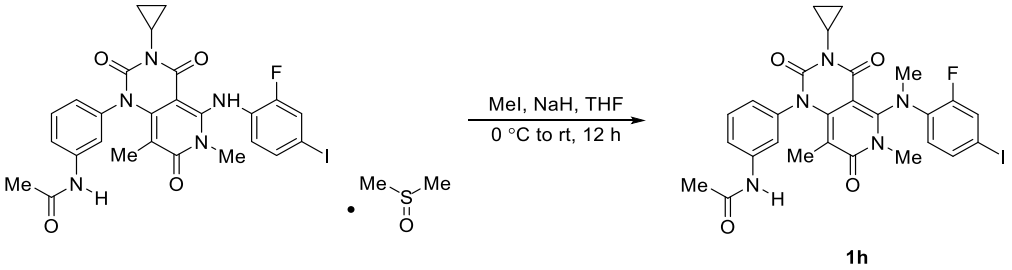


To a stirred solution of *δ*-tocopherol (805.3 mg, 2.0 mmol, 1.0 equiv), triethylamine (834.0 μL, 6.0 mmol, 3.0 equiv) in CH_2Cl_2 (10 mL) was added trifluoromethanesulfonic anhydride (370.1 μL, 2.2 mmol, 1.1 equiv) dropwise at 0 °C. The resulting mixture was warmed up to room temperature and stirred for 1 h. The resulting mixture was quenched with saturated $NaHCO_3$ (20 mL), extracted with CH_2Cl_2 (20 mL × 3), dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure.[6] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (20:1) to give a yellow oil (1.03 g, 97% yield).

To a flask permanently connected to a reflux condenser was added and $Pd(PPh_3)_4$ (115.6 mg, 5mol%), LiCl (423.9 mg, 10.0 mmol, 5.0 equiv), and bis(tributyltin) (2.32 g, 4.0 mmol, 2.0 equiv) under argon atmosphere. Added to the mixture was the yellow oil (1.07 g, 2.0 mmol, 1.0 equiv) from the last step and 20 mL dioxane. The mixture was heated to 90 °C and stirred 20 h. After cooling to rt, 50 mL hexanes added, the mixture was filtered through celite and solvents were evaporated to give crude product. Without further purification the product from the last step, it was dissolved in 75 mL THF followed by N-

iodosuccinimide (1.35 g, 6.0 mmol, 3.0 equiv). The mixture stirred for 2 h at rt. The reaction mixture was poured into saturated $Na_2S_2O_3$ and extracted with EtOAc (100 mL × 3). The organic layers were washed with brine and dried over Na_2SO_4. After rotary evaporation the mixture solvent was concentrated by rotary evaporation to obtain the residue.[7] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (100:1) to give **1g** as a clear oil (881.1 mg, 86% yield).

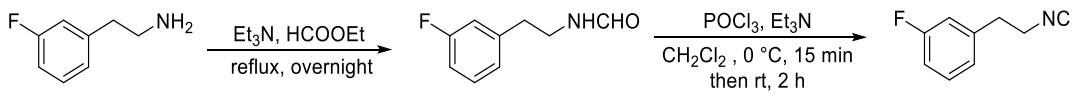
3.8 Preparation of **1h**



1h

A 50 mL single-necked flask with a magnetic stir bar was charged with Trametinib (1.39 g, 2.0 mmol, 1.0 equiv) and dissolved in THF (10 mL). Add NaH (120.0 mg, 3.0 mmol, 1.5 equiv) to the reaction mixture at 0 ºC and stir for 10 min, then add Iodomethane (186.8 μL, 3.0 mmol, 1.5 equiv). After the addition was completed, the reaction mixture was stirred at 0 ºC for 10 min and then at room temperature for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the solvent was concentrated by rotary evaporation to obtain the residue.[8] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (1:1) to give **1h** as a white solid (943.6 mg, 75% yield).

3.9 Preparation of isocyanides **2a**



2a

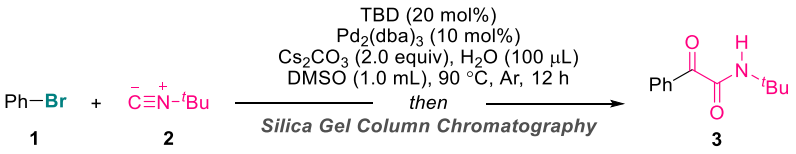
A 50 mL single-necked flask equipped with a stir bar and a reflux condenser was charged with a mixture of 2-(3-fluorophenyl)ethan-1-amine (695.4 mg, 5.0 mmol, 1.0 equiv), triethylamine (1.39 mL, 10.0 mmol, 2.0 equiv) and ethyl formate (12.3 mL, 150.0 mmol,

30.0 equiv). The reaction mixture was stirred and heated under reflux overnight. After the completion of the reaction monitored by TLC (thin layer chromatography), the solvent was concentrated by rotary evaporation to obtain the formamide as a residue, which was used directly in the next step without purification.

The residue prepared by above method was dissolved in CH_2Cl_2 (20 mL) and then triethylamine was added (2.08 mL, 15.0 mmol, 3.0 equiv). The mixture was cooled at 0 ºC and then the solution of $POCl_3$ (513 µL, 5.5 mmol, 1.1 equiv) in 10 mL of CH_2Cl_2 was added dropwise to the mixture over 30 min. After the addition was completed, the reaction mixture was stirred at 0 ºC for 15 min and then at room temperature for 2 h. After the completion of the reaction monitored by TLC (thin layer chromatography), an ice-cold saturated $NaHCO_3$ solution (20 mL) was added to the mixture and extracted with CH_2Cl_2 (3 × 20 mL). The combined organic layers were washed with saturated K_2CO_3 (3 × 60 mL), dried over anhydrous Na_2SO_4, filtered and concentrated by rotary evaporation.[9-11] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (20:1) to give 1-fluoro-3-(2-isocyanoethyl)benzene **2a** as a brown oil (693.1 mg, 93% yield).

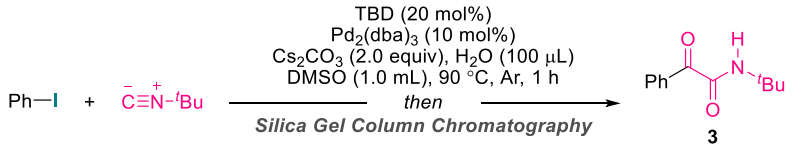
4. Representative procedure for the synthesis of 3

*Synthesis of compound **3** from bromobenzene*



A 4-mL flame-dried vial with a magnetic stir bar was charged with bromobenzene (20.9 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **3** (33.2 mg, 81% yield).

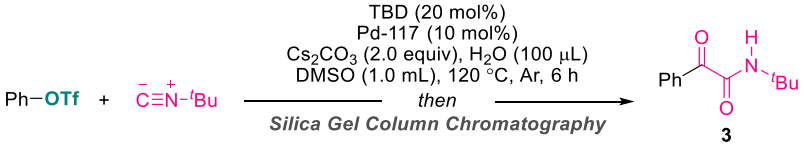
*Synthesis of compound **3** from iodobenzene*



A 4-mL flame-dried vial with a magnetic stir bar was charged with iodobenzene (22.4 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 1 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by

flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **3** (38.2 mg, 93% yield).

*Synthesis of compound **3** from phenyl trifluoromethanesulfonate*

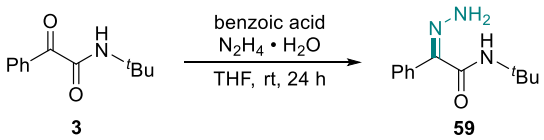


A 4-mL flame-dried vial with a magnetic stir bar was charged with phenyl trifluoromethanesulfonate (32.4 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), Pd-117 (14.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 120 ºC (oil bath) for 6 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **3** (14.8 mg, 36% yield).

Products **5** – **58**, **70** – **75** were synthesized following these procedures.

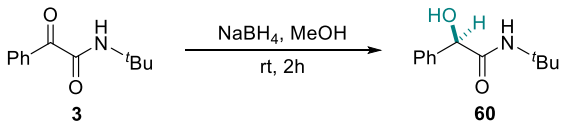
5. Procedures for the synthesis of 59-69 and 76-81

5.1 Synthesis of **59** from **3**



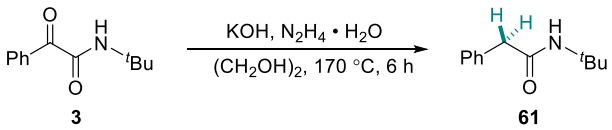
A 10 mL single-necked flask with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv), benzoic acid (24.4 mg, 0.2 mmol, 1.0 equiv), $N_2H_4 \cdot H_2O$ (12.5 μL, 0.2 mmol, 1.0 equiv) and dissolved in THF (1.0 mL). After the addition was completed, the reaction mixture was stirred at room temperature for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the solvent was concentrated by rotary evaporation to obtain a residue.[12] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (2:1) to give **59** as a yellow oil (43.1 mg, 98% yield).

5.2 Synthesis of **60** from **3**



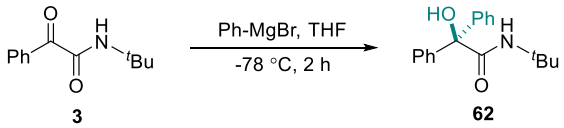
A 10 mL single-necked flask with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv) and dissolved in MeOH (1.0 mL). Add $NaBH_4$ (8.3 mg, 0.22 mmol, 1.1 equiv) to the reaction mixture at 0 ºC and stir for 10 min. Then the reaction mixture was stirred at room temperature for 2 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the solvent was concentrated by rotary evaporation to obtain a residue.[13] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (2:1) to give **60** as a white solid (37.9 mg, 92% yield).

5.3 Synthesis of **61** from **3**



A 10 mL single-necked flask with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv), KOH (56.1 mg, 1.0 mmol, 5.0 equiv), $N_2H_4 \cdot H_2O$ (0.5 mL) and dissolved in $(CH_2OH)_2$ (1.0 mL). After the addition was completed, the reaction mixture was stirred at 170 ºC for 6 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (10 mL), extracted with CH_2Cl_2 (3 × 10 mL), washed with brine (2 × 30 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[14] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (5:1) to give **61** as a white solid (31.6 mg, 83% yield).

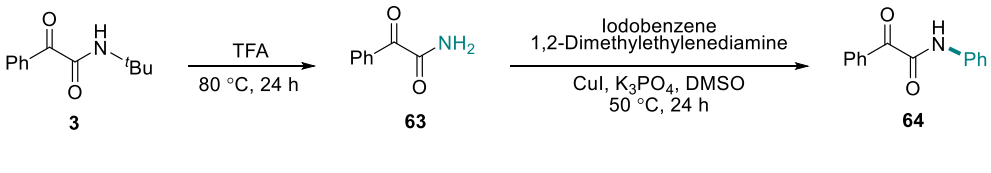
5.4 Synthesis of **62** from **3**



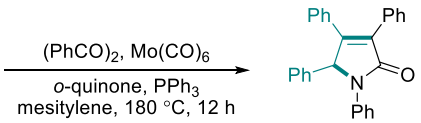
3 **62**

A 10 mL single-necked flask with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv) and dissolved in THF (1.0 mL). Add the solution of Ph-MgBr (0.22 mL, 1 M in THF) to the reaction mixture at -78 ºC and stir for 2 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was return to the room temperature and treated with water (10 mL), extracted with CH_2Cl_2 (3 × 10 mL), the solvent was concentrated by rotary evaporation to obtain a residue.[15] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (5:1) to give **62** as a white solid (53.4 mg, 94% yield).

5.5 Synthesis of **63**, **64** and **65** from **3**



3 **63** **64**



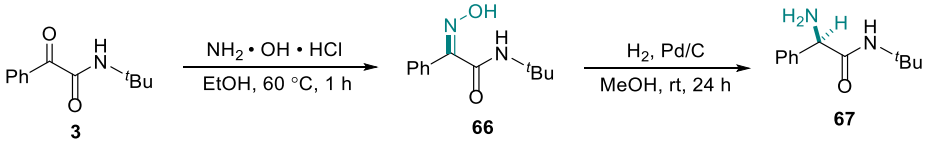
65

A 10-mL pressure tube with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv) and trifluoroacetic acid (2.0 mL). The mixture was stirred at 80 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was diluted with water (30 mL) and extracted with CH_2Cl_2 (3 × 30 mL). The combined organic layers were washed with water (60 mL) and saturated $NaHCO_3$ solution (2 × 60 mL), dried over Na_2SO_4 and filtered.[16] The solvent was concentrated by rotary evaporation and the residue was fully loaded onto a silica gel column and eluted with petroleum ether/ethyl acetate (10:1 – 1:1) to afford compound **63** as a white solid (17.9 mg, 60% yield).

A mixture of **63** (29.8 mg, 0.2 mmol, 1.0 equiv), iodobenzene (26.9 μL, 0.24 mmol, 1.2 equiv), 1,2-Dimethylethylenediamine (1.8 mg, 10 mol%), CuI (3.8 mg, 10 mol%), K_3PO_4 (84.9 mg, 2.0 equiv) and DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and stirred at 50 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[17] The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (10:1 – 5:1) to afford the product **64** as a yellow solid (41.4 mg, 92% yield).

Add **64** (45.0 mg, 0.2 mmol, 1.0 equiv) in a 10-mL pressure tube with a magnetic stir bar, and add $(PhCO)_2$ (63.1 mg, 0.3 mmol, 1.5 equiv), $Mo(CO)_6$ (5.3 mg, 10 mol%), *o*-quinone (4.4 mg, 10 mol%), PPh_3 (210.0 mg, 0.8 mmol, 4.0 equiv) and mesitylene (1.0 mL). The mixture was stirred at 180 ˚C for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and concentrated by rotary evaporation.[18] The residue was fully loaded onto a silica gel column and eluted with petroleum ether/ethyl acetate (10:1 – 5:1) to afford compound **65** as a yellow solid (62.7 mg, 81% yield).

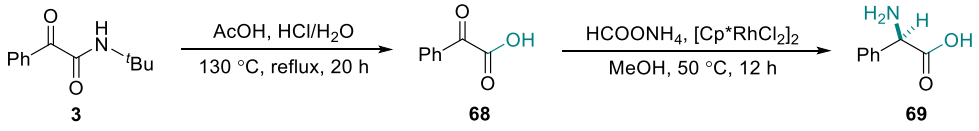
5.6 Synthesis of **66** and **67** from **3**



A 10 mL single-necked flask with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv), hydroxylamine (22.2 mg, 0.32 mmol, 1.6 equiv) and dissolved in EtOH (1.0 mL) at 60 ºC and stir for 1 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and concentrated by rotary evaporation to obtain a residue.[19] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (2:1) to give **66** as a white solid (41.8 mg, 95% yield).

A mixture of **66** (44.0 mg, 0.2 mmol, 1.0 equiv), Pd/C (50 mg), and MeOH (5.0 mL). The reaction was stirred at room temperature for 24 h under hydrogen atmosphere. After the completion of the reaction monitored by TLC (thin layer chromatography). Filter with diatomaceous earth, remove palladium-carbon, rinse with CH_2Cl_2 (30 mL), incorporate organic phase and the solvent was concentrated by rotary evaporation to obtain a residue.[20] The residue was purified by flash column chromatography on silica gel and eluted with ethyl acetate to afford the product **67** as a white solid (37.1 mg, 90% yield).

5.7 Synthesis of **68** and **69** from **3**

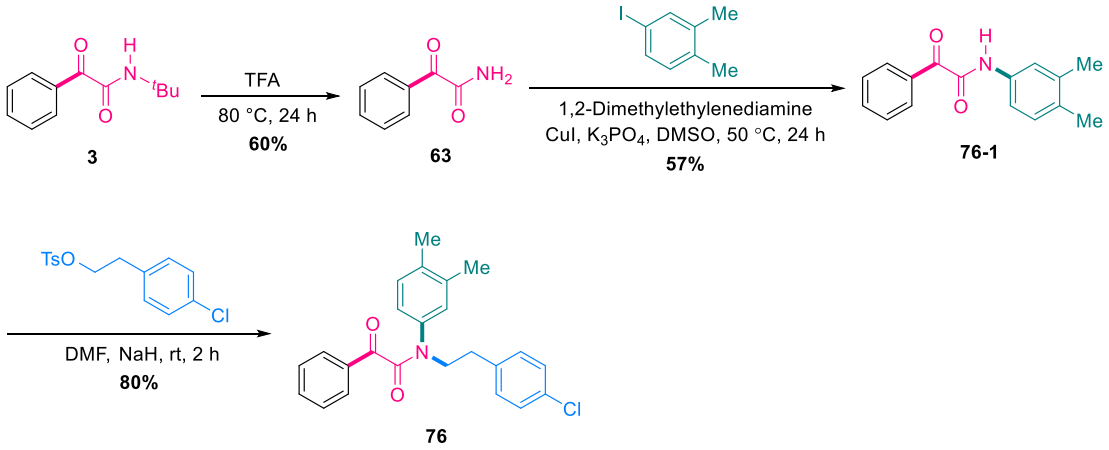


A 50 mL single-necked flask equipped with a stir bar and a reflux condenser was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv), dissolved in AcOH (0.5 mL) and HCl/H_2O (0.5 mL). Then the reaction mixture was stirred at 130 ºC and reflux for 20 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature, diluted with water (30 mL) and extracted with CH_2Cl_2 (3 × 30 mL). The combined organic layers were washed with water (60 mL) and saturated $NaHCO_3$ solution (2 × 60 mL), dried over Na_2SO_4, filtered and concentrated.[21]

The residue was fully loaded onto a silica gel column and was eluted with dichloromethane/methyl alcohol (10:1 – 5:1) to give **68** as a white solid (29.4 mg, 98% yield).

A mixture of **68** (44.0 mg, 0.2 mmol, 1.0 equiv), $HCOONH_4$ (mg, 1.0 mol, 5.0 equiv), $[Cp^*RhCl_2]_2$ (mg, 1% mol%), and dissolved in MeOH (1.0 mL). The reaction was stirred 50 ºC for 12 h under argon atmosphere. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature. Then, the reaction mixture was filtered and washed with methyl alcohol.[22] After drying, the product **69** was obtained as a white solid (24.3 mg, 80% yield).

5.8 Synthesis of **76** from **3**



3 **63** **76-1** **76**

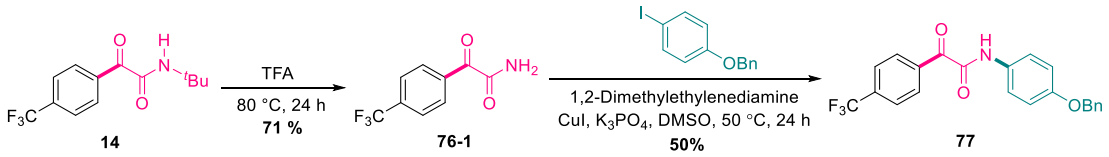
A 10-mL pressure tube with a magnetic stir bar was charged with **3** (41.0 mg, 0.2 mmol, 1.0 equiv) and trifluoroacetic acid (2.0 mL). The mixture was stirred at 80 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was diluted with water (30 mL) and extracted with CH_2Cl_2 (3 × 30 mL). The combined organic layers were washed with water (60 mL) and saturated $NaHCO_3$ solution (2 × 60 mL), dried over Na_2SO_4 and filtered.[16] The solvent was concentrated by rotary evaporation and the residue was fully loaded onto a silica gel column and eluted with petroleum ether/ethyl acetate (10:1 – 1:1) to afford compound **63** as a white solid (17.9 mg, 60% yield).

A mixture of **63** (29.8 mg, 0.2 mmol, 1.0 equiv), 4-iodo-1,2-dimethylbenzene (55.7 mg, 0.24 mmol, 1.2 equiv), 1,2-Dimethylethylenediamine (1.8 mg, 10 mol%), CuI (3.8 mg, 10 mol%), K_3PO_4 (84.9 mg, 2.0 equiv) and DMSO (1.0 mL). The vial was evacuated and

backfilled with argon for three times and stirred at 50 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[17] The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (10:1 – 5:1) to afford the product **76-1** as a yellow solid (28.9 mg, 57% yield).

A 10 mL single-necked flask with a magnetic stir bar was charged with **75-1** (50.6 mg, 0.2 mmol, 1.0 equiv) and dissolved in DMF (1.0 mL). Add NaH (5.8 mg, 0.24 mmol, 1.2 equiv) to the reaction mixture at 0 ºC and stir for 10 min, then add 4-chlorophenethyl 4-methylbenzenesulfonate (74.4 mg, 0.24 mmol, 1.2 equiv). After the addition was completed, the reaction mixture was stirred at 0 ºC for 10 min and then at room temperature for 2 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.the solvent was concentrated by rotary evaporation to obtain a residue. The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (5:1) to give **76** as a white solid (62.6 mg, 80% yield).

5.9 Synthesis of **77** from **14**

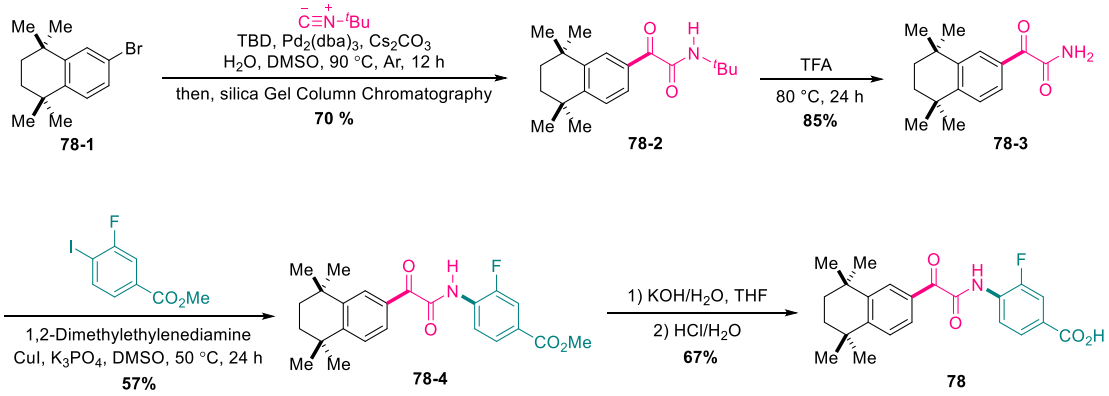


A 10-mL pressure tube with a magnetic stir bar was charged with **14** (54.6 mg, 0.2 mmol, 1.0 equiv) and trifluoroacetic acid (2.0 mL). The mixture was stirred at 80 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was diluted with water (30 mL) and extracted with CH_2Cl_2 (3 × 30 mL). The combined organic layers were washed with water (60 mL) and saturated $NaHCO_3$ solution (2 × 60 mL), dried over Na_2SO_4 and filtered.[16] The solvent was concentrated by rotary evaporation and the residue was fully loaded onto a silica gel column and eluted

with petroleum ether/ethyl acetate (10:1 – 1:1) to afford compound **77-1** as a white solid (30.8 mg, 71% yield).

A mixture of **77-1** (43.4 mg, 0.2 mmol, 1.0 equiv), 1-(benzyloxy)-4-iodobenzene (74.4 mg, 0.24 mmol, 1.2 equiv), 1,2-Dimethylethylenediamine (1.8 mg, 10 mol%), CuI (3.8 mg, 10 mol%), K_3PO_4 (84.9 mg, 2.0 equiv) and DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and stirred at 50 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[17] The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (10:1 – 5:1) to afford the product **77** as a yellow solid (39.9 mg, 50% yield).

5.10 Synthesis of **78** from **78-1**



A 4-mL flame-dried vial with a magnetic stir bar was charged with **78-1** (53.2 mg, 0.2 mmol, 1.0 equiv), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol, 2.0 equiv), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The

residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **78-2** (44.1 mg, 70% yield).

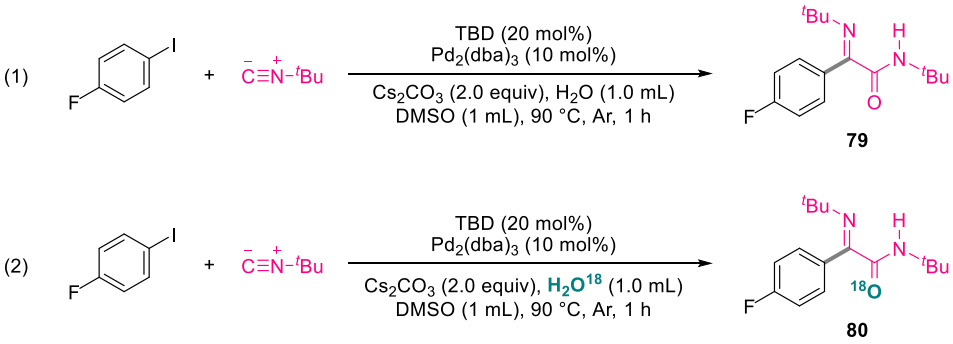
A 10-mL pressure tube with a magnetic stir bar was charged with **78-2** (63.0 mg, 0.2 mmol, 1.0 equiv) and trifluoroacetic acid (2.0 mL). The mixture was stirred at 80 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was diluted with water (30 mL) and extracted with CH_2Cl_2 (3 × 30 mL). The combined organic layers were washed with water (60 mL) and saturated $NaHCO_3$ solution (2 × 60 mL), dried over Na_2SO_4 and filtered.[16] The solvent was concentrated by rotary evaporation and the residue was fully loaded onto a silica gel column and eluted with petroleum ether/ethyl acetate (10:1 – 1:1) to afford compound **78-3** as a yellow solid (44.1 mg, 85% yield).

A mixture of **78-3** (51.8 mg, 0.2 mmol, 1.0 equiv), methyl 3-fluoro-4-iodobenzoate (67.2 mg, 0.24 mmol, 1.2 equiv), 1,2-Dimethylethylenediamine (1.8 mg, 10 mol%), CuI (3.8 mg, 10 mol%), K_3PO_4 (84.9 mg, 2.0 equiv) and DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and stirred at 50 ˚C for 24 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[17] The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (10:1 – 5:1) to afford the product **78-4** as a yellow solid (46.9 mg, 57% yield).

A 50 mL single-necked flask with a magnetic stir bar was charged with **78-4** (82.2 mg, 0.2 mmol, 1.0 equiv), KOH (56.1 mg, 1.0 mmol, 5.0 equiv), dissolved in H_2O (5.0 mL) and THF (5.0 mL). After the addition was completed, the reaction mixture was stirred at room temperature for 6 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was acidified with HCl/H_2O (1.0 mol/L), a white precipitate can be observed. Then the reaction mixture was treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), and the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.the solvent was concentrated by rotary evaporation to obtain a

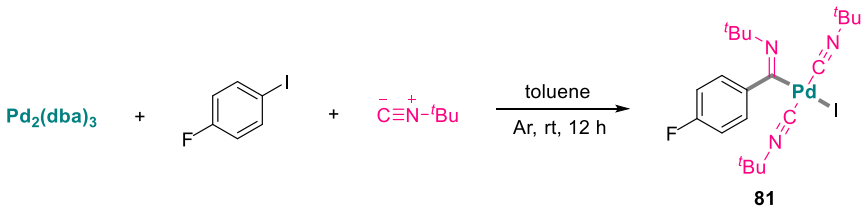
residue. The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (5:1) to give **78** as a white solid (53.4 mg, 67% yield).

5.11 Synthesis of **78** and **80**



A 25-mL flame-dried flask with a magnetic stir bar was charged with 1-fluoro-4-iodobenzene (230.6 μL, 2.0 mmol, 1.0 equiv), TBD (55.7 mg, 20 mol%), $Pd_2(dba)_3$ (183.0 mg, 10 mol%), Cs_2CO_3 (1303.3 mg, 4.0 mmol, 2.0 equiv), H_2O (1.0 mL) and extra dry DMSO (5.0 mL). The flask was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (565.5 μL, 5.0 mmol, 2.5 equiv) was added by syringe under argon. The flask was then sealed and was stirred at 90 ºC (oil bath) for 1 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (50 mL), extracted with CH_2Cl_2 (3 × 50 mL), washed with brine (2 × 150 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was recrystallization with petroleum ether and dichloromethane. Finally, the product **79** was obtained as a yellow solid (323.6 mg, 58% yield by recrystallization). Product **80** was synthesized following these procedures.

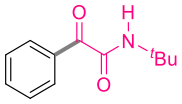
5.12 Synthesis of **81**



A 10-mL flame-dried flask with a magnetic stir bar was charged with $Pd_2(dba)_3$ (91.5

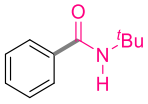
mg, 0.1 mmol, 1.0 equiv), 1-fluoro-4-iodobenzene (46.1 μL, 0.4 mmol, 4.0 equiv), dissolved in dry toluene (1.0 mL), and the flask was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (90.5 μL, 0.8 mmol, 8.0 equiv) was added by syringe under argon. After the addition was completed, the flask was sealed and was stirred at room temperature for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction concentrated by rotary evaporation to obtain a residue.[23] The residue was fully loaded onto a silica gel column and was eluted with petroleum ether/ethyl acetate (10:1 – 3:1) to give the compound **81** as a yellow solid (57.7 mg, 50% yield).

6. Characterization data of 3-81



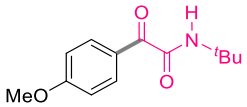
3

***N*-(*tert*-butyl)-2-oxo-2-phenylacetamide (3).** Yellow solid, 33.2 mg, 81% yield (From bromobenzene); 14.8 mg, 36% yield (From phenyl trifluoromethanesulfonate); 38.2 mg, 93% yield (From iodobenzene), m.p. = 72.8 – 74.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.29 (d, J = 7.2 Hz, 2H), 7.60 (t, J = 7.4 Hz, 1H), 7.46 (t, J = 7.7 Hz, 2H), 6.94 (br s, 1H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.7, 161.2, 134.3, 133.5, 131.3, 128.5, 51.8, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{16}NO_2]^+$ (M + H^+): 206.1176, found: 206.1173.



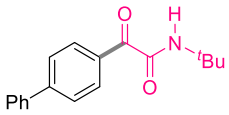
4

***N*-(*tert*-butyl)benzamide (4).** White solid, 26.2 mg, 74% yield (From bromobenzene), m.p. = 130.4 – 131.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 7.65 (d, J = 7.3 Hz, 2H), 7.35 (t, J = 7.3 Hz, 1H), 7.28 (t, J = 7.4 Hz, 2H), 6.18 (br s, 1H), 1.39 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 166.9, 135.7, 130.9, 128.2, 126.7, 51.4, 28.7; **HRMS** (ESI-Orbitrap): calcd. for $[C_{11}H_{16}NO]^+$ (M + H^+): 178.1226, found: 178.1226.



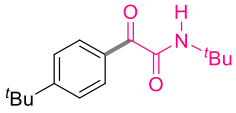
5

***N*-(*tert*-butyl)-2-(4-methoxyphenyl)-2-oxoacetamide (5).** White solid, 38.6 mg, 82% yield (From 1-bromo-4-methoxybenzene); 30.1 mg, 64% yield (From 1-iodo-4-methoxybenzene), m.p. = 60.3 – 62.9 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.36 (d, J = 9.0 Hz, 2H), 6.98 (br s, 1H), 6.91 (d, J = 9.0 Hz, 2H), 3.86 (s, 3H), 1.43 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 186.6, 164.6, 161.8, 134.0, 126.5, 113.8, 55.6, 51.6, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{17}NNaO_3]^+$ (M + Na^+): 258.1101, found: 258.1101.



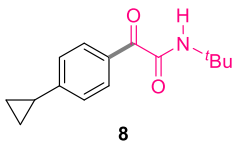
6

2-([1,1'-biphenyl]-4-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (6). Yellow solid, 41.6 mg, 74% yield, (From 4-bromo-1,1'-biphenyl); 11.8 mg, 21% yield ([1,1'-biphenyl]-4-yl trifluoromethanesulfonate); 41.6 mg, 74% yield (From 4-iodo-1,1'-biphenyl), m.p. = 130.0 – 131.9 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.41 (d, J = 8.5 Hz, 2H), 7.68 (d, J = 8.5 Hz, 2H), 7.63 (d, J = 7.2 Hz, 2H), 7.47 (t, J = 7.4 Hz, 2H), 7.40 (t, J = 7.3 Hz, 1H), 7.02 (br s, 1H), 1.48 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.0, 161.3, 146.8, 139.8, 132.2, 131.9, 129.0, 128.5, 127.4, 127.1, 51.7, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{18}H_{19}NNaO_2]^+$ (M + Na^+): 304.1308, found: 304.1301.



7

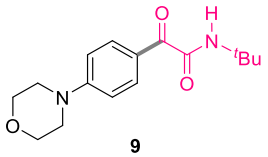
***N*-(*tert*-butyl)-2-(4-(*tert*-butyl)phenyl)-2-oxoacetamide (7).** Yellow solid, 43.4 mg, 83% yield, (From 1-bromo-4-(*tert*-butyl)benzene); 10.4 mg, 20% yield (4-(*tert*-butyl)phenyl trifluoromethanesulfonate); 44.9 mg, 86% yield (From 1-(*tert*-butyl)-4-iodobenzene), m.p. = 73.3 – 74.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.23 (d, J = 8.7 Hz, 2H), 7.46 (d, J = 8.7 Hz, 2H), 6.94 (br s, 1H), 1.44 (s, 9H), 1.32 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.3, 161.5, 158.1, 131.3, 130.9, 125.5, 51.7, 35.3, 31.1, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{24}NO_2]^+$ (M + H^+): 262.1802, found: 262.1801.



8

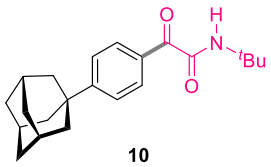
***N*-(*tert*-butyl)-2-(4-cyclopropylphenyl)-2-oxoacetamide (8).** Yellow solid, 25.5 mg, 52% yield (From 1-bromo-4-cyclopropylbenzene), m.p. = 77.6 – 79.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.21 (d, J = 8.3 Hz, 2H), 7.09 (d, J = 8.3 Hz, 2H), 6.95 (br s, 1H), 2.01 – 1.85 (m, 1H), 1.43 (s, 9H), 1.13 – 0.99 (m, 2H), 0.85 – 0.72 (m, 2H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ

187.9, 161.6, 152.0, 131.5, 130.7, 125.3, 51.7, 28.5, 16.1, 10.9; **HRMS** (ESI-Orbitrap): calcd. for $[C_{15}H_{20}NO_2]^+$ (M + H^+): 246.1489, found: 246.1489.



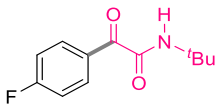
9

***N*-(*tert*-butyl)-2-(4-morpholinophenyl)-2-oxoacetamide (9).** Yellow solid, 45.8 mg, 79% yield (From 4-(4-bromophenyl)morpholine), m.p. = 90.9 – 92.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.33 (d, *J* = 9.1 Hz, 2H), 7.01 (br s, 1H), 6.82 (d, *J* = 9.1 Hz, 2H), 3.82 (t, 4H), 3.33 (t, 4H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 185.7, 162.3, 154.9, 133.8, 123.8, 112.8, 66.5, 51.5, 47.1, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{23}N_2O_3]^+$ (M + H^+): 291.1703, found: 291.1706.



10

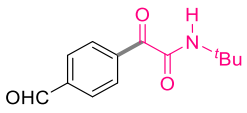
2-(4-((1*s*,3*R*,5*S*,7*s*)-adamantan-1-yl)phenyl)-*N*-(*tert*-butyl)-2-oxoacetamide (10). Yellow solid, 34.6 mg, 51% yield (From (1*S*,3*R*,5*S*,7*S*)-1-(4-bromophenyl)adamantane), m.p. = 134.9 – 136.7 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.25 (d, *J* = 8.5 Hz, 2H), 7.44 (d, *J* = 8.6 Hz, 2H), 6.96 (br s, 1H), 2.10 (s, 3H), 1.90 (s, 6H), 1.76 (q, *J* = 12.4 Hz, 6H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.2, 161.5, 158.2, 131.3, 130.8, 125.1, 51.6, 42.8, 36.9, 36.7, 28.8, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{22}H_{30}NO_2]^+$ (M + H^+): 340.2271, found: 340.2273.



11

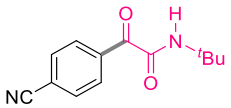
***N*-(*tert*-butyl)-2-(4-fluorophenyl)-2-oxoacetamide (11).** White solid, 33.5 mg, 75% yield (From 1-bromo-4-fluorobenzene); 9.4 mg, 21% yield (From 4-fluorophenyl trifluoromethanesulfonate); 43.7 mg, 98% yield (From 1-fluoro-4-iodobenzene), m.p. = 48.4

– 49.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.43 – 8.31 (m, 2H), 7.10 (t, J = 8.7 Hz, 2H), 6.99 (br s, 1H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 186.7, 166.5 (d, J = 257.2 Hz), 161.0, 134.3 (d, J = 9.6 Hz), 129.8 (d, J = 3.0 Hz), 115.7 (d, J = 21.8 Hz), 51.8, 28.4; **^{19}F NMR** ($CDCl_3$, 376 MHz) δ -99.04 – -106.36 (m); **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{15}FNO_2]^+$ (M + H^+): 224.1081, found: 224.1090.



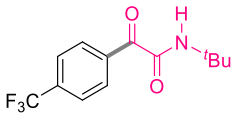
12

***N*-(*tert*-butyl)-2-(4-formylphenyl)-2-oxoacetamide (12).** Yellow solid, 39.2 mg, 84% yield (From 4-bromobenzaldehyde); 40.1 mg, 86% yield (From 4-iodobenzaldehyde), m.p. = 28.5 – 30.4 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 10.06 (s, 1H), 8.38 (d, J = 8.2 Hz, 2H), 7.91 (d, J = 8.5 Hz, 2H), 6.98 (br s, 1H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 191.8, 188.0, 160.4, 139.4, 137.8, 131.7, 129.3, 51.9, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{16}NO_3]^+$ (M + H^+): 234.1125, found: 234.1123.



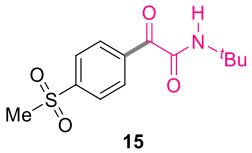
13

***N*-(*tert*-butyl)-2-(4-cyanophenyl)-2-oxoacetamide (13).** Yellow solid, 40.0 mg, 87% yield (From 4-bromobenzonitrile); 41.0 mg, 89% yield (From 4-iodobenzonitrile), m.p. = 108.8 – 110.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.37 (d, J = 8.5 Hz, 2H), 7.73 (d, J = 8.5 Hz, 2H), 6.97 (br s, 1H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.2, 160.0, 136.6, 132.1, 131.6, 117.9, 117.1, 52.0, 28.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{15}N_2O_2]^+$ (M + H^+): 231.1128, found: 231.1124.



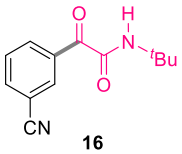
14

***N*-(*tert*-butyl)-2-oxo-2-(4-(trifluoromethyl)phenyl)acetamide (14).** White solid, 41.5 mg, 76% yield (From 1-bromo-4-(trifluoromethyl)benzene); 14.2 mg, 26% yield (From 4-(trifluoromethyl)phenyl trifluoromethanesulfonate); 48.1 mg, 88% yield (From 1-iodo-4-(trifluoromethyl)benzene), m.p. = 83.9 – 85.9ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.39 (d, J = 8.1 Hz, 2H), 7.70 (d, J = 8.3 Hz, 2H), 6.99 (br s, 1H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.6, 160.4, 136.2 (d, J = 1.1 Hz), 135.1 (q, J = 32.7 Hz), 131.6, 125.4 (q, J = 3.7 Hz), 123.6 (q, J = 272.9 Hz), 52.0, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{15}F_3NO_2]^+$ (M + H^+): 274.1049, found: 274.1051.



15

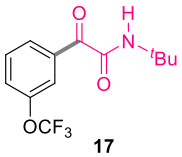
***N*-(*tert*-butyl)-2-(4-(methylsulfonyl)phenyl)-2-oxoacetamide (15).** Yellow solid, 34.5 mg, 61% yield (From 1-bromo-4-(methylsulfonyl)benzene), m.p. = 122.4 – 124.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.45 (d, J = 8.7 Hz, 2H), 8.03 (d, J = 8.7 Hz, 2H), 6.99 (br s, 1H), 3.07 (s, 3H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.5, 160.0, 144.7, 137.6, 132.1, 127.4, 52.1, 44.4, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{18}NO_4S]^+$ (M + H^+): 284.0951, found: 284.0956.



16

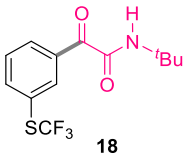
***N*-(*tert*-butyl)-2-(3-cyanophenyl)-2-oxoacetamide (16).** Yellow solid, 30.4 mg, 66% yield (From 3-bromobenzonitrile); 40.5 mg, 88% yield (From 3-iodobenzonitrile), m.p. = 70.3 – 71.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.63 (s, 1H), 8.49 (d, J = 8.0 Hz, 1H), 7.83 (d, J =

7.8 Hz, 1H), 7.57 (t, *J* = 7.9 Hz, 1H), 7.00 (br s, 1H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.3, 160.0, 136.8, 135.1, 135.0, 134.2, 129.4, 117.8, 112.9, 52.0, 28.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{15}N_2O_2]^+$ (M + H^+): 231.1128, found: 231.1122.



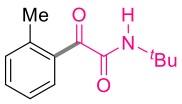
17

***N*-(*tert*-butyl)-2-oxo-2-(3-(trifluoromethoxy)phenyl)acetamide (17).** Yellow oil, 42.8 mg, 74% yield (From 1-bromo-3-(trifluoromethoxy)benzene); 47.4 mg, 82% yield (From 1-iodo-3-(trifluoromethoxy)benzene). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.27 (d, *J* = 7.6 Hz, 1H), 8.17 (s, 1H), 7.49 (dd, *J* = 11.9, 3.9 Hz, 1H), 7.43 (d, *J* = 8.3 Hz, 1H), 6.98 (br s, 1H), 1.43 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.0, 160.5, 149.2 (q, *J* = 1.9 Hz), 135.2, 130.0, 129.8, 126.6, 123.6 (d, *J* = 0.6 Hz), 120.5 (q, *J* = 258.0 Hz), 51.9, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{15}F_3NO_3]^+$ (M + H^+): 290.0999, found: 290.0999.



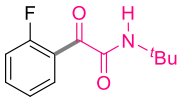
18

***N*-(*tert*-butyl)-2-oxo-2-(3-((trifluoromethyl)thio)phenyl)acetamide (18).** Yellow oil, 50.0 mg, 82% yield (From (3-bromophenyl)(trifluoromethyl)sulfane). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.59 (s, 1H), 8.46 (d, *J* = 7.9 Hz, 1H), 7.88 (d, *J* = 7.7 Hz, 1H), 7.54 (t, *J* = 7.8 Hz, 1H), 6.99 (br s, 1H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.2, 160.4, 141.5, 138.9, 134.8, 133.7, 129.7, 129.5 (q, *J* = 308.2 Hz), 125.3 (q, *J* = 2.2 Hz), 52.0, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{15}F_3NO_2S]^+$ (M + H^+): 306.0770, found: 306.0773.



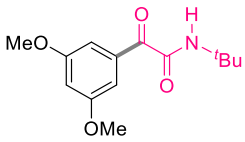
19

***N*-(*tert*-butyl)-2-oxo-2-(o-tolyl)acetamide (19).** Yellow solid, 21.9 mg, 50% yield (From 1-bromo-2-methylbenzene), 28.0 mg, 64% yield (From 1-iodo-2-methylbenzene), m.p. = 56.0 – 57.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 7.85 (d, J = 7.9 Hz, 1H), 7.40 (t, J = 7.5 Hz, 1H), 7.25 (t, J = 7.8 Hz, 2H), 6.92 (br s, 1H), 2.46 (s, 3H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 192.4, 161.3, 139.8, 133.0, 132.5, 131.8, 131.6, 125.3, 51.7, 28.4, 20.8; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{17}NNaO_2]^+$ (M + Na^+): 242.1151, found: 242.1152.



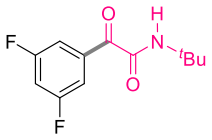
20

***N*-(*tert*-butyl)-2-(2-fluorophenyl)-2-oxoacetamide (20).** Yellow solid, 39.3 mg, 88% yield (From 1-bromo-2-fluorobenzene), 30.8 mg, 69% yield (From 1-fluoro-2-iodobenzene), m.p. = 63.6 – 64.8 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 7.84 (t, J = 6.7 Hz, 1H), 7.53 (dd, J = 13.1, 6.2 Hz, 1H), 7.21 (t, J = 7.6 Hz, 1H), 7.11 (t, 1H), 6.74 (br s, 1H), 1.43 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.9, 161.8 (d, J = 257.8 Hz), 160.8, 135.1 (d, J = 9.0 Hz), 132.0 (d, J = 1.6 Hz), 124.1 (d, J = 3.7 Hz), 123.0 (d, J = 11.6 Hz), 116.5 (d, J = 21.6 Hz), 51.9, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{15}FNO_2]^+$ (M + H^+): 224.1081, found: 224.1085.



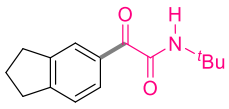
21

***N*-(*tert*-butyl)-2-(3,5-dimethoxyphenyl)-2-oxoacetamide (21).** Yellow solid, 45.1 mg, 85% yield (From 1-bromo-3,5-dimethoxybenzene); 42.4 mg, 80% yield (From 1-iodo-3,5-dimethoxybenzene), m.p. = 61.4 – 62.4 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 7.42 (dd, J = 2.3, 1.5 Hz, 2H), 6.90 (br s, 1H), 6.65 (td, J = 2.3, 1.1 Hz, 1H), 3.79 (d, J = 0.9 Hz, 6H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.1, 161.3, 160.5, 134.9, 108.6, 107.3, 55.6, 51.7, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{20}NO_4]^+$ (M + H^+): 266.1387, found: 266.1385.



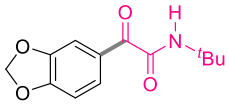
22

***N*-(*tert*-butyl)-2-(3,5-difluorophenyl)-2-oxoacetamide (22).** Yellow oil, 33.8 mg, 70% yield (From 1-bromo-3,5-difluorobenzene); 39.1 mg,81% yield (From 1,3-difluoro-5-iodobenzene). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.93 – 7.83 (m, 2H), 7.04 (tt, *J* = 8.4, 2.4 Hz, 1H), 6.96 (br s, 1H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 185.9 (t, *J* = 2.6 Hz), 162.7 (d, *J* = 250.3 Hz), 62.6 (d, *J* = 250.3 Hz), 160.1, 135.9 (t, *J* = 8.6 Hz), 114.4 (d, *J* = 7.5 Hz), 114.2 (d, *J* = 7.4 Hz), 109.6 (t, *J* = 25.3 Hz), 52.0, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{14}FNO_2]^+$ (M + H^+): 242.0987, found: 242.0988.



23

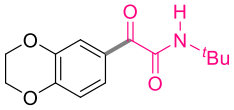
***N*-(*tert*-butyl)-2-(2,3-dihydro-1*H*-inden-5-yl)-2-oxoacetamide (23).** Yellow solid, 29.9 mg, 61% yield (From 5-bromo-2,3-dihydro-1H-indene), m.p. = 93.8 – 96.6 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.17 (s, 1H), 8.09 (d, *J* = 8.0 Hz, 1H), 7.29 (d, *J* = 7.8 Hz, 1H), 6.94 (br s, 1H), 2.94 (t, *J* = 7.5 Hz, 4H), 2.10 (p, *J* = 7.5 Hz, 2H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.6, 161.7, 151.9, 144.7, 131.8, 129.9, 127.2, 124.4, 51.7, 33.3, 32.6, 28.5, 25.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{15}H_{20}NO_2]^+$ (M + H^+): 246.1489, found: 246.1489.



24

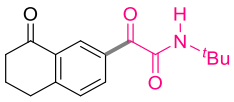
2-(benzo[*d*][1,3]dioxol-5-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (24). Yellow solid, 38.9 mg, 78% yield (From 5-bromobenzo[d][1,3]dioxole); 19.9 mg, 40% yield (From benzo[d][1,3]dioxol-5-yl trifluoromethanesulfonate); 41.4 mg, 83% yield (From 5-iodobenzo[d][1,3]dioxole), m.p. = 27.1 – 29.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.10 (d, *J* = 8.3 Hz, 1H), 7.71 (s, 1H), 6.95 (br s, 1H), 6.82 (d, *J* = 8.3 Hz, 1H), 6.01 (s, 2H), 1.41 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.2, 161.6, 152.9, 147.9, 129.0, 127.9, 110.4, 108.0,

102.0, 51.6, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{16}NO_4]^+$ (M + H^+): 250.1074, found: 250.1071.



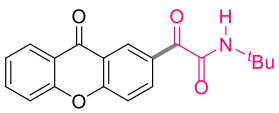
25

***N*-(*tert*-butyl)-2-(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)-2-oxoacetamide (25).** Yellow oil, 36.8 mg, 70% yield (From 6-bromo-2,3-dihydrobenzo[b][1,4]dioxine). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.93 (dd, *J* = 8.5, 2.0 Hz, 1H), 7.89 (d, *J* = 1.9 Hz, 1H), 6.92 (br s, 1H), 6.88 (d, *J* = 8.5 Hz, 1H), 4.36 – 4.21 (m, 4H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.7, 161.6, 149.4, 143.3, 127.1, 126.1, 120.9, 117.3, 65.0, 64.1, 51.7, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{18}NO_4]^+$ (M + H^+): 264.1230, found: 264.1240.



26

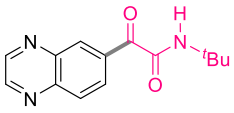
N-**(*tert*-butyl)-2-oxo-2-(8-oxo-5,6,7,8-tetrahydronaphthalen-2-yl)acetamide (26).** Yellow solid, 29.5 mg, 54% yield (From 7-bromo-3,4-dihydronaphthalen-1(2*H*)-one), m.p. = 39.8 – 41.7 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.88 (s, 1H), 8.42 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.35 (d, *J* = 8.1 Hz, 1H), 6.95 (br s, 1H), 3.02 (t, *J* = 6.0 Hz, 2H), 2.69 (t, 2H), 2.21 – 2.11 (m, 2H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 197.3, 187.7, 160.7, 150.5, 135.4, 132.7, 132.3, 130.6, 129.2, 51.9, 39.1, 30.1, 28.5, 22.8; **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{20}NO_3]^+$ (M + H^+): 274.1438, found: 274.1438.



27

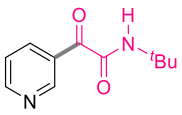
***N*-(*tert*-butyl)-2-oxo-2-(9-oxo-9*H*-xanthen-2-yl)acetamide (27).** Yellow solid, 50.4 mg, 78% yield (From 2-bromo-9*H*-xanthen-9-one), m.p. = 130.0 – 132.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.27 (d, *J* = 2.0 Hz, 1H), 8.67 (dd, *J* = 8.9, 2.2 Hz, 1H), 8.31 (dd, *J* = 8.0, 1.4

Hz, 1H), 7.73 (t, *J* = 7.0 Hz, 1H), 7.53 – 7.46 (m, 2H), 7.40 (t, *J* = 7.1 Hz, 1H), 7.04 (br s, 1H), 1.47 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.6, 176.4, 160.8, 159.4, 155.9, 136.9, 135.4, 131.9, 129.3, 127.0, 124.8, 121.9, 121.5, 118.4, 118.2, 51.9, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{19}H_{18}NO_4]^+$ (M + H^+): 324.1230, found: 324.1230.



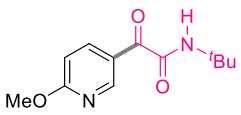
28

***N*-(*tert*-butyl)-2-oxo-2-(quinoxalin-6-yl)acetamide (28).** Yellow solid, 26.7 mg, 52% yield (From 6-bromoquinoxaline), m.p. = 87.4 – 89.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.20 (d, *J* = 1.5 Hz, 1H), 8.92 (d, *J* = 4.6 Hz, 2H), 8.47 (dd, *J* = 8.8, 1.8 Hz, 1H), 8.14 (d, *J* = 8.8 Hz, 1H), 7.00 (br s, 1H), 1.48 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.0, 160.6, 147.1, 146.2, 145.5, 142.3, 135.2, 134.2, 130.1, 129.9, 52.0, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{16}N_3O_2]^+$ (M + H^+): 258.1237, found: 258.1237.



29

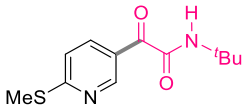
***N*-(*tert*-butyl)-2-oxo-2-(pyridin-3-yl)acetamide (29).** Yellow oil, 30.1 mg, 73% yield (From 3-bromopyridine); 39.2 mg, 95% yield (From 3-iodopyridine). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.38 (s, 1H), 8.72 (d, *J* = 4.7 Hz, 1H), 8.54 (d, *J* = 8.0 Hz, 1H), 7.34 (dd, *J* = 8.0, 4.9 Hz, 1H), 7.03 (br s, 1H), 1.39 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.5, 160.2, 154.0, 152.1, 138.5, 129.2, 123.2, 51.8, 28.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_{11}H_{15}N_2O_2]^+$ (M + H^+): 207.1128, found: 207.1127.



30

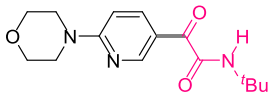
***N*-(*tert*-butyl)-2-(6-methoxypyridin-3-yl)-2-oxoacetamide (30).** Yellow oil, 34.0 mg, 72% yield (From 5-bromo-2-methoxypyridine); 46.3 mg, 98% yield (From 5-iodo-2-

methoxypyridine). **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 9.26 (s, 1H), 8.47 (d, J = 8.8 Hz, 1H), 7.00 (br s, 1H), 6.75 (d, J = 8.8 Hz, 1H), 3.99 (s, 3H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 186.2, 167.2, 160.9, 153.0, 140.9, 123.6, 110.9, 54.3 51.7, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{17}N_2O_3]^+$ (M + H^+): 237.1234, found: 237.1234.



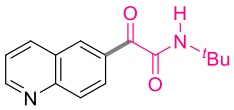
31

***N*-(*tert*-butyl)-2-(6-(methylthio)pyridin-3-yl)-2-oxoacetamide (31).** Yellow oil, 23.2 mg, 46% yield (From 5-bromo-2-(methylthio)pyridine). **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 9.37 (d, J = 1.4 Hz, 1H), 8.40 (dd, J = 8.6, 2.1 Hz, 1H), 7.23 (d, J = 8.6 Hz, 1H), 7.00 (br s, 1H), 2.60 (s, 3H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 186.7, 167.3, 160.6, 152.7, 137.5, 125.0, 120.8, 51.8, 28.4, 13.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{17}N_2O_2S]^+$ (M + H^+): 253.1005, found: 253.1004.



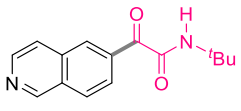
32

***N*-(*tert*-butyl)-2-(6-morpholinopyridin-3-yl)-2-oxoacetamide (32).** Yellow solid, 46.0 mg, 79% yield (From 4-(5-bromopyridin-2-yl)morpholine); 47.2 mg, 81% yield (From 4-(5-iodopyridin-2-yl)morpholine), m.p. = 90.9 – 92.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 9.22 (d, J = 2.3 Hz, 1H), 8.41 (dd, J = 9.2, 2.3 Hz, 1H), 7.03 (br s, 1H), 6.53 (d, J = 9.2 Hz, 1H), 3.78 – 3.73 (m, 4H), 3.70 – 3.67 (m, 4H), 1.40 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 185.0, 161.7, 160.4 154.2, 140.1, 119.4, 104.9, 66.6, 51.4, 44.8, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{15}H_{22}N_3O_3]^+$ (M + H^+): 292.1656, found: 292.1655.



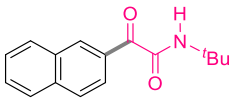
33

***N*-(*tert*-butyl)-2-oxo-2-(quinolin-6-yl)acetamide (33).** Yellow solid, 46.1 mg, 90% yield (From 6-bromoquinoline); 16.9 mg, 33% yield (From quinolin-6-yl trifluoromethanesulfonate); 48.2 mg, 94% yield (From 6-iodoquinoline), m.p. = 106.6 – 108.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.07 (d, *J* = 1.8 Hz, 1H), 8.92 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.30 (dd, *J* = 8.9, 1.9 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.3 Hz, 1H), 8.04 (d, *J* = 8.9 Hz, 1H), 7.38 (dd, *J* = 8.3, 4.3 Hz, 1H), 7.09 (br s, 1H), 1.42 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.4, 161.0, 153.1, 150.3, 138.1, 134.6, 131.0, 129.8, 129.2, 127.2, 121.9, 51.8, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{15}H_{17}N_2O_2]^+$ (M + H^+): 257.1285, found: 257.1287.



34

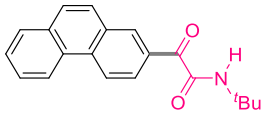
***N*-(*tert*-butyl)-2-(isoquinolin-6-yl)-2-oxoacetamide (34).** Yellow solid, 33.8 mg, 66% yield (From 6-bromoisoquinoline); 16.4 mg, 32% yield (From isoquinolin-6-yl trifluoromethanesulfonate), m.p. = 67.1 – 69.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.31 (s, 1H), 9.08 (s, 1H), 8.61 (d, J = 5.6 Hz, 1H), 8.25 (d, J = 8.6 Hz, 1H), 8.01 (d, J = 8.6 Hz, 1H), 7.79 (d, J = 5.6 Hz, 1H), 7.07 (br s, 1H), 1.48 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.9, 160.6, 152.5, 144.0, 135.0, 134.4, 132.8, 130.2 127.9, 127.1, 122.1, 52.0, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{15}H_{17}N_2O_2]^+$ (M + H^+): 257.1285, found: 257.1284.



35

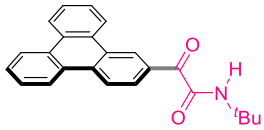
***N*-(*tert*-butyl)-2-(naphthalen-2-yl)-2-oxoacetamide (35).** Yellow solid, 38.8 mg, 76% yield (From 2-bromonaphthalene); 13.3 mg, 26% yield (From naphthalen-2-yl trifluoromethanesulfonate); 43.9 mg, 86% yield (From 2-iodonaphthalene), m.p. = 75.8 – 77.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.16 (s, 1H), 8.16 (dd, *J* = 8.7, 1.6 Hz, 1H), 7.98 (d,

J = 8.1 Hz, 1H), 7.84 (t, *J* = 8.5 Hz, 2H), 7.62 – 7.56 (m, 1H), 7.55 – 7.49 (m, 1H), 7.09 (br s, 1H), 1.49 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.1, 161.4, 136.0, 134.9, 132.4, 130.6, 130.3, 129.2, 128.3, 127.8, 126.8, 125.5, 51.8, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{18}NO_2]^+$ (M + H^+): 256.1332, found: 256.1333.



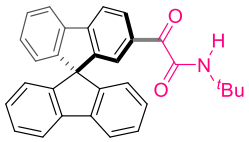
36

***N*-(*tert*-butyl)-2-oxo-2-(phenanthren-2-yl)acetamide (36).** Yellow solid, 45.2 mg, 74% yield (From 2-bromophenanthrene), m.p. = 138.3 – 139.7 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.08 (d, *J* = 1.6 Hz, 1H), 8.69 – 8.60 (m, 2H), 8.40 (dd, *J* = 8.8, 1.7 Hz, 1H), 7.90 – 7.85 (m, 1H), 7.78 (dd, *J* = 25.2, 8.9 Hz, 2H), 7.69 – 7.61 (m, 2H), 7.13 (br s, 1H), 1.52 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.9, 161.4, 134.1, 133.9, 133.3, 131.2, 131.1, 129.5, 128.7, 128.1, 127.8, 127.7, 127.2, 127.0, 123.5, 123.0, 51.8, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{20}H_{20}NO_2]^+$ (M + H^+): 306.1489, found: 306.1487.



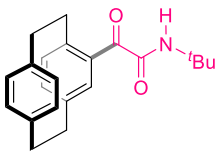
37

***N*-(*tert*-butyl)-2-oxo-2-(triphenylen-2-yl)acetamide (37).** Yellow solid, 52.6 mg, 74% yield (From 2-bromotriphenylene), m.p. = 159.7 – 160.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.72 (s, 1H), 8.66 – 8.58 (m, 1H), 8.52 (t, *J* = 8.3 Hz, 4H), 8.44 – 8.37 (m, 1H), 7.69 – 7.54 (m, 4H), 7.18 (br s, 1H), 1.56 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.7, 161.5, 134.0, 131.5, 131.0, 129.7, 129.5, 129.3, 128.7, 128.6, 128.4, 127.9, 127.8, 127.6, 127.4, 124.2, 123.7, 123.4, 123.3, 123.2, 51.8, 28.6; **HRMS** (ESI-Orbitrap): calcd. for $[C_{24}H_{22}NO_2]^+$ (M + H^+): 356.1645, found: 356.1645.



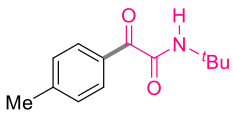
38

2-(9,9'-spirobi[fluoren]-2-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (38). Yellow solid, 70.9 mg, 80% yield (From 2-bromo-9,9'-spirobi[fluorene]), m.p. = 207.4 – 210.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.59 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.95 (dd, *J* = 7.8, 2.5 Hz, 2H), 7.88 (d, *J* = 7.6 Hz, 2H), 7.63 (d, *J* = 0.9 Hz, 1H), 7.40 (q, *J* = 7.6 Hz, 3H), 7.19 (t, *J* = 7.5 Hz, 1H), 7.12 (t, *J* = 7.5 Hz, 2H), 6.88 (br s, 1H), 6.78 (d, *J* = 7.6 Hz, 1H), 6.73 (d, *J* = 7.6 Hz, 2H), 1.41 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.8, 161.4, 150.5, 149.0, 147.8, 147.7, 141.9, 140.2, 132.8, 132.6, 129.6, 128.1, 128.1, 128.0, 126.4, 124.3, 124.0, 121.3, 120.3, 119.7, 65.9, 51.6, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{31}H_{26}NO_2]^+$ (M + H^+): 444.1958, found: 444.1959.



39

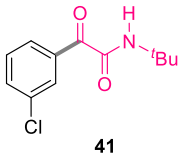
2-(1,4(1,4)-dibenzenacyclohexaphane-1^{2}-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (39). Yellow solid, 55.6 mg, 83% yield (From 12-bromo-1,4(1,4)-dibenzenacyclohexaphane), m.p. = 70.4 – 72.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 6.84 (d, *J* = 7.9 Hz, 1H), 6.65 (s, 1H), 6.58 – 6.51 (m, 3H), 6.49 – 6.41 (m, 2H), 5.40 (br s, 1H), 3.76 – 3.47 (m, 1H), 3.23 – 2.82 (m, 7H), 1.47 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 168.7, 140.2, 139.6, 139.3, 138.2, 136.6, 135.8, 134.6, 132.6 (d, *J* = 1.8 Hz), 132.5, 132.1, 131.9, 51.5, 35.5, 35.4, 35.2, 34.9, 29.0; **HRMS** (ESI-Orbitrap): calcd. for $[C_{22}H_{26}NO_2]^+$ (M + H^+): 336.1958, found: 336.1960.



40

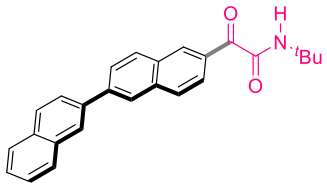
***N*-(*tert*-butyl)-2-oxo-2-(*p*-tolyl)acetamide (40).** White solid, 18.8 mg, 43% yield (From 1-iodo-4-methylbenzene); 36.4 mg, 83% yield (From p-tolyl trifluoromethanesulfonate), m.p.

= 48.4 – 49.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.21 (d, *J* = 8.2 Hz, 2H), 7.24 (d, *J* = 8.1 Hz, 2H), 6.95 (br s, 1H), 2.40 (s, 3H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.1, 161.5, 145.4, 131.6, 130.9, 129.2, 51.7, 28.5, 22.0; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{18}NO_2]^+$ (M + H^+): 220.1332, found: 220.1330.



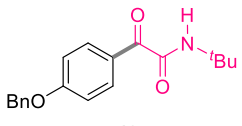
41

***N*-(*tert*-butyl)-2-(3-chlorophenyl)-2-oxoacetamide (41).** Yellow oil, 12.0 mg, 25% yield (From 3-chlorophenyl trifluoromethanesulfonate). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.31 (s, 1H), 8.22 (d, *J* = 7.8 Hz, 1H), 7.60 – 7.54 (m, 1H), 7.41 (t, *J* = 7.9 Hz, 1H), 6.95 (br s, 1H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.2, 160.5, 134.9, 134.7, 134.2, 131.2, 129.8, 129.5, 51.9, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{15}ClNO_2]^+$ (M + H^+): 240.0786, found: 240.0788.



42

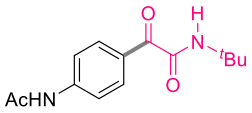
2-([2,2'-binaphthalen]-6-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (42). Yellow solid, 19.1 mg, 25% yield (From [2,2'-binaphthalen]-6-yl trifluoromethanesulfonate), m.p. = 143.2 – 145.7 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.24 (s, 1H), 8.27 – 8.15 (m, 3H), 8.11 (d, *J* = 8.5 Hz, 1H), 8.01 – 7.81 (m, 6H), 7.60 – 7.47 (m, 2H), 7.10 (br s, 1H), 1.51 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.9, 161.4, 141.8, 137.8, 136.5, 134.8, 133.7, 133.0, 131.6, 131.1, 130.7, 128.8, 128.6, 128.5, 127.8, 126.7, 126.6, 126.5, 126.1, 125.9, 125.6, 51.8, 28.6; **HRMS** (ESI-Orbitrap): calcd. for $[C_{26}H_{24}NO_2]^+$ (M + H^+): 382.1802, found: 382.1804.



43

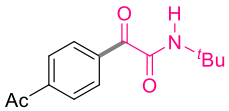
2-(4-(benzyloxy)phenyl)-*N*-(*tert*-butyl)-2-oxoacetamide (43). Yellow solid, 54.8 mg, 88% yield (From 1-(benzyloxy)-4-iodobenzene), m.p. = 93.6 – 95.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400

MHz): δ 8.38 (d, J = 8.9 Hz, 2H), 7.46 – 7.33 (m, 5H), 7.05 – 6.94 (m, 3H), 5.12 (s, 2H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 186.6, 163.7, 161.7, 136.0, 134.0, 128.8, 128.4, 127.6, 126.6, 114.6, 70.2, 51.6, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{19}H_{22}NO_3]^+$ (M + H^+): 312.1594, found: 312.1598.



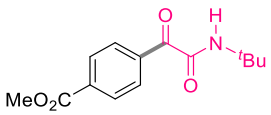
44

2-(4-acetamidophenyl)-*N*-(*tert*-butyl)-2-oxoacetamide (44). Yellow solid, 30.4 mg, 58% yield (From *N*-(4-iodophenyl)acetamide), m.p. = 161.2 – 163.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.53 (s, 1H), 8.14 (d, J = 8.7 Hz, 2H), 7.52 (d, J = 8.7 Hz, 2H), 7.00 (br s, 1H), 2.13 (s, 3H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.3, 169.5, 162.4, 143.8, 132.5, 128.5, 119.0, 51.9, 28.5, 24.7; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{19}N_2O_3]^+$ (M + H^+): 263.1390, found: 263.1391.



45

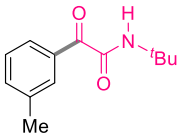
2-(4-acetylphenyl)-*N*-(*tert*-butyl)-2-oxoacetamide (45). Yellow solid, 35.1 mg, 71% yield (From 1-(4-iodophenyl)ethan-1-one), m.p. = 67.2 – 69.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.33 (d, J = 8.4 Hz, 2H), 7.97 (d, J = 8.4 Hz, 2H), 6.97 (br s, 1H), 2.61 (s, 3H), 1.43 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 197.6, 188.0, 160.6, 140.6, 136.7, 131.4, 128.1, 51.9, 28.4, 27.0; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{18}NO_3]^+$ (M + H^+): 248.1281, found: 248.1282.



46

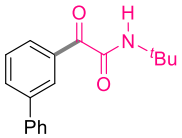
Methyl 4-(2-(*tert*-butylamino)-2-oxoacetyl)benzoate (46). White solid, 35.3 mg, 67% yield (From methyl 4-iodobenzoate), m.p. = 115.9 – 117.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.32 (d, J = 8.5 Hz, 2H), 8.07 (d, J = 8.5 Hz, 2H), 6.97 (br s, 1H), 3.92 (s, 3H), 1.43 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.1, 166.2, 160.6, 136.8, 134.6, 131.2, 129.5, 52.6,

51.9, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{18}NO_4]^+$ (M + H^+): 264.1230, found: 264.1233.



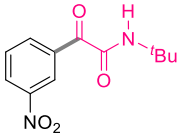
47

***N*-(*tert*-butyl)-2-oxo-2-(*m*-tolyl)acetamide (47).** White solid, 33.7 mg, 77% yield (From 1-iodo-3-methylbenzene), m.p. = 58.5 – 60.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.07 (d, *J* = 8.0 Hz, 2H), 7.39 (d, *J* = 7.3 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 1H), 6.94 (br s, 1H), 2.39 (s, 3H), 1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.8, 161.3, 138.2, 135.1, 133.4, 131.6, 128.5, 128.3, 51.7, 28.4, 21.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{13}H_{17}NNaO_2]^+$ (M + Na^+): 242.1151, found: 242.1155.



48

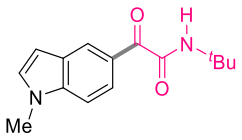
2-([1,1'-biphenyl]-3-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (48). Yellow oil, 36.5 mg, 65% yield (From 3-iodo-1,1'-biphenyl). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.54 (s, 1H), 8.30 (d, *J* = 7.8 Hz, 1H), 7.83 (d, *J* = 7.9 Hz, 1H), 7.63 (d, *J* = 7.3 Hz, 2H), 7.53 (t, *J* = 7.8 Hz, 1H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.38 (t, *J* = 7.3 Hz, 1H), 7.02 (br s, 1H), 1.48 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.6, 161.2, 141.5, 140.0, 133.9, 132.8, 130.1, 129.8, 129.0, 128.9, 127.8, 127.3, 51.8, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{18}H_{19}NNaO_2]^+$ (M + Na^+): 304.1308, found: 304.1304.



49

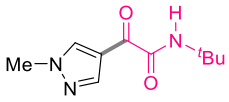
***N*-(*tert*-butyl)-2-(3-nitrophenyl)-2-oxoacetamide (49).** Yellow solid, 37.5 mg, 75% yield (From 1-iodo-3-nitrobenzene), m.p. = 27.3 – 29.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.12 (s, 1H), 8.66 (d, *J* = 7.8 Hz, 1H), 8.42 (ddd, *J* = 8.2, 2.1, 0.9 Hz, 1H), 7.66 (t, *J* = 8.0 Hz,

1H), 7.02 (br s, 1H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.2, 159.9, 148.2, 137.0, 134.7, 129.7, 128.2, 126.2, 52.1, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{14}N_2NaO_4]^+$ (M + Na^+): 273.0846, found: 273.0851.



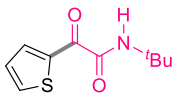
50

***N*-(*tert*-butyl)-2-(1-methyl-1*H*-indol-5-yl)-2-oxoacetamide (50).** Yellow solid, 28.4 mg, 55% yield (From 5-iodo-1-methyl-1*H*-indole), m.p. = 64.0 – 66.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.89 (d, *J* = 1.5 Hz, 1H), 8.13 (dd, *J* = 8.8, 1.6 Hz, 1H), 7.31 (d, *J* = 8.8 Hz, 1H), 7.08 (d, *J* = 3.2 Hz, 1H), 7.01 (br s, 1H), 6.61 (d, *J* = 3.1 Hz, 1H), 3.78 (s, 3H), 1.47 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.2, 162.6, 139.8, 130.6, 128.0, 127.5, 125.2, 124.3, 109.3, 103.9, 51.6, 33.1, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{15}H_{19}N_2O_2]^+$ (M + H^+): 259.1441, found: 259.1446.



51

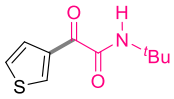
***N*-(*tert*-butyl)-2-(1-methyl-1*H*-pyrazol-4-yl)-2-oxoacetamide (51).** Yellow solid, 33.9 mg, 81% yield (From 4-iodo-1-methyl-1H-pyrazole), m.p. = 66.2 – 67.9 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.60 (s, 1H), 8.16 (s, 1H), 7.14 (br s, 1H), 3.90 (s, 3H), 1.39 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 181.1, 160.5, 143.1, 137.1, 118.6, 51.3, 39.3, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{10}H_{16}N_3O_2]^+$ (M + H^+): 210.1237, found: 210.1237.



52

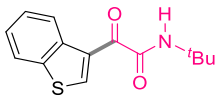
***N*-(*tert*-butyl)-2-oxo-2-(thiophen-2-yl)acetamide (52).** Yellow solid, 25.8 mg, 61% yield (From 2-iodothiophene), m.p. = 31.3 – 33.7 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.34 (dd, *J* = 3.8, 0.7 Hz, 1H), 7.81 (dd, *J* = 4.9, 1.0 Hz, 1H), 7.19 (br s, 1H), 7.16 (t, *J* = 4.4 Hz, 1H),

1.44 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 179.3, 160.1, 138.8, 138.0, 136.3, 128.1, 51.7, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{10}H_{14}NO_2S]^+$ (M + H^+): 212.0740, found: 212.0741.



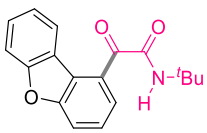
53

***N*-(*tert*-butyl)-2-oxo-2-(thiophen-3-yl)acetamide (53).** Yellow solid, 35.9 mg, 85% yield (From 3-iodothiophene), m.p. = 36.8 – 37.6 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.08 (dd, *J* = 2.9, 1.1 Hz, 1H), 7.73 (dd, *J* = 5.1, 1.1 Hz, 1H), 7.26 (dd, *J* = 5.2, 2.9 Hz, 1H), 7.13 (br s, 1H), 1.41 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 181.0, 160.6, 139.4, 137.0, 128.9, 125.6, 51.5, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{10}H_{14}NO_2S]^+$ (M + H^+): 212.0740, found: 212.0742.



54

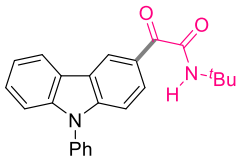
2-(benzo[*b*]thiophen-3-yl)-*N*-(*tert*-butyl)-2-oxoacetamide (54). Yellow solid, 50.6 mg, 97% yield (From 3-iodobenzo[b]thiophene), m.p. = 35.3 – 36.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 9.72 (s, 1H), 8.70 (d, *J* = 8.2 Hz, 1H), 7.87 (d, *J* = 8.0 Hz, 1H), 7.50 (td, *J* = 7.64 Hz, 1.1 Hz, 1H), 7.41 (td, *J* = 8.1, 1.2 Hz, 1H), 7.30 (br s, 1H), 1.47 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 181.2, 161.0, 145.7, 138.9, 137.6, 129.9, 126.1, 125.6, 125.2, 122.4, 51.5, 28.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{16}NO_2S]^+$ (M + H^+): 262.0896, found: 262.0897.



55

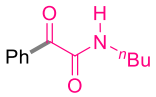
***N*-(*tert*-butyl)-2-(dibenzo[*b,d*]furan-1-yl)-2-oxoacetamide (55).** White solid, 42.5 mg, 72% yield (From 1-iododibenzo[b,d]furan), m.p. = 117.4 – 119.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.46 (d, *J* = 8.0 Hz, 1H), 8.24 (d, *J* = 7.7 Hz, 1H), 7.77 (d, *J* = 8.2 Hz, 1H), 7.57 (d, *J* = 8.2 Hz, 1H), 7.53 – 7.48 (m, 2H), 7.33 (t, *J* = 8.1 Hz, 1H), 7.12 (br s, 1H), 1.51 (s, 9H); **^{13}C-**

NMR ($CDCl_3$, 101 MHz): δ 189.8, 161.5, 157.0, 156.6, 128.6, 128.5, 126.0, 125.5, 124.2, 122.8, 117.2, 111.5, 51.9, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{18}H_{18}NO_3]^+$ (M + H^+): 296.1281, found: 296.1281.



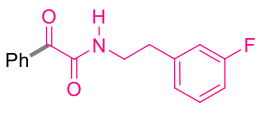
56

***N*-(*tert*-butyl)-2-oxo-2-(9-phenyl-9*H*-carbazol-3-yl)acetamide (56).** Yellow solid, 62.9 mg, 85% yield (From 3-iodo-9-phenyl-9*H*-carbazole), m.p. = 194.9 – 196.7 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 9.38 (s, 1H), 8.41 (d, *J* = 8.8 Hz, 1H), 8.24 (d, *J* = 7.7 Hz, 1H), 7.62 (d, *J* = 7.7 Hz, 2H), 7.57 – 7.51 (m, 3H), 7.48 – 7.32 (m, 5H), 7.13 (br s, 1H), 1.51 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.2, 162.2, 144.3, 141.8, 136.8, 130.2, 129.6, 128.3, 127.2, 126.9, 125.9, 125.7, 123.7, 123.2, 121.3, 121.0, 110.4, 109.7, 51.7, 28.6; **HRMS** (ESI-Orbitrap): calcd. for $[C_{24}H_{23}N_2O_2]^+$ (M + H^+): 371.1754, found: 371.1755.



57

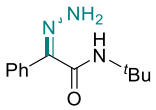
***N*-butyl-2-oxo-2-phenylacetamide (57).** Yellow oil, 32.8 mg, 80% yield (From 1-isocyanobutane). **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.38 – 8.27 (m, 2H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.47 (t, *J* = 7.8 Hz, 2H), 7.11 (br s, 1H), 3.39 (dd, *J* = 13.6, 6.8 Hz, 2H), 1.67 – 1.51 (m, 2H), 1.47 – 1.33 (m, 2H), 0.95 (t, *J* = 7.3 Hz, 3H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 188.0, 161.9, 134.5, 133.5, 131.3, 128.6, 39.3, 31.4, 20.2, 13.8; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{16}NO_2]^+$ (M + H^+): 206.1176, found: 206.1180.



58

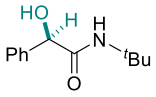
***N*-(2-fluorophenethyl)-2-oxo-2-phenylacetamide (58).** Yellow oil, 40.7 mg, 75% yield (From 1-fluoro-3-(2-isocyanoethyl)benzene). **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.29 (d, *J* = 7.8

Hz, 2H), 7.62 (t, *J* = 7.4 Hz, 1H), 7.47 (t, *J* = 7.7 Hz, 2H), 7.31 – 7.24 (m, 1H), 7.21 (br s, 1H), 7.00 (d, *J* = 7.6 Hz, 1H), 6.97 – 6.90 (m, 2H), 3.65 (q, *J* = 6.9 Hz, 2H), 2.90 (t, *J* = 7.1 Hz, 2H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.7, 163.0 (d, *J* = 246.2 Hz), 161.9, 140.9 (d, *J* = 7.4 Hz), 134.6, 133.3, 131.2, 130.3 (d, *J* = 8.4 Hz), 128.6, 124.5 (d, *J* = 2.8 Hz), 115.7 (d, *J* = 21.1 Hz), 113.7 (d, *J* = 21.0 Hz), 40.4, 35.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{15}FNO_2]^+$ (M + H^+): 272.1081, found: 272.1090.



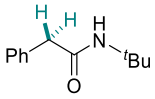
59

***N*-(*tert*-butyl)-2-hydrazono-2-phenylacetamide (59).** Yellow oil, 43.1 mg, 98% yield. 95:5 1:1 *Z*/*E*; **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* (*Z* + *E*) 7.64 (s, 2H), 7.44 (t, *J* = 7.7 Hz, 4H), 7.36 (t, *J* = 7.8 Hz, 4H), 7.30 (t, *J* = 6.8 Hz, 2H), 6.94 (br s, 1H), 5.73 (s, 2H), 5.60 (s, 1H), 1.40 (s, 9H), 1.37 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* (*Z* + *E*) 163.6, 163.4, 142.1, 138.1, 136.4, 129.2, 129.1, 128.9, 128.8, 128.4, 127.6, 52.0, 50.8, 28.9, 28.8; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{18}N_3O]^+$ (M + H^+): 220.1444, found: 220.1443.



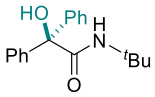
60

***N*-(*tert*-butyl)-2-hydroxy-2-phenylacetamide (60).** White solid, 37.9 mg, 92% yield, m.p. = 116.7 – 117.5 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.31 (s, 5H), 6.32 (br s, 1H), 4.77 (s, 1H), 4.24 (br s, 1H), 1.28 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 171.6, 140.0, 128.8, 128.4, 126.9, 74.2, 51.4, 28.7; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{18}NO_2]^+$ (M + H^+): 208.1332, found: 208.1333.



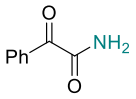
61

***N*-(*tert*-butyl)-2-phenylacetamide (61).** White solid, 31.6 mg, 83% yield, m.p. = 107.5 – 108.9 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.34 (t, *J* = 7.2 Hz, 2H), 7.28 (d, *J* = 7.1 Hz, 1H), 7.24 (d, *J* = 8.0 Hz, 2H), 5.25 (br s, 1H), 3.48 (s, 2H), 1.28 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 170.4, 135.6, 129.4, 129.0, 127.2, 51.3, 45.0, 28.8; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{18}NO]^+$ (M + H^+): 192.1383, found: 192.1382.



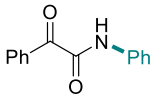
62

***N*-(*tert*-butyl)-2-hydroxy-2,2-diphenylacetamide (62).** White solid, 53.4 mg, 94% yield, m.p. = 124.7 – 126.2 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.44 – 7.35 (m, 4H), 7.33 – 7.29 (m, 6H), 6.49 (br s, 1H), 4.55 (s, 1H), 1.34 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 172.3, 143.3, 128.2, 127.8, 127.5, 81.2, 51.5, 28.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{18}H_{22}NO_2]^+$ (M + H^+): 284.1645, found: 284.1649.



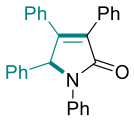
63

2-oxo-2-phenylacetamide (63). White solid, 17.9 mg, 60% yield, m.p. = 71.8 – 73.0 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.22 (d, *J* = 7.9 Hz, 2H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.44 (t, *J* = 7.7 Hz, 2H), 7.25 (br s, 1H), 7.02 (br s, 1H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.0, 164.9, 134.5, 132.9, 131.0, 128.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_8H_8NO_2]^+$ (M + H^+): 150.0550, found: 150.0548.



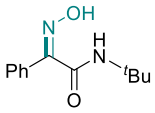
64

2-oxo-*N*,2-diphenylacetamide (64). Yellow solid, 41.4 mg, 92% yield, m.p. = 56.7 – 58.4 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 9.04 (br s, 1H), 8.40 (d, J = 7.8 Hz, 2H), 7.71 (d, J = 8.0 Hz, 2H), 7.65 (t, J = 7.4 Hz, 1H), 7.50 (t, J = 7.7 Hz, 2H), 7.39 (t, J = 7.8 Hz, 2H), 7.20 (t, J = 7.4 Hz, 1H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.5, 159.0, 136.7, 134.7, 133.1, 131.5, 129.3, 128.6, 125.3, 120.0; **HRMS** (ESI-Orbitrap): calcd. for $[C_{14}H_{12}NO_2]^+$ (M + H^+): 226.0863, found: 226.0864.



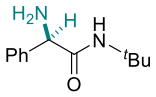
65

1,3,4,5-tetraphenyl-1,5-dihydro-2*H*-pyrrol-2-one (65). Yellow solid, 62.7 mg, 81% yield, m.p. = 146.5 – 148.4 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 7.63 (d, J = 8.2 Hz, 2H), 7.56 – 7.46 (m, 2H), 7.38 – 7.25 (m, 5H), 7.25 – 7.12 (m, 8H), 7.11 – 7.02 (m, 3H), 6.00 (s, 1H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 169.5, 153.4, 137.6, 135.7, 132.6, 132.1, 131.1, 129.9, 129.9, 128.9, 128.7, 128.5, 128.4, 128.3, 127.6, 124.7, 122.0, 121.9 121.9, 67.7 (d, J = 7.9 Hz); **HRMS** (ESI-Orbitrap): calcd. for $[C_{28}H_{22}NO]^+$ (M + H^+): 388.1696, found: 388.1696.



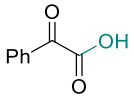
66

(*Z*)-*N*-(*tert*-butyl)-2-(hydroxyimino)-2-phenylacetamide (66). White solid, 41.8 mg, 95% yield, m.p. = 147.4 – 149.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 10.37 (s, 1H), 7.57 (dd, J = 7.8, 1.8 Hz, 2H), 7.45 – 7.31 (m, 3H), 5.89 (br s, 1H), 1.43 (s, 9H); **^{13}C-NMR** (CD_3OD, 101 MHz): δ 166.3, 154.3, 133.6, 130.5, 129.5, 127.1, 53.0, 29.0; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{17}N_2O_2]^+$ (M + H^+): 221.1285, found: 221.1286.



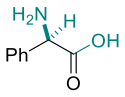
67

2-amino-*N*-(*tert*-butyl)-2-phenylacetamide (67). White solid, 37.1 mg, 90% yield, m.p. = 49.8 – 50.8 ºC **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 7.37 – 7.22 (m, 5H), 6.99 (br s, 1H), 4.36 (s, 1H), 1.87 (br s, 2H), 1.32 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 172.2, 141.5, 128.8, 127.9, 126.9, 60.3, 50.8, 28.7; **HRMS** (ESI-Orbitrap): calcd. for $[C_{12}H_{19}N_2O]^+$ (M + H^+): 207.1492, found: 207.1495.



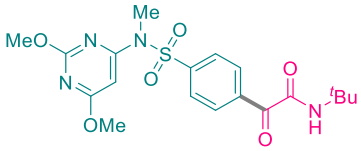
68

2-oxo-2-phenylacetic acid (68). White solid, 29.4 mg, 98% yield, m.p. = 57.2 – 59.0 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 9.60 (s, 1H), 8.24 (d, J = 8.5 Hz, 2H), 7.70 (t, J = 7.5 Hz, 1H), 7.53 (t, J = 7.8 Hz, 2H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 184.9, 163.1, 135.8, 131.8, 131.2, 129.1; **HRMS** (ESI-Orbitrap): calcd. for $[C_8H_7O_3]^+$ (M + H^+): 151.0390, found: 151.0394.



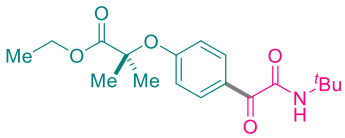
69

2-amino-2-phenylacetic acid (69). White solid, 24.3 mg, 80% yield. **^{1}H-NMR** (D_2O, 400 MHz) δ 7.34 – 7.17 (m, 5H), 4.98 (s, 1H); **^{13}C-NMR** (D_2O, 101 MHz): δ 170.5, 131.1, 130.3, 129.6, 128.0, 56.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_8H_{10}NO_2]^+$ (M + H^+): 152.0706, found: 152.0713. The **^{1}H-NMR** and **^{13}C-NMR** spectra are in agreement with those reported in the literature.[24]



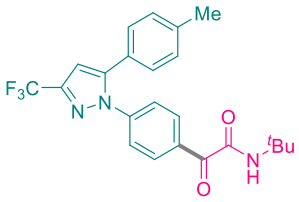
70

***N*-(*tert*-butyl)-2-(4-(*N*-(2,6-dimethoxypyrimidin-4-yl)-*N*-methylsulfamoyl)phenyl)-2-oxoacetamide (70).** Yellow solid, 56.7 mg, 65% yield (From aryl bromide derivative of Sulfadimethoxine); 75.9 mg, 87% yield (From aryl iodide derivative of Sulfadimethoxine), m.p. = 39.4 – 41.4 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.36 (d, J = 8.3 Hz, 2H), 7.84 (d, J = 8.3 Hz, 2H), 6.95 (br s, 1H), 6.55 (s, 1H), 3.89 (s, 3H), 3.80 (s, 3H), 3.43 (s, 3H), 1.41 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 187.1, 172.6, 164.3, 161.0, 160.0, 142.9, 137.0, 131.9, 127.0, 90.0, 54.9, 54.2, 52.0, 34.7, 28.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_{19}H_{25}N_4O_6S]^+$ (M + H^+): 437.1489, found: 437.1490.



71

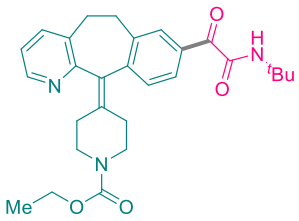
Ethyl 2-(4-(2-(*tert*-butylamino)-2-oxoacetyl)phenoxy)-2-methylpropanoate (71). Yellow solid, 50.9 mg, 76% yield (From aryl iodide derivative of Clofibrate), m.p. = 96.9 – 98.6 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): δ 8.28 (d, J = 9.1 Hz, 2H), 6.95 (br s, 1H), 6.79 (d, J = 9.1 Hz, 2H), 4.19 (q, J = 7.1 Hz, 2H), 1.63 (s, 6H), 1.41 (s, 9H), 1.18 (t, J = 7.1 Hz, 3H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): δ 186.7, 173.6, 161.6, 160.9, 133.5, 126.8, 117.0, 79.4, 61.8, 51.6, 28.4, 25.4, 14.1; **HRMS** (ESI-Orbitrap): calcd. for $[C_{18}H_{26}NO_5]^+$ (M + H^+): 336.1805, found: 336.1806.



72

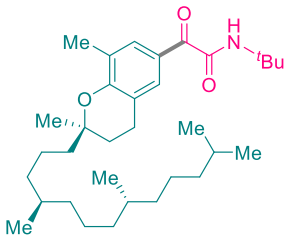
***N*-(*tert*-butyl)-2-oxo-2-(4-(5-(p-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl) acetamide (72).** Yellow solid, 73.0 mg, 85% yield (From aryl bromide derivative of

Celecoxib); 78.1 mg, 91% yield (From aryl iodide derivative of Celecoxib), m.p. = 89.5 – 91.3 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.34 (d, *J* = 8.7 Hz, 2H), 7.42 (d, *J* = 8.7 Hz, 2H), 7.13 (dd, *J* = 18.6, 8.1 Hz, 4H), 6.99 (br s, 1H), 6.73 (s, 1H), 2.37 (s, 3H), 1.45 (s, 9H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 187.1, 160.7 145.3, 144.0 (q, *J* = 78.1, 39.6 Hz), 143.6, 139.7, 134.8, 132.6, 132.4, 130.6, 129.7, 129.0, 128.8, 128.5, 126.0, 125.5, 124.7, 121.2 (q, *J* = 269.1 Hz), 106.4 (d, *J* = 1.8 Hz), 51.8, 28.4, 21.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{23}H_{23}F_3N_3O_2]^+$ (M + H^+): 430.1737, found: 430.1739.



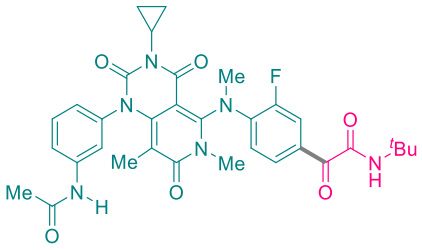
73

Ethyl 4-(8-(2-(*tert*-butylamino)-2-oxoacetyl)-5,6-dihydro-11*H*-benzo[5,6]cyclohepta [1,2-*b*]pyridin-11-ylidene)piperidine-1-carboxylate (73). Yellow solid, 82.7 mg, 87% yield (From aryl iodide derivative of Loratadine), m.p. = 175.9 – 177.8 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.37 (d, *J* = 3.6 Hz, 1H), 8.14 (s, 1H), 8.06 (d, *J* = 8.0 Hz, 1H), 7.41 (d, *J* = 7.5 Hz, 1H), 7.28 (s, 1H), 7.07 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.95 (br s, 1H), 4.10 (q, *J* = 7.1 Hz, 2H), 3.79 (s, 2H), 3.50 – 3.39 (m, 1H), 3.38 – 3.28 (m, 1H), 3.18 – 3.02 (m, 2H), 2.94 – 2.78 (m, 2H), 2.54 – 2.42 (m, 1H), 2.38 – 2.21 (m, 3H), 1.40 (s, 9H), 1.21 (t, *J* = 7.1 Hz, 3H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 188.0, 161.2, 156.1, 155.4, 146.7, 145.7, 138.1, 138.1 137.8, 134.6, 133.5, 132.5, 131.8, 129.3, 129.1, 122.4, 61.3, 51.6, 44.8, 31.6 (d, *J* = 4.4 Hz), 30.9, 30.5, 28.3, 28.3; **HRMS** (ESI-Orbitrap): calcd. for $[C_{28}H_{34}N_3O_4]^+$ (M + H^+): 476.2544, found: 476.2544.



74

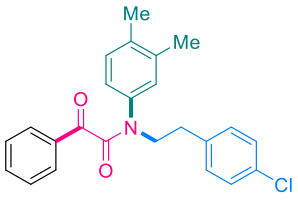
***N*-(*tert*-butyl)-2-((*R*)-2,8-dimethyl-2-((4*R*,8*R*)-4,8,12-trimethyltridecyl)chroman-6-yl)-2-oxoacetamide (74).** Yellow oil, 41.1 mg, 40% yield (From aryl iodide derivative of *δ*-Vitamin E). **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.10 (s, 1H), 7.96 (s, 1H), 6.98 (br s, 1H), 2.79 (t, *J* = 6.6 Hz, 2H), 2.18 (s, 3H), 1.92 – 1.69 (m, 2H), 1.63 – 0.97 (m, 33H), 0.94 – 0.74 (m, 12H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.9, 162.2, 158.4, 132.1, 131.7, 126.7, 124.7, 120.3, 78.0, 51.5, 40.3, 39.5, 37.6, 37.5, 37.5, 37.4, 32.9, 32.8, 31.0, 28.6, 28.1, 24.9, 24.6, 24.5, 22.9, 22.8, 22.3, 21.1, 19.9, 19.8, 16.2; **HRMS** (ESI-Orbitrap): calcd. for $[C_{33}H_{56}NO_3]^+$ (M + H^+): 514.4255, found: 514.4263.



75

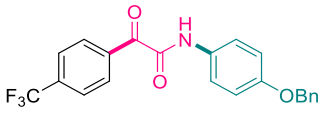
2-(4-((1-(3-acetamidophenyl)-3-cyclopropyl-6,8-dimethyl-2,4,7-trioxo-1,2,3,4,6,7-hexahydropyrido[4,3-*d*]pyrimidin-5-yl)(methyl)amino)-3-fluorophenyl)-*N*-(*tert*-butyl)-2-oxoacetamide (75). Yellow solid, 121.0 mg, 96% yield (From aryl iodide derivative of Trametinib), m.p. = 167.6 – 169.9 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 11.34 – 11.14 (m, 1H), 7.54 (d, *J* = 11.1 Hz, 1H), 7.47 (d, *J* = 8.3 Hz, 1H), 7.41 (t, *J* = 8.1 Hz, 1H), 7.23 – 7.10 (m, 3H), 6.86 (t, *J* = 8.0 Hz, 1H), 6.31 (s, 1H), 3.18 (s, 3H), 3.10 (s, 3H), 2.63 (dt, *J* = 10.7, 3.6 Hz, 1H), 1.83 (s, 3H), 1.37 (s, 9H), 1.32 (s, 3H), 1.03 (d, *J* = 6.9 Hz, 2H), 0.70 (s, 2H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 170.4, 164.7, 164.6, 164.6, 163.8, 154.8 (d, *J* = 249.7 Hz), 151.9, 151.5, 145.1, 144.8, 141.1, 134.3, 134.2, 130.4 (d, *J* = 12.1 Hz), 130.1, 128.1, 126.8, 123.3, 123.2, 123.0, 115.5 (d, *J* = 20.7 Hz), 110.1, 103.6, 90.1, 52.1, 37.3, 34.8, 28.9, 25.3, 22.7,

13.8, 8.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{33}H_{36}FN_6O_6]^+$ (M + H^+): 653.2494, found: 653.2503.



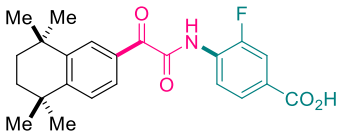
76

***N*-(4-chlorophenethyl)-*N*-(3,4-dimethylphenyl)-2-oxo-2-phenylacetamide (76).** White solid, 20.0 mg, 25% yield, m.p. = 113.2 – 114.6 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.62 (d, *J* = 7.2 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.7 Hz, 2H), 7.31 (d, *J* = 8.3 Hz, 2H), 7.21 (d, *J* = 8.3 Hz, 2H), 6.93 (d, *J* = 7.9 Hz, 1H), 6.77 (s, 1H), 6.68 (d, *J* = 7.9 Hz, 1H), 4.18 (t, *J* = 7.4 Hz, 2H), 2.91 (t, *J* = 7.4 Hz, 2H), 2.16 (s, 3H), 2.09 (s, 3H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 190.7, 167.0, 138.3, 137.2, 136.9, 136.7, 134.3, 133.7, 132.5, 130.7, 130.5, 129.5, 128.8, 128.7, 125.1, 48.9, 33.1, 19.8, 19.5; **HRMS** (ESI-Orbitrap): calcd. for $[C_{24}H_{23}ClNO_2]^+$ (M + H^+): 392.1412, found: 392.1411.



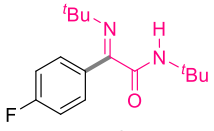
77

***N*-(4-(benzyloxy)phenyl)-2-oxo-2-(4-(trifluoromethyl)phenyl)acetamide (77).** Yellow solid, 24.7 mg, 31% yield, m.p. = 127.1 – 128.1 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 8.89 (br s, 1H), 8.52 (d, *J* = 8.2 Hz, 2H), 7.77 (d, *J* = 8.3 Hz, 2H), 7.62 (d, *J* = 8.8 Hz, 2H), 7.48 – 7.30 (m, 5H), 7.01 (d, *J* = 8.8 Hz, 2H), 5.08 (s, 2H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 186.8, 158.0, 156.5, 136.8, 136.0, 135.5 (q, *J* = 65.3, 32.6 Hz), 131.9, 129.8, 128.8, 128.2, 127.6, 125.6 (q, *J* = 3.7 Hz), 123.6 (q, *J* = 545.8, 272.9 Hz), 121.7, 115.5, 70.4; **HRMS** (ESI-Orbitrap): calcd. for $[C_{22}H_{17}F_3NO_3]^+$ (M + H^+): 400.1155, found: 400.1157.



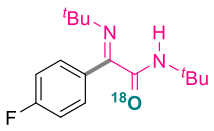
78

3-fluoro-4-(2-oxo-2-(5,5,8,8-tetramethyl-5,6,7,8-tetrahydronaphthalen-2-yl) acetamido) benzoic acid (78). White solid, 18.3 mg, 23% yield, m.p. = 33.2 – 34.9 ºC. **^{1}H-NMR** (DMSO-*d*$_6$, 400 MHz): *δ* 13.18 (br s, 1H), 11.07 (s, 1H), 8.14 (t, *J* = 7.8 Hz, 1H), 7.99 (s, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.79 (d, *J* = 10.9 Hz, 1H), 7.74 (d, *J* = 8.1 Hz, 1H), 7.57 (d, *J* = 8.3 Hz, 1H), 1.66 (s, 4H), 1.26 (s, 12H); **^{13}C-NMR** (DMSO-*d*$_6$, 101 MHz): *δ* 188.7, 166.0, 164.7, 153.4 (d, *J* = 247.8 Hz), 152.5, 145.5, 130.1, 129.0, 128.8, 127.9 (d, *J* = 5.5 Hz), 127.6, 127.2, 126.1, 124.0, 116.5 (d, *J* = 21.4 Hz), 34.7, 34.1, 31.5, 31.2; **HRMS** (ESI-Orbitrap): calcd. for $[C_{23}H_{25}FNO_4]^+$ (M + H$^+$): 398.1762, found: 398.1789.



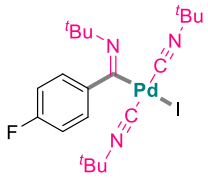
79

***N*-(*tert*-butyl)-2-(*tert*-butylimino)-2-(4-fluorophenyl)acetamide (79).** Yellow solid, 58% yield by recrystallization, m.p. = 122.4 – 124.0 ºC. **^{1}H-NMR** (DMSO-*d6*, 400 MHz): *δ* 8.32 (s, 1H), 7.85 – 7.66 (m, 2H), 7.24 (t, *J* = 8.9 Hz, 2H), 1.36 (s, 9H), 1.34 (s, 9H); **^{13}C-NMR** (DMSO-*d*$_6$, 101 MHz): *δ* 167.2, 163.2 (d, *J* = 247.2 Hz), 156.5, 134.1 (d, *J* = 2.9 Hz), 129.1 (d, *J* = 8.7 Hz), 115.1 (d, *J* = 21.7 Hz), 56.9, 51.1, 30.3, 28.2; **^{19}F NMR** (DMSO-*d*$_6$, 376 MHz) *δ* -111.33 (s, 1F). **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{24}FN_2O]^+$ (M + H$^+$): 279.1867, found: 279.1878.



80

***N*-(*tert*-butyl)-2-(tert-butylimino)-2-(4-fluorophenyl)acetamide-^{18}O (80).** Yellow solid, 64% yield by ^{19}F NMR, m.p. = 128.9 – 130.4 ºC. **HRMS** (ESI-Orbitrap): calcd. for $[C_{16}H_{24}FN_2{}^{18}O]^+$ (M + H$^+$): 281.1910, found: 279.1921.

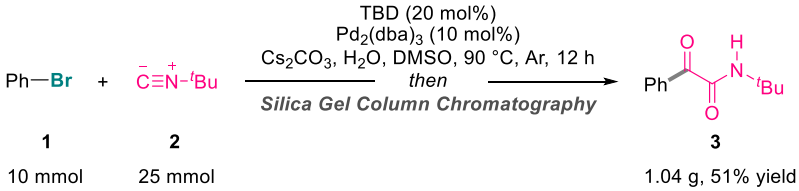


81

Bis((*tert*-butyl-λ^4-azanylidyne)methyl)((*tert*-butylimino)(4-fluorophenyl)methyl) palladium (IV) iodide (81). Yellow solid, 57.7 mg, 50 % yield, m.p. = 152.1 – 154.0 ºC. **^{1}H-NMR** ($CDCl_3$, 400 MHz): *δ* 7.83 (dd, *J* = 8.7, 5.7 Hz, 2H), 6.99 (t, *J* = 8.7 Hz, 2H), 1.55 (s, 9H), 1.38 (s, 18H); **^{13}C-NMR** ($CDCl_3$, 101 MHz): *δ* 165.3 (d, *J* = 246.9 Hz), 161.6, 141.4 (d, *J* = 3.0 Hz), 130.6 (d, *J* = 8.2 Hz), 114.7 (d, *J* = 21.5 Hz), 58.0, 57.3, 31.3, 29.8; **^{19}F NMR** $CDCl_3$, 376 MHz) *δ* -113.33 (s, 1F); **HRMS** (ESI-Orbitrap): calcd. for $[C_{21}H_{32}FIN_3Pd]^+$ (M + H^+): 578.0654, found: 578.0678.

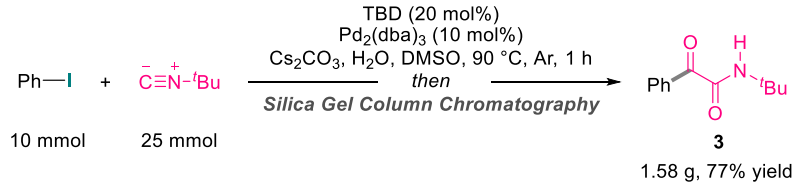
7. Gram-scale experiments

*Synthesis of compound **3** from bromobenzene*



A 100 mL oven-dried single-necked flask equipped with a stir bar was charged with bromobenzene (**1**, 1.05 mL, 10.0 mmol, 1.0 equiv), TBD (278.4 mg, 20 mol%), $Pd_2(dba)_3$ (915.7 mg, 10 mol%), Cs_2CO_3 (6.52 g, 20.0 mmol, 2.0 equiv), H_2O (5.0 mL) and extra dry DMSO (50 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (**2**, 2.83 mL, 25 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (80 mL), extracted with CH_2Cl_2 (3 × 80 mL), washed with brine (2 × 200 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (20:1 – 5:1) to afford the product **3** (1.04 g, 51% yield).

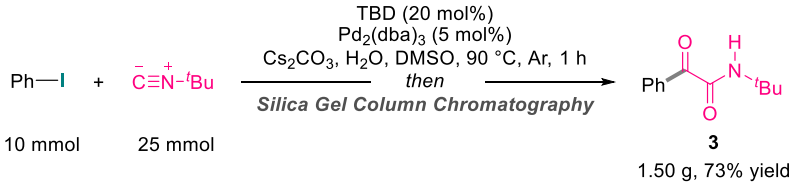
*Synthesis of compound **3** from iodobenzene*



A 100 mL oven-dried single-necked flask equipped with a stir bar was charged with iodobenzene (1.12 mL, 10.0 mmol, 1.0 equiv), TBD (278.4 mg, 20 mol%), $Pd_2(dba)_3$ (915.7 mg, 10 mol%), Cs_2CO_3 (6.52 g, 20.0 mmol, 2.0 equiv), H_2O (5.0 mL) and extra dry DMSO (50 mL). The flask was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (2.83 mL, 25 mmol) was added by syringe under argon. The flask was

then sealed and was stirred at 90 ºC (oil bath) for 1 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (80 mL), extracted with CH_2Cl_2 (3 × 80 mL), washed with brine (2 × 200 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (20:1 – 5:1) to afford the product **3** (1.58 g, 77% yield).

*Synthesis of compound **3** from iodobenzene with 5 mol% $Pd_2(dba)_3$*



A 100 mL oven-dried single-necked flask equipped with a stir bar was charged with iodobenzene (1.12 mL, 10.0 mmol, 1.0 equiv), TBD (278.4 mg, 20 mol%), $Pd_2(dba)_3$ (457.9 mg, 5 mol%), Cs_2CO_3 (6.52 g, 20.0 mmol, 2.0 equiv), H_2O (5.0 mL) and extra dry DMSO (50 mL). The flask was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (2.83 mL, 25 mmol) was added by syringe under argon. The flask was then sealed and was stirred at 90 ºC (oil bath) for 1 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (80 mL), extracted with CH_2Cl_2 (3 × 80 mL), washed with brine (2 × 200 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (20:1 – 5:1) to afford the product **3** (1.50 g, 73% yield).

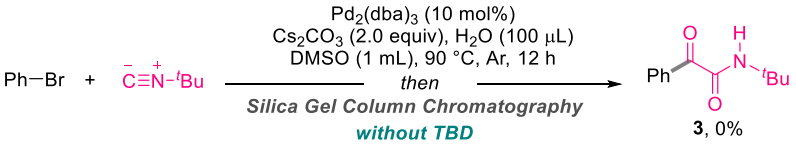
8. Mechanistic studies

8.1 Control experiment

8.1.1 Crossover reaction

A 4-mL flame-dried vial with a magnetic stir bar was charged with bromobenzene (20.9 μL, 0.2 mmol), 2-(3-fluorophenyl)ethan-1-amine (65.3μL, 0.5 mmol, 2.5 equiv), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **3** (19.7 mg, 48% yield), the compound **58** was not detected.

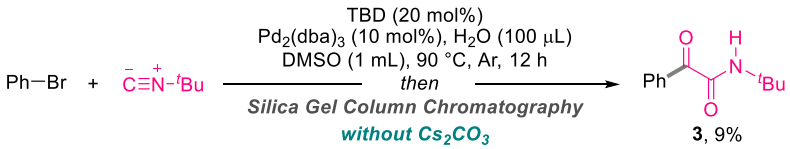
8.1.2 The model reaction in the absence of TBD



A 4-mL flame-dried vial with a magnetic stir bar was charged with bromobenzene (20.9 μL, 0.2 mmol), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was

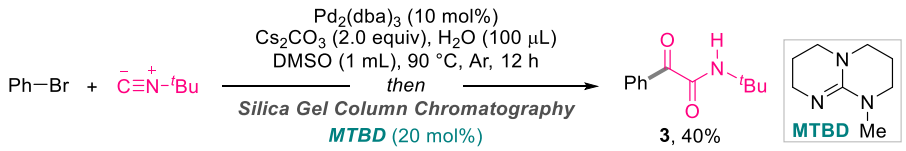
cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1). However, product **3** was not obtained (0% yield).

8.1.3 The model reaction in the absence of Cs_2CO_3



A 4-mL flame-dried vial with a magnetic stir bar was charged with bromobenzene (20.9 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **3** (3.7 mg, 9% yield).

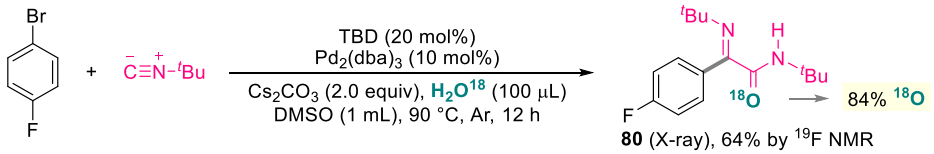
8.1.4 The model reaction by replacing TBD with MTBD



A 4-mL flame-dried vial with a magnetic stir bar was charged with bromobenzene (20.9 μL, 0.2 mmol), MTBD (6.1 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was

added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated. The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 10:1) to afford the product **3** (16.4 mg, 40% yield).

8.2 Isotope labeling experiment



80 (X-ray), 64% by ^{19}F NMR

A 4-mL flame-dried vial with a magnetic stir bar was charged with 1-bromo-4-fluorobenzene (22.0 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), $H_2{}^{18}O$ (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, filtered through a filter membrane. Then the yield of compound **80** was given in 64% yield determined by ^{19}F-NMR.

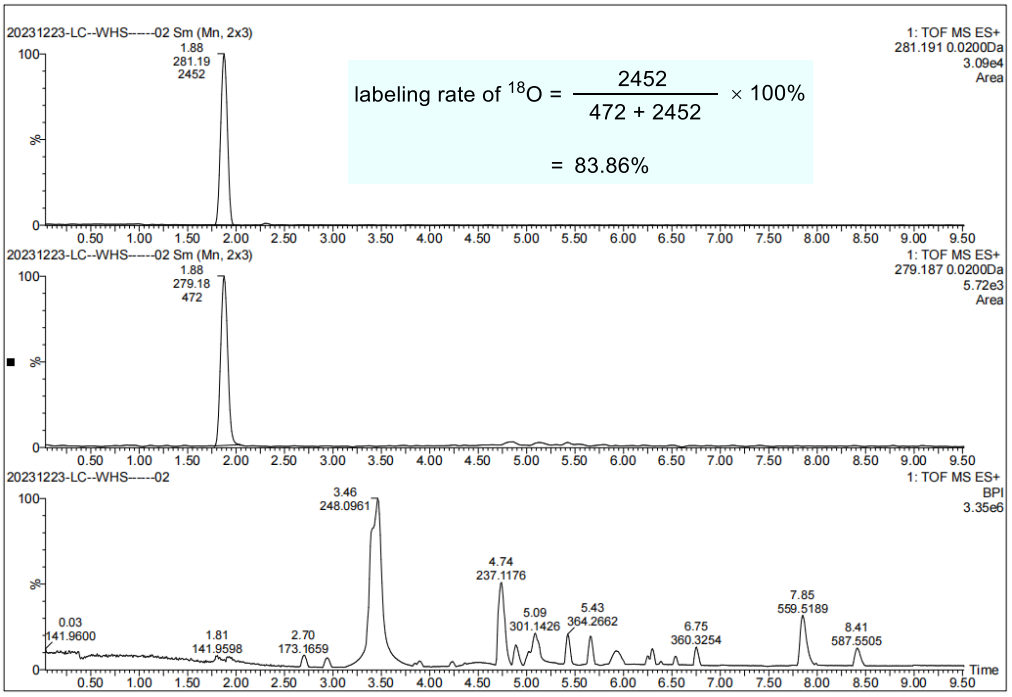
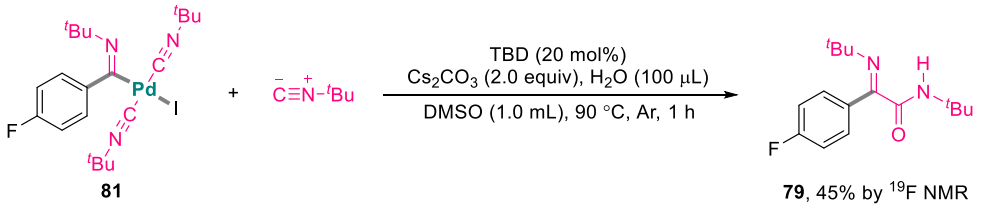


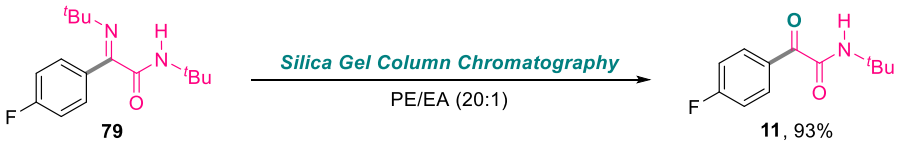
Fig. S2 Content determination of ^{18}O labelled midbody

8.3 Control experiment with imidoylpalladium complex



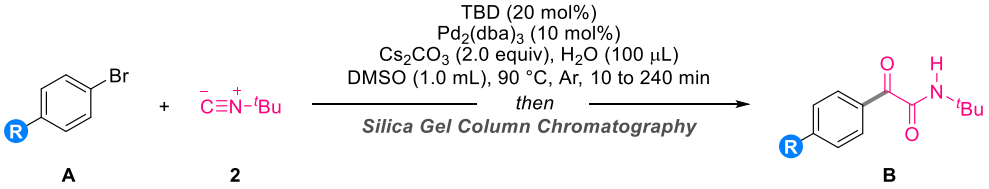
A 4-mL flame-dried vial with a magnetic stir bar was charged with **81** (115.4 mg, 0.2 mmol), TBD (5.6 mg, 20 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (22.6 μL, 0.2 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 1 h. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, filtered through a filter membrane. Then the yield of compound **79** was given in 45% determined by ^{19}F-NMR.

8.4 Control experiment with α-ketoimine amide



The sample **79** (55.6 mg, 0.2 mmol) was eluted by silica gel column chromatography with petroleum ether/ethyl acetate (20:1) to give the product **11** (41.3 mg, 93% yield).

8.5 Hammett's correlation



A 4-mL flame-dried vial with a magnetic stir bar was charged with substrate (**A1** – **A7**), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 10 min – 240 min. After the completion of the reaction monitored by TLC (thin layer chromatography), the reaction mixture was cooled to the room temperature and treated with water (15 mL), extracted with CH_2Cl_2 (3 × 15 mL), washed with brine (2 × 40 mL). Then the organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[25,26] The residue was purified by flash column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (30:1 – 5:1) to afford the corresponding product.

Table S6. **Raw data of Hammett correlation experiment**

Substrate (R)	Weight of **A** (mg)	Time (min)	Weight of **B** (mg)	Yield of **B** (%)
A1 (H)	31.4	60	4.5	11.0
A1 (H)	31.4	120	5.5	13.4
A1 (H)	31.4	180	9.2	22.4
A1 (H)	31.4	240	11.1	27.1

A2 (F)	35.0	60	3.9	8.7
A2 (F)	35.0	120	10.4	23.3
A2 (F)	35.0	180	14.1	31.6
A2 (F)	35.0	240	19.8	44.4
A3 (Cl)	38.3	60	6.8	14.2
A3 (Cl)	38.3	120	11.5	24.1
A3 (Cl)	38.3	180	18.7	39.1
A3 (Cl)	38.3	240	27.6	57.7
A4 (CF_3)	45.0	30	14.6	26.7
A4 (CF_3)	45.0	60	22.9	41.9
A4 (CF_3)	45.0	90	30.4	55.7
A4 (CF_3)	45.0	120	41.5	76.0
A5 (CN)	36.4	10	3.6	7.8
A5 (CN)	36.4	20	7.2	15.6
A5 (CN)	36.4	30	12	26.1
A5 (CN)	36.4	40	17.5	38.0
A6 (Me)	34.2	60	1.8	4.1
A6 (Me)	34.2	120	3.7	8.4
A6 (Me)	34.2	180	5.8	13.2
A6 (Me)	34.2	240	7.6	17.3
A7 (OMe)	37.4	60	3.8	8.1
A7 (OMe)	37.4	120	4.6	9.8
A7 (OMe)	37.4	180	7.1	15.1
A7 (OMe)	37.4	240	9.7	20.6

Table S7. Plot of Hammett correlation experiment

Substrate (R)	Rate constant	k_R/k_H	Log (k_R/k_H)	Substitution constant (σ_P)
A1 (H)	0.0955	1	0	0
A2 (F)	0.1923	2.01	0.3	0.06

A3 (Cl)	0.2425	2.54	0.4	0.28
A4 (CF_3)	0.539	5.64	0.75	0.54
A5 (CN)	1.011	10.59	1.02	0.66
A6 (Me)	0.074	0.775	-0.11	-0.17
A7 (OMe)	0.0713	0.747	-0.13	-0.27

The individual rate constants were then plotted against the substituent constants (σm) and a hammett correlation with a negative slope was obtained (ρ = 1.235, R^2= 0.961).

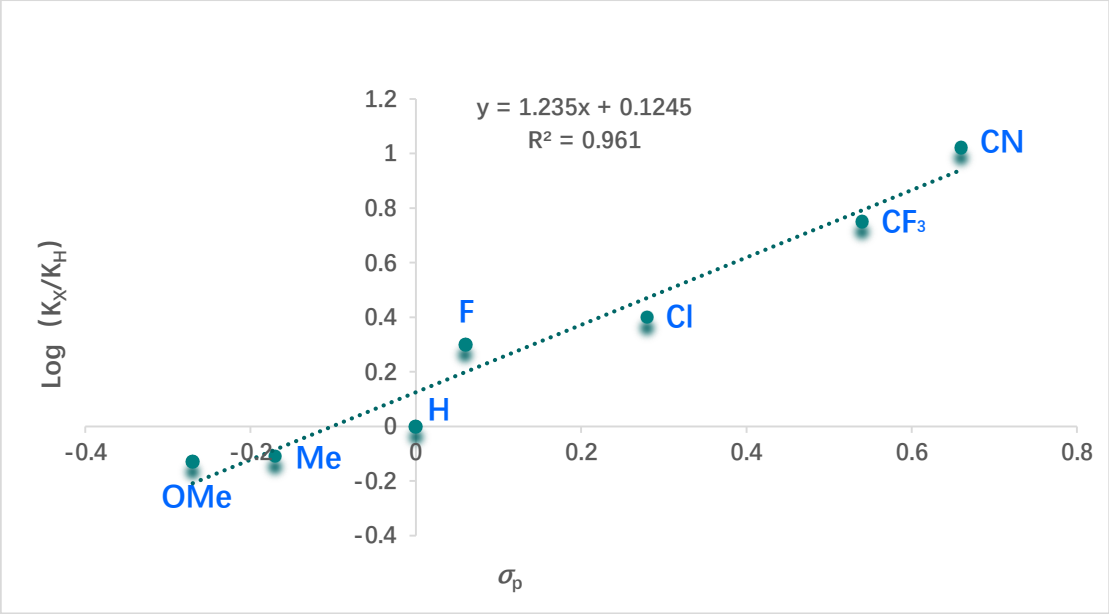
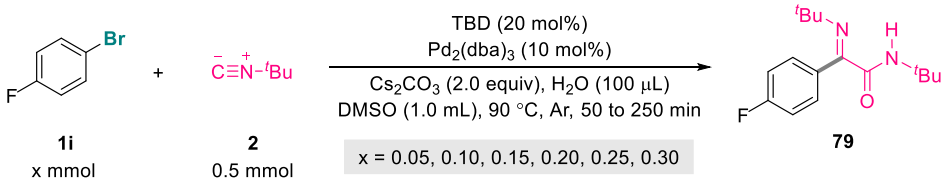


Fig. S3 Hammett correlation plot

8.6 Kinetic Studies under standard reaction conditions

8.6.1 Dependence of the reaction rate on concentration of *p*-bromofluorobenzene (**1i**)



1i x mmol | **2** 0.5 mmol | x = 0.05, 0.10, 0.15, 0.20, 0.25, 0.30 | **79**

General procedure: **1i (x mmol)**, TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 µL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide **2** (56.6 µL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. One of the reaction vials was cooled to room

temperature every 50 minutes. The reaction mixture was added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, and filtered through a filter membrane. The yield of **79** was determined by ^{19}F-NMR using benzotrifluoride as an internal standard.[27,28]

Kinetic profiles of different initial concentrations of **1i** were collected (Fig. S4). The rate was plotted against the concentration of **1i** (Fig. S5).

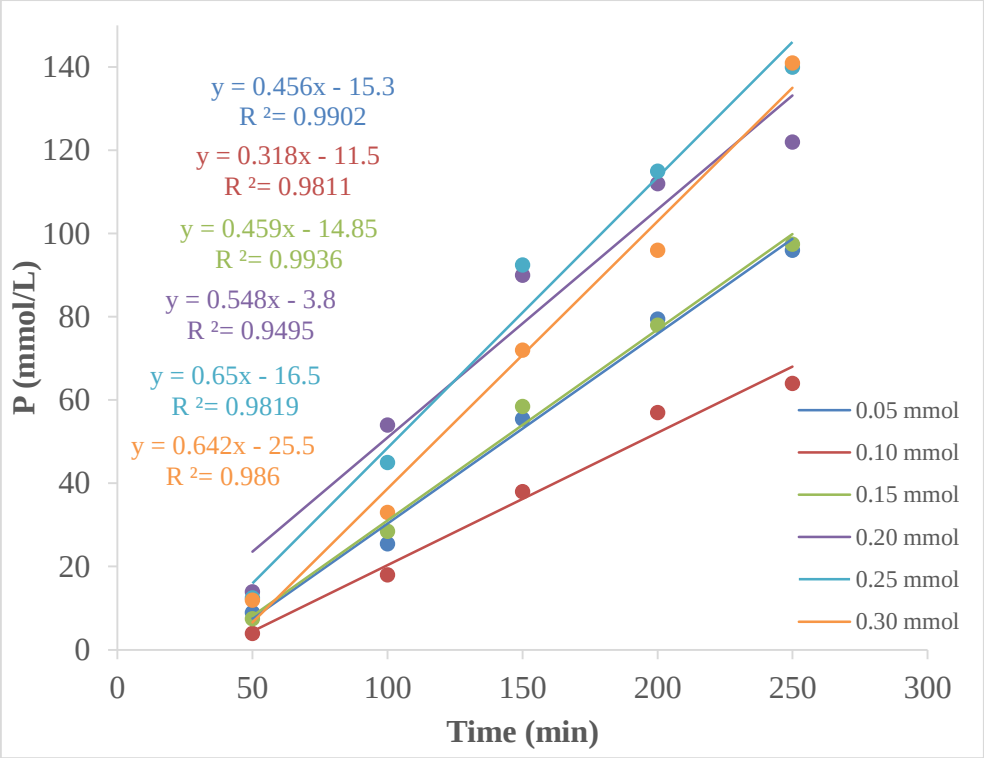


Fig. S4 Reaction profiles for **1i**

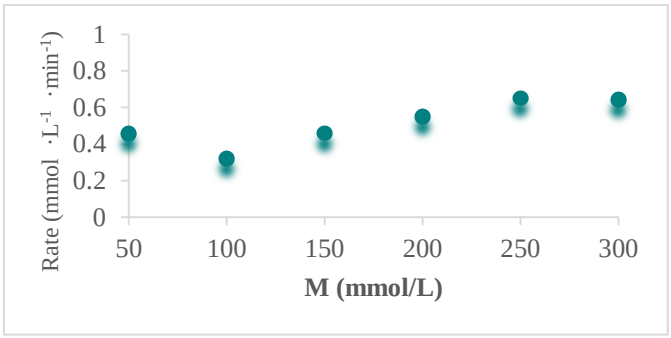
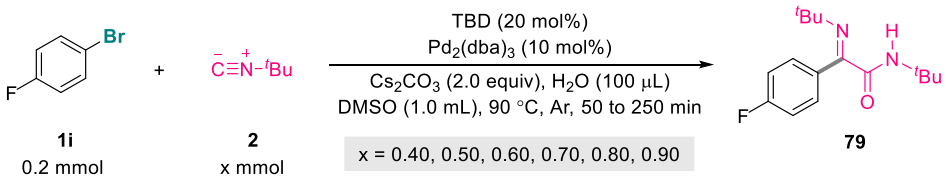


Fig. S5 Initial reaction rate dependence on concentration of **1i**

8.6.2 Dependence of the reaction rate on concentration of *tert*-butyl isocyanide (**2**)



General procedure: **1i** (22.0 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide **2 (x mmol)** was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. One of the reaction vials was cooled to room temperature every 50 minutes. The reaction mixture was added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, and filtered through a filter membrane. The yield of **79** was determined by ^{19}F-NMR using benzotrifluoride as an internal standard.[27,28]

Kinetic profiles of different initial concentrations of **2** were collected (Fig. S6). The rate was plotted against the concentration of **2** (Fig. S7).

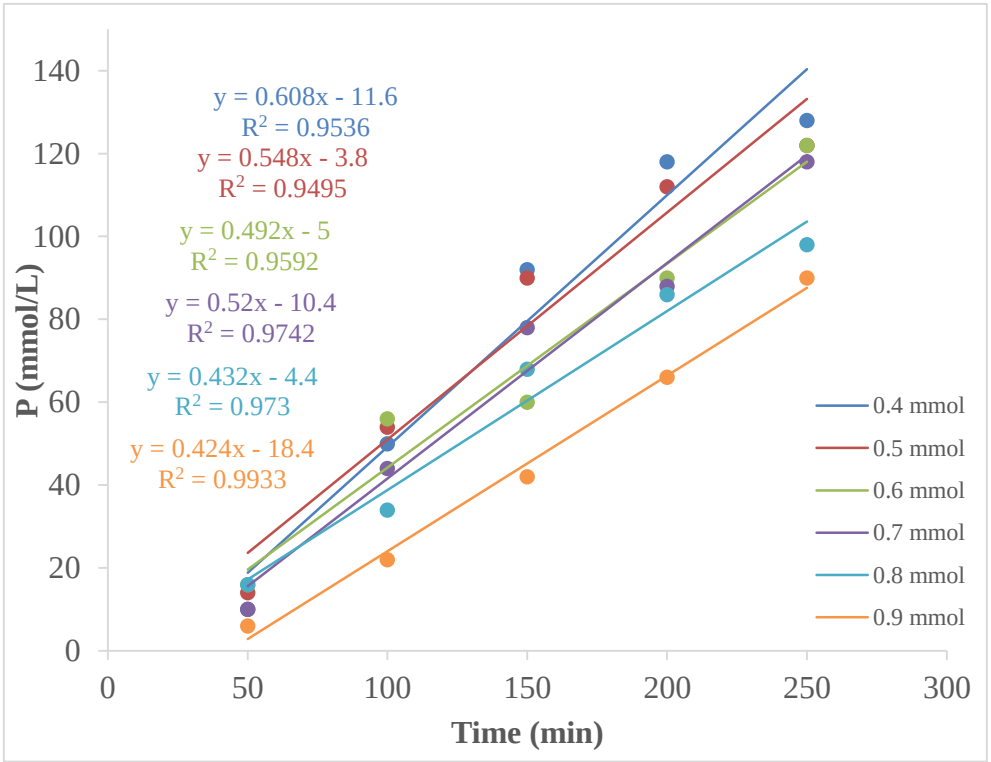


Fig. S6 Reaction profiles for **2**

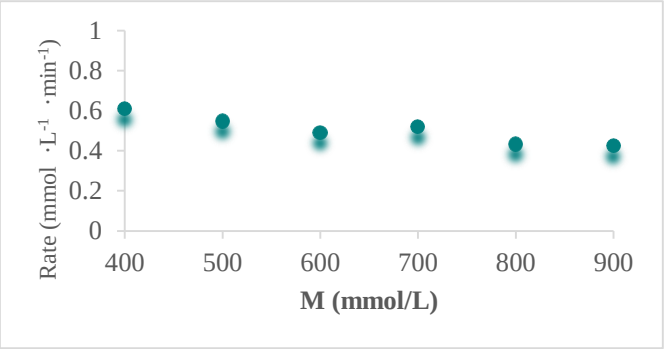
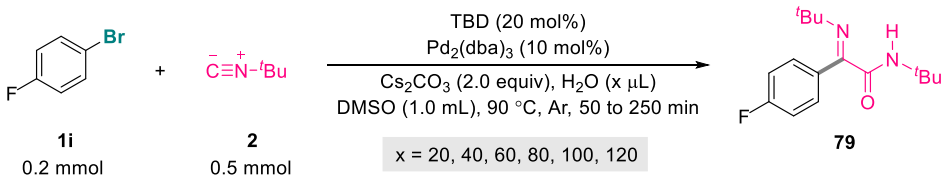


Fig. S7 Initial reaction rate dependence on concentration of **2**

8.6.3 Dependence of the reaction rate on concentration of **H_2O**



1i
0.2 mmol

2
0.5 mmol

x = 20, 40, 60, 80, 100, 120

79

General procedure: **1i** (22.0 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), **H_2O (x μL)** and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide **2** (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. One of the reaction vials was cooled to room temperature every 50 minutes. The reaction mixture was added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, and filtered through a filter membrane. The yield of **79** was determined by ^{19}F-NMR using benzotrifluoride as an internal standard.[27,28]

Kinetic profiles of different initial concentrations of **H_2O** were collected (Fig. S8). The rate was plotted against the concentration of **H_2O** (Fig. S9).

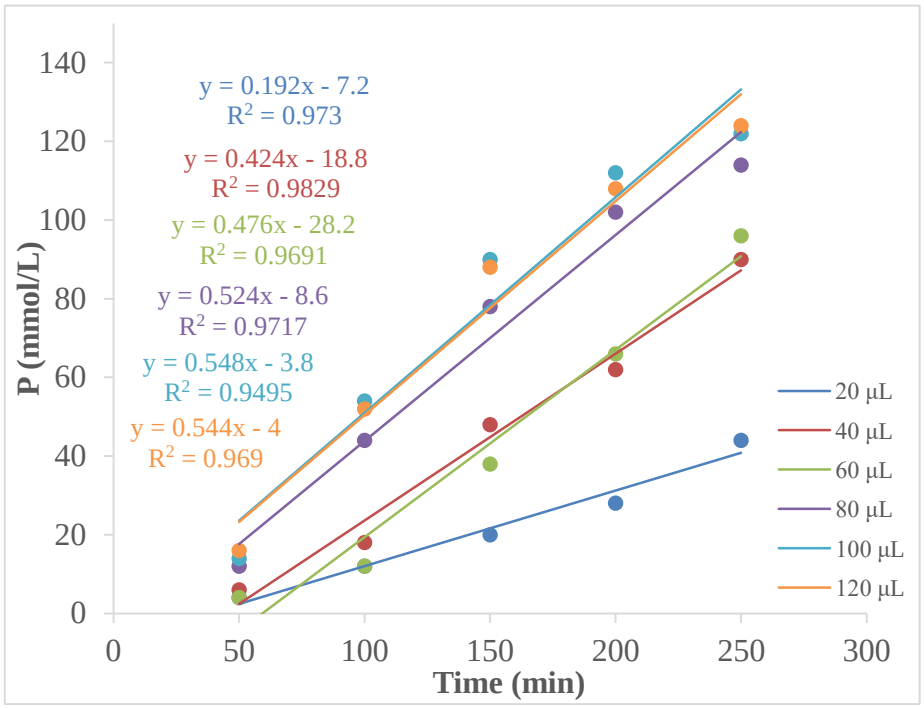


Fig. S8 Reaction profiles for **H_2O**

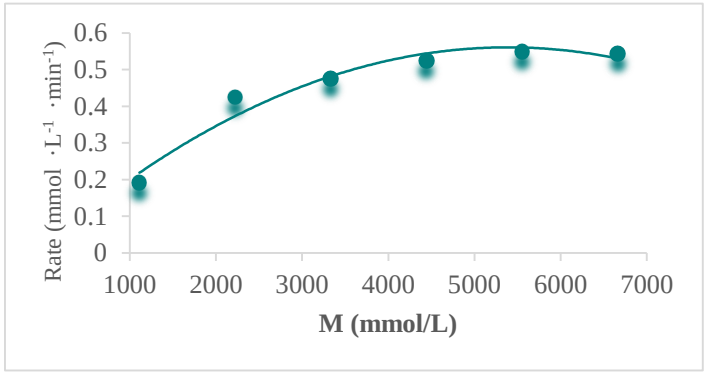
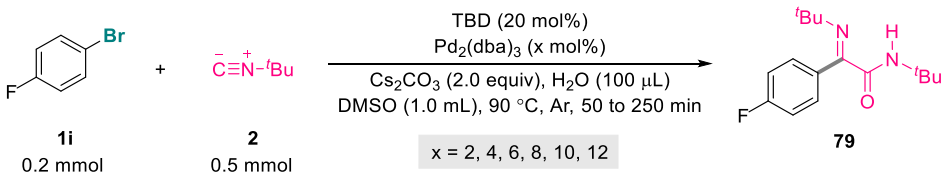


Fig. S9 Initial reaction rate dependence on concentration of **H_2O**

8.6.4 Dependence of the reaction rate on concentration of **$Pd_2(dba)_3$**



General procedure: **1i** (22.0 μL, 0.2 mmol), TBD (5.6 mg, 20 mol%), **$Pd_2(dba)_3$ (x mol%)**, Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide **2** (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and

was stirred at 90 ºC (oil bath) for 12 h. One of the reaction vials was cooled to room temperature every 50 minutes. The reaction mixture was added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, and filtered through a filter membrane. The yield of **79** was determined by ^{19}F-NMR using benzotrifluoride as an internal standard.[27,28]

Kinetic profiles of different initial concentrations of **$Pd_2(dba)_3$** were collected (Fig. S10). The rate was plotted against the concentration of **$Pd_2(dba)_3$** (Fig. S11).

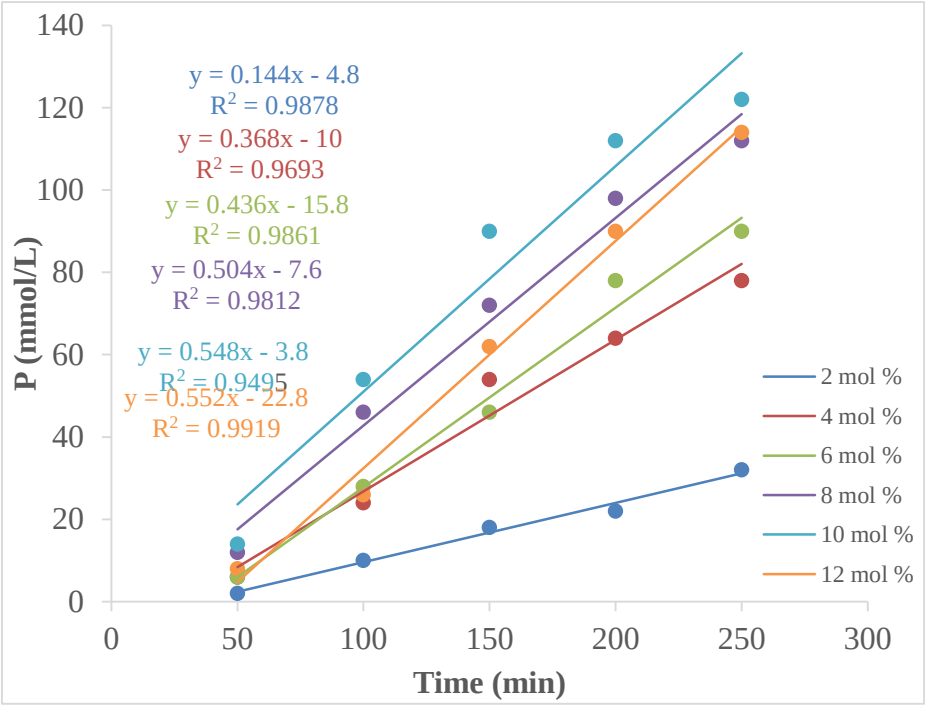


Fig. S10 Reaction profiles for **$Pd_2(dba)_3$**

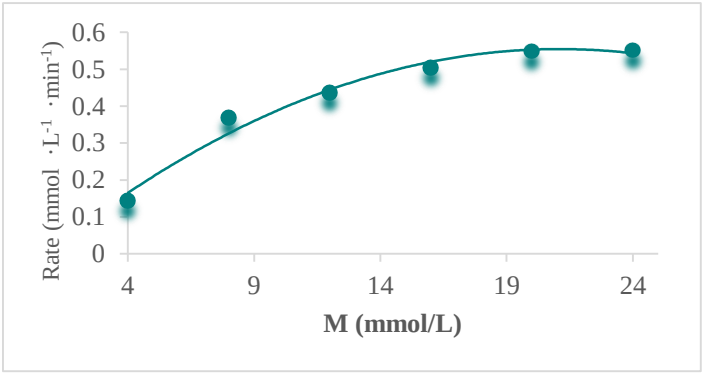
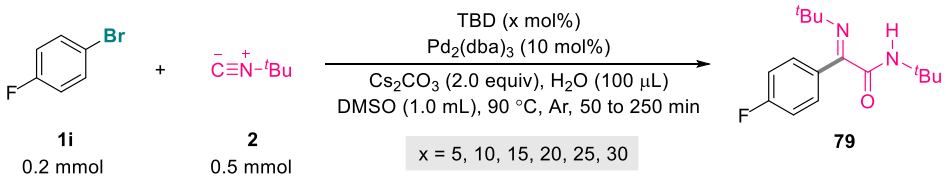


Fig. S11 Initial reaction rate dependence on concentration of **$Pd_2(dba)_3$**

8.6.5 Dependence of the reaction rate on concentration of **TBD**



General procedure: **1i** (22.0 μL, 0.2 mmol), **TBD (x mol%)**, $Pd_2(dba)_3$ (18.3 mg, 10 mol%), Cs_2CO_3 (130.3 mg, 0.4 mmol), H_2O (100 μL) and extra dry DMSO (1.0 mL). The vial was evacuated and backfilled with argon for three times and then *tert*-butyl isocyanide **2** (56.6 μL, 0.5 mmol) was added by syringe under argon. The vial was then sealed and was stirred at 90 ºC (oil bath) for 12 h. One of the reaction vials was cooled to room temperature every 50 minutes. The reaction mixture was added with benzotrifluoride (internal standard, 24.6 μL, 0.2 mmol), stirred for additional 1 min at room temperature, and filtered through a filter membrane. The yield of **79** was determined by ^{19}F-NMR using benzotrifluoride as an internal standard.[27,28]

Kinetic profiles of different initial concentrations of **TBD** were collected (Fig. S12). The rate was plotted against the concentration of **TBD** (Fig. S13).

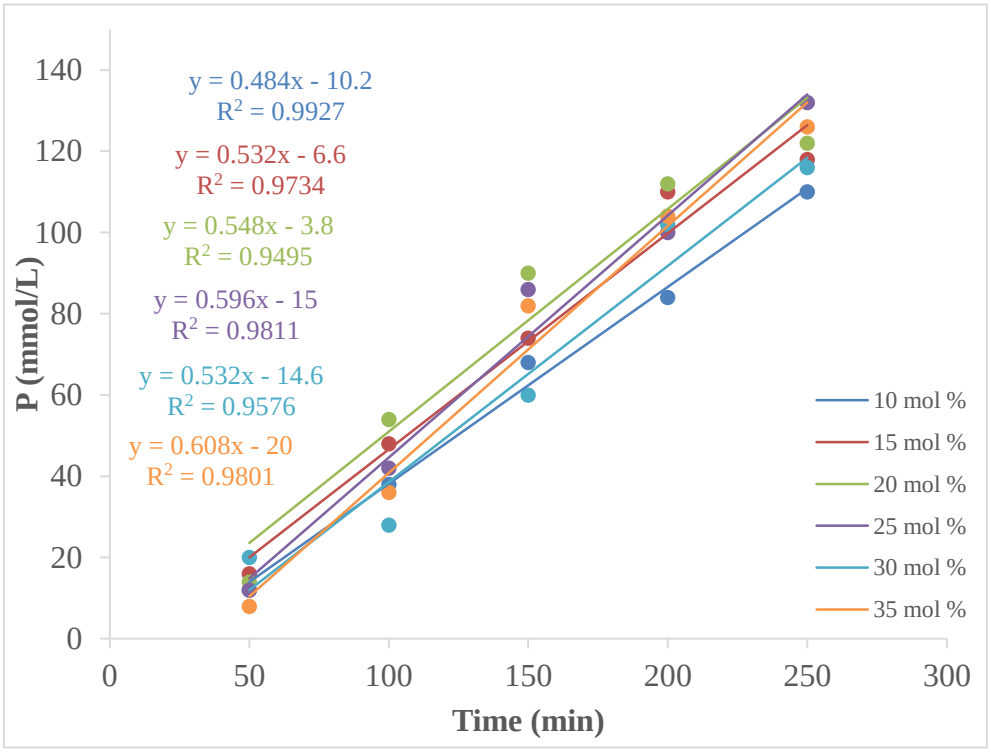


Fig. S12 Reaction profiles for **TBD**

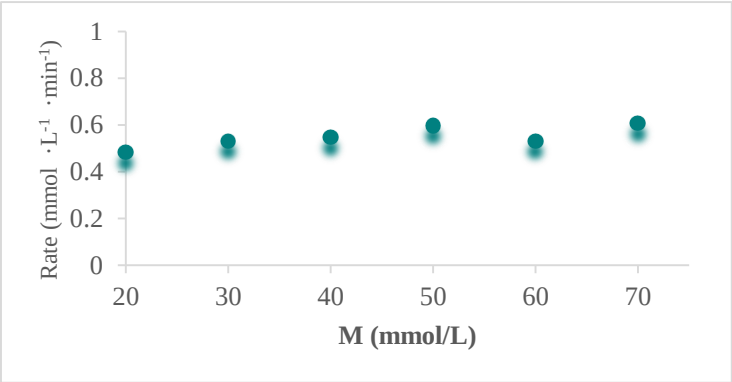


Fig. S13 Initial reaction rate dependence on concentration of **TBD**

9. Single crystal X-ray diffraction

9.1 Cultivation of single crystals

Compounds **6**, **79** and **81** were dissolved in a mixture of ethyl acetate and petroleum ether solution, respectively, then put it in the ambient temperature. Suitable crystals of compounds **6**, **79** and **81** were obtained by slowly evaporating a mixture of ethyl acetate and petroleum ether solution at ambient temperature.

9.2 Crystal measurement

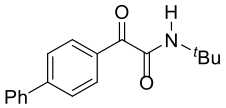
Compounds **6**, **79** and **81**, were collected at 100 K on a Rigaku Oxford Diffraction Supernova Dual Source, Cu at Zero equipped with an AtlasS2 CCD using Cu Kα radiation. The data were collected and processed using CrysAlisPro. The structures were solved by direct methods using Olex2 software, and the non-hydrogen atoms were located from the trial structure and then refined anisotropically with SHELXL-2018 using a full-matrix least squares procedure based on F^2. The weighted *R* factor, *wR* and goodness-of-fit S values were obtained based on F^2. The hydrogen atom positions were fixed geometrically at the calcd. distances and allowed to ride on their parent atoms.

CCDC-2338684 (**6**), CCDC-2338685 (**79**), CCDC-2338686 (**81**) contain the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

9.3 X-ray crystallographic data of **6**, **79** and **81**

The ellipsoids are shown at 30% probability levels.

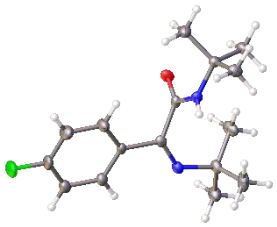
Table S8. X-ray crystallographic data of 6

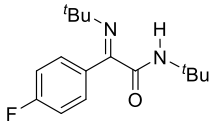


6 (CCDC:2338684)

Identification code	**6**
Empirical formula	$C_{18}H_{19}NO_2$
Formula weight	281.34
Temperature/K	170.00(10)
Crystal system	monoclinic
Space group	$P2_1/n$
a/Å	5.9331(9)
b/Å	26.240(3)
c/Å	9.8813(11)
α/°	90
β/°	104.418(13)
γ/°	90
Volume/Å^3	1489.9(3)
Z	4
ρ_{calc}g/cm^3	1.254
μ/mm^{-1}	0.081
F(000)	600.0
Crystal size/mm^3	0.15 × 0.13 × 0.12
Radiation	Mo Kα (λ = 0.71073)
2Θ range for data collection/°	4.53 to 49.996
Index ranges	-5 ≤ h ≤ 7, -29 ≤ k ≤ 31, -11 ≤ l ≤ 11
Reflections collected	6245
Independent reflections	2612 [R_{int} = 0.0318, R_{sigma} = 0.0455]
Data/restraints/parameters	2612/0/193
Goodness-of-fit on F^2	1.079
Final R indexes [I>=2σ (I)]	R_1 = 0.0473, wR_2 = 0.0996
Final R indexes [all data]	R_1 = 0.0631, wR_2 = 0.1089
Largest diff. peak/hole / e Å^{-3}	0.17/-0.20

Table S9. X-ray crystallographic data of 79

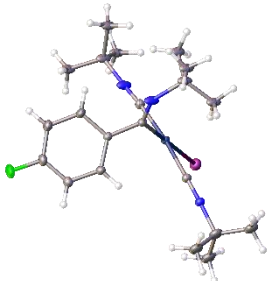


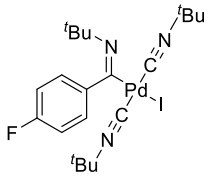


79 (CCDC:2338685)

Identification code	**79**
Empirical formula	$C_{16}H_{23}FN_2O$
Formula weight	278.36
Temperature/K	149.94(12)
Crystal system	triclinic
Space group	P-1
a/Å	9.3415(10)
b/Å	10.0623(13)
c/Å	19.6690(17)
α/°	81.197(9)
β/°	78.568(8)
γ/°	63.180(12)
Volume/Å^3	1612.9(3)
Z	4
ρ_{calc}g/cm^3	1.146
μ/mm^{-1}	0.080
F(000)	600.0
Crystal size/mm^3	0.15 × 0.12 × 0.1
Radiation	Mo Kα (λ = 0.71073)
2Θ range for data collection/°	4.236 to 49.998
Index ranges	-11 ≤ h ≤ 11, -11 ≤ k ≤ 11, -20 ≤ l ≤ 23
Reflections collected	10972
Independent reflections	5670 [R_{int} = 0.0384, R_{sigma} = 0.0617]
Data/restraints/parameters	5670/0/377
Goodness-of-fit on F^2	1.056
Final R indexes [I>=2σ (I)]	R_1 = 0.0871, wR_2 = 0.2139
Final R indexes [all data]	R_1 = 0.1141, wR_2 = 0.2326
Largest diff. peak/hole / e Å^{-3}	0.41/-0.34

Table S10. X-ray crystallographic data of 81

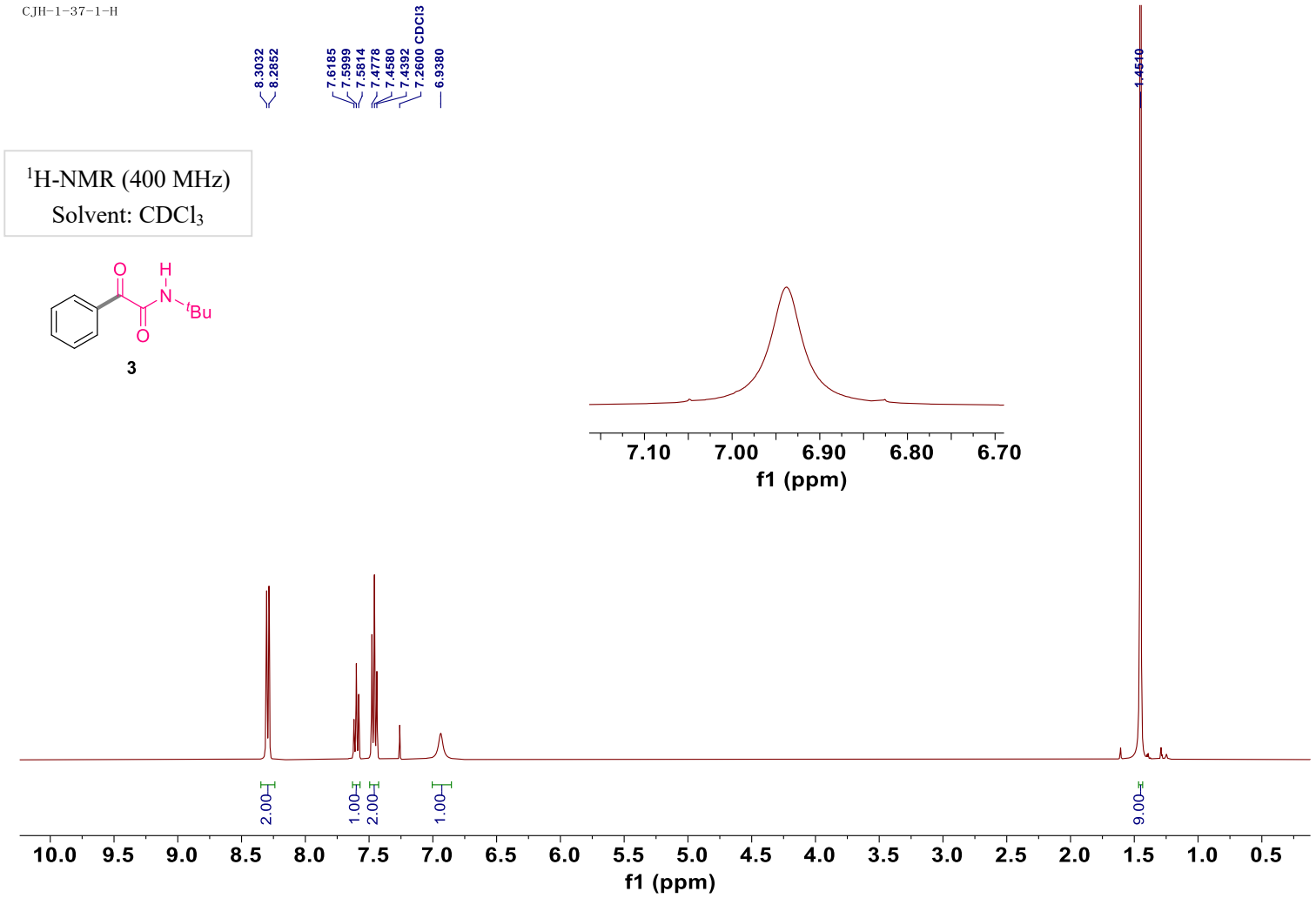


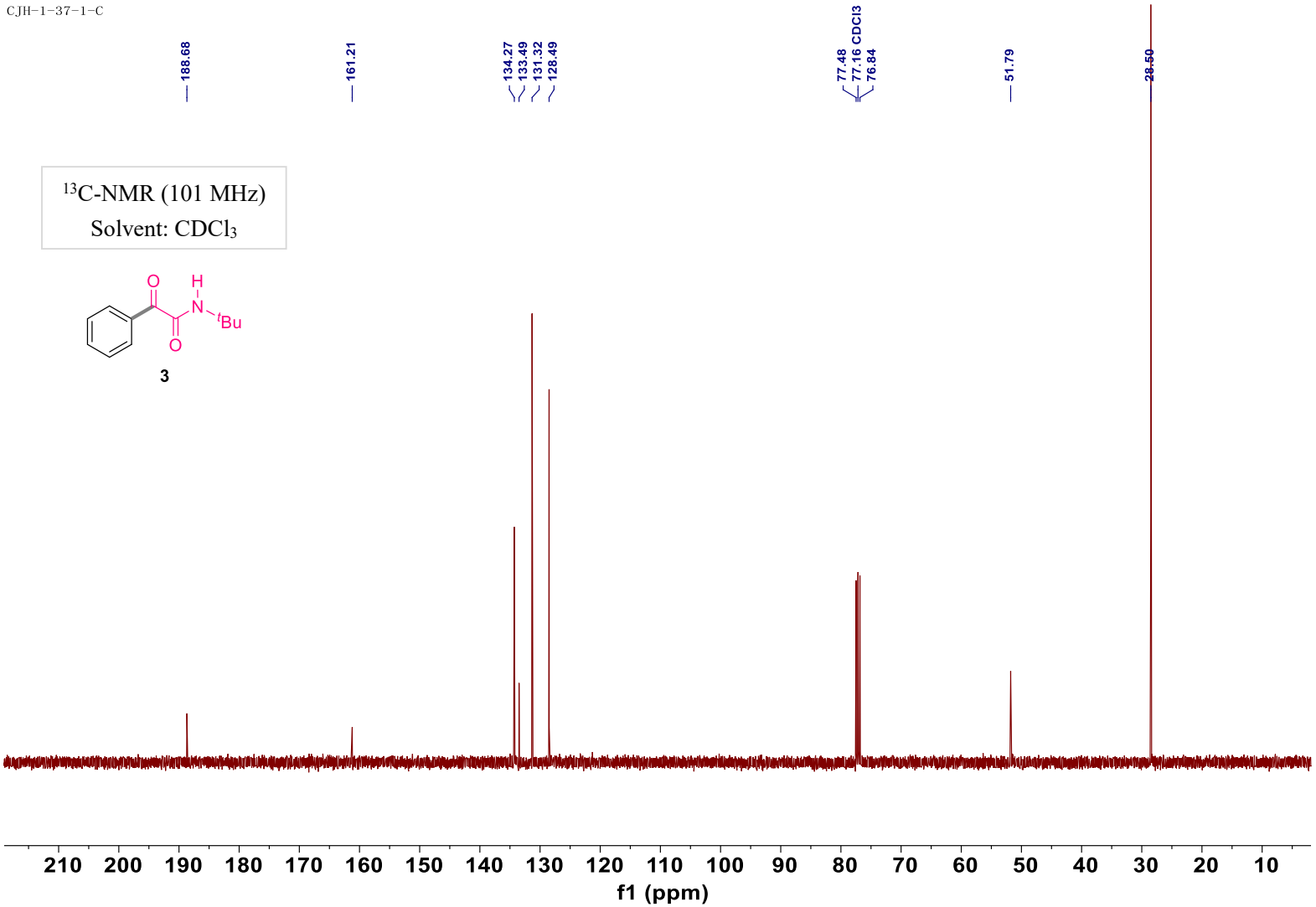


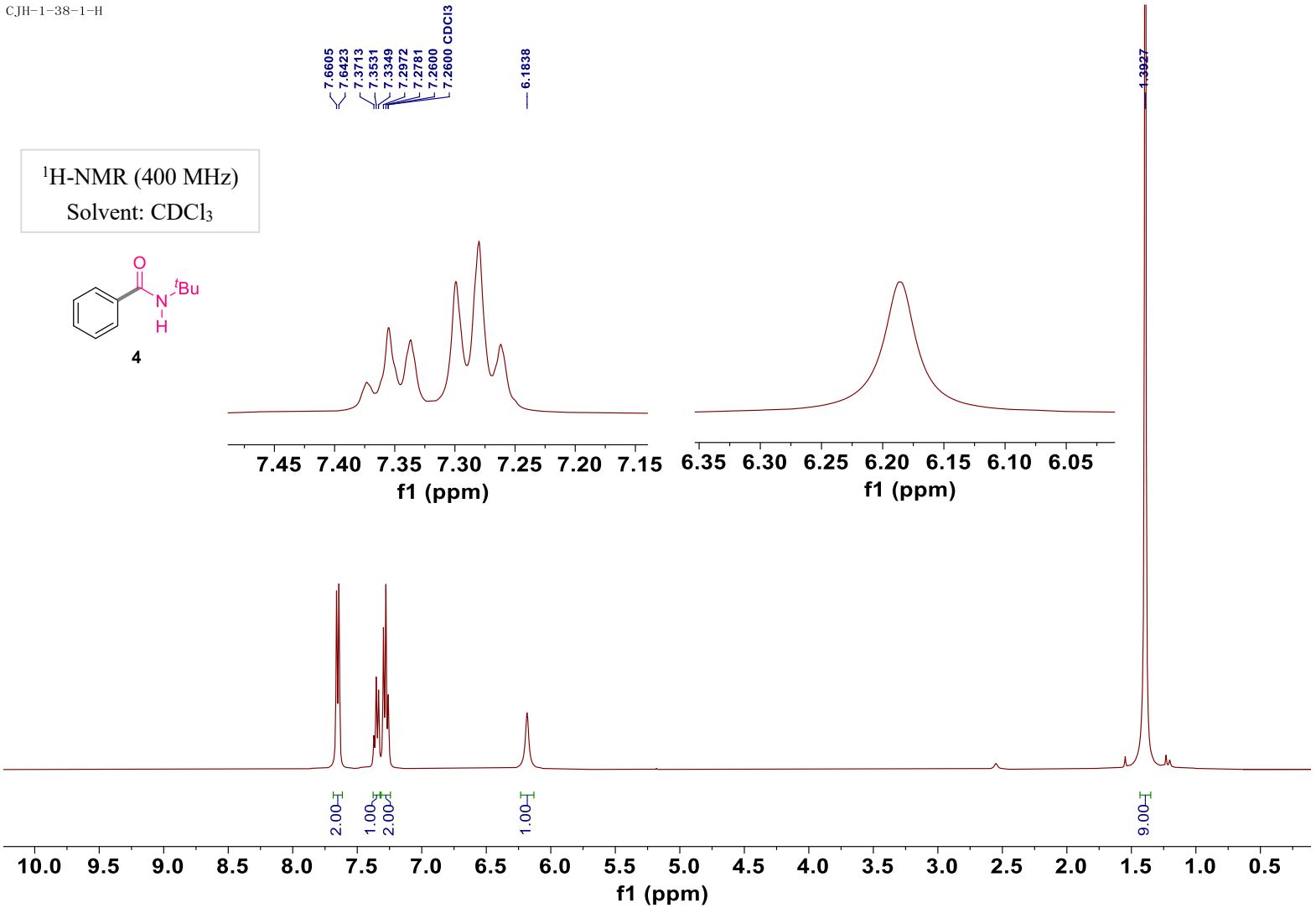
81 (CCDC:2338686)

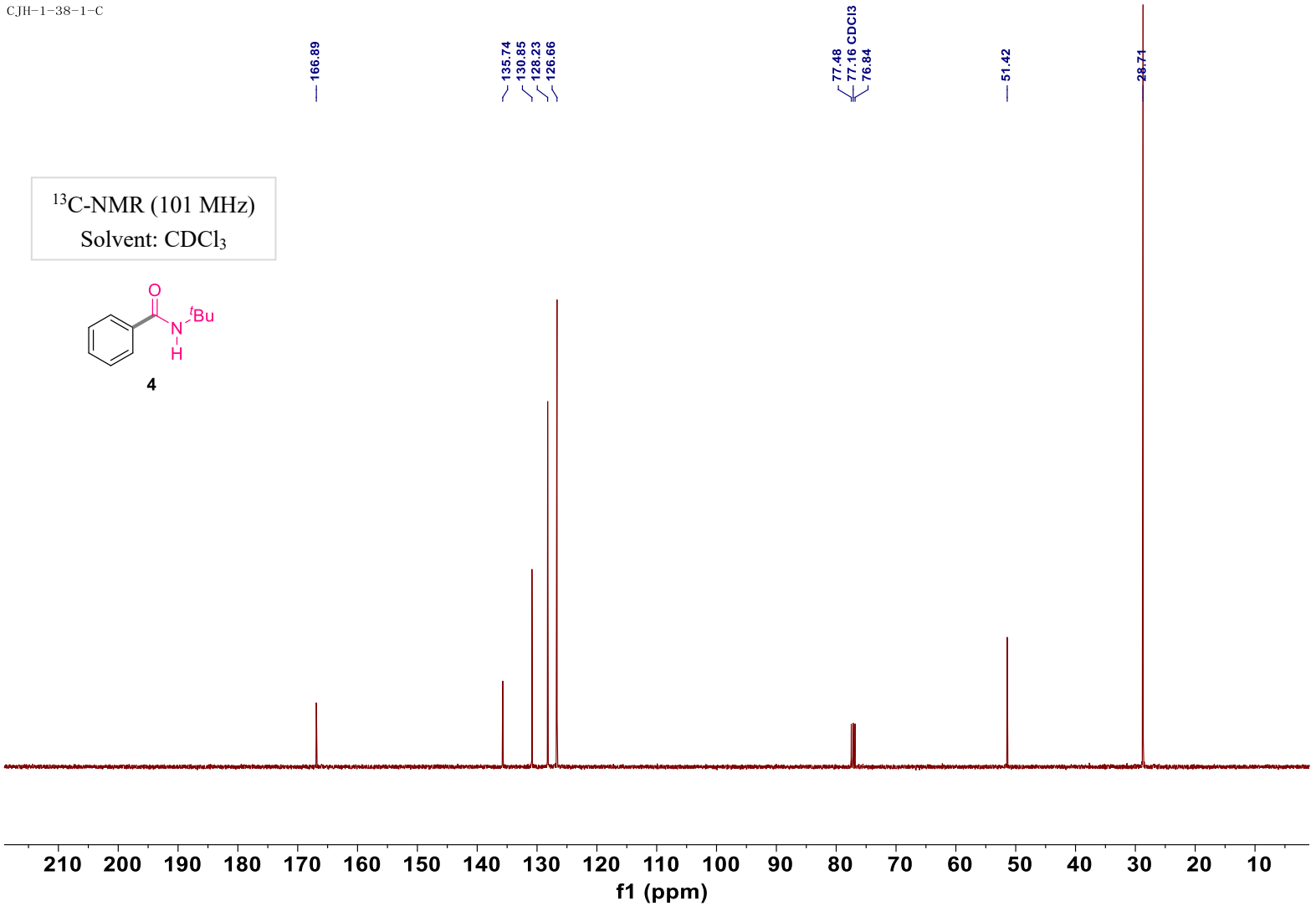
Identification code	**81**
Empirical formula	$C_{16}H_{23}FN_2O$
Formula weight	278.36
Temperature/K	149.94(12)
Crystal system	triclinic
Space group	P-1
a/Å	9.3415(10)
b/Å	10.0623(13)
c/Å	19.6690(17)
α/°	81.197(9)
β/°	78.568(8)
γ/°	63.180(12)
Volume/Å^3	1612.9(3)
Z	4
ρ_{calc}g/cm^3	1.146
μ/mm^{-1}	0.080
F(000)	600.0
Crystal size/mm^3	0.15 × 0.12 × 0.1
Radiation	Mo Kα (λ = 0.71073)
2Θ range for data collection/°	4.236 to 49.998
Index ranges	-11 ≤ h ≤ 11, -11 ≤ k ≤ 11, -20 ≤ l ≤ 23
Reflections collected	10972
Independent reflections	5670 [R_{int} = 0.0384, R_{sigma} = 0.0617]
Data/restraints/parameters	5670/0/377
Goodness-of-fit on F^2	1.056
Final R indexes [I>=2σ (I)]	R_1 = 0.0871, wR_2 = 0.2139
Final R indexes [all data]	R_1 = 0.1141, wR_2 = 0.2326
Largest diff. peak/hole / e Å^{-3}	0.41/-0.34

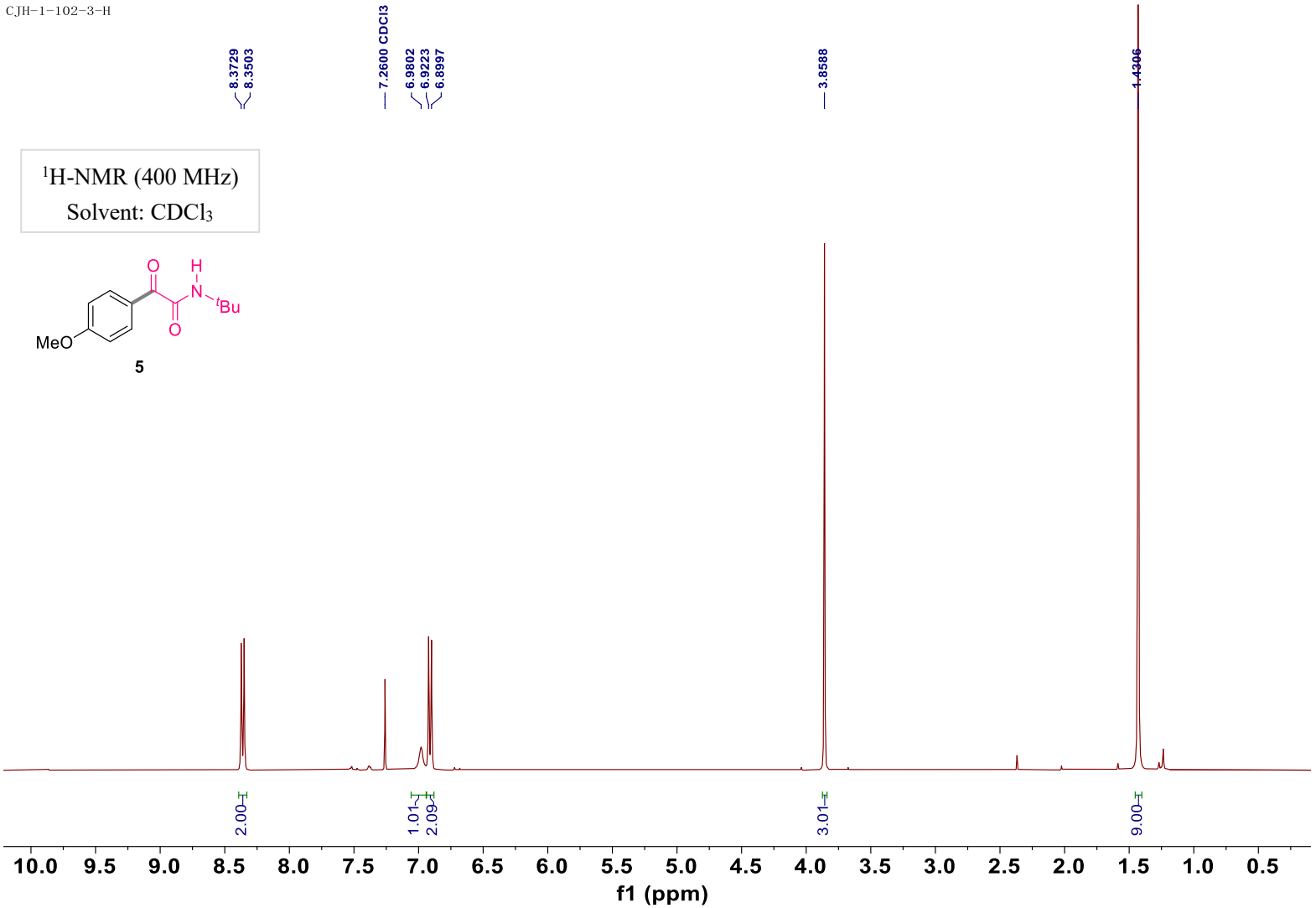
10. Copies of ^{1}H-NMR, ^{13}C-NMR and ^{19}F-NMR spectra

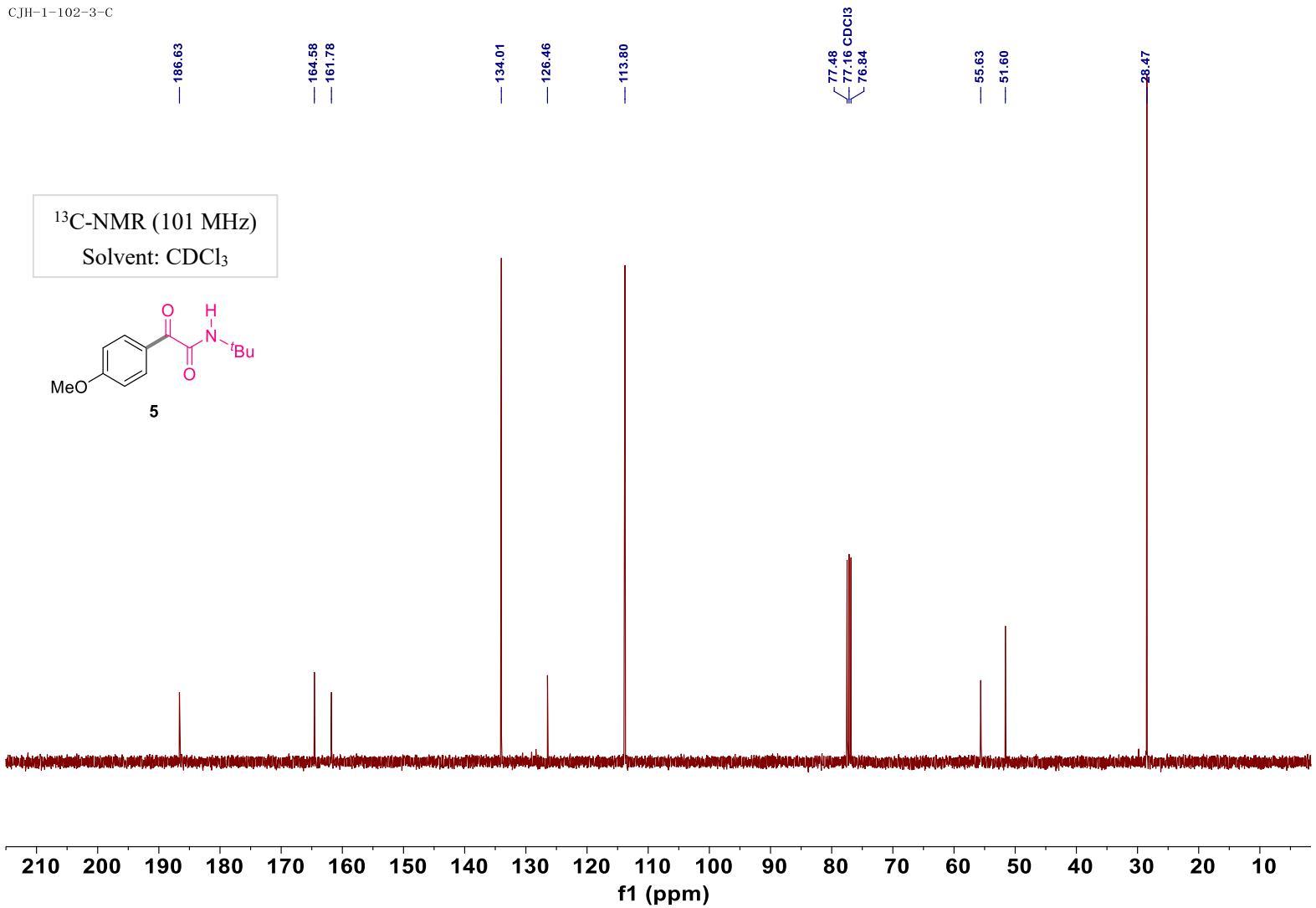


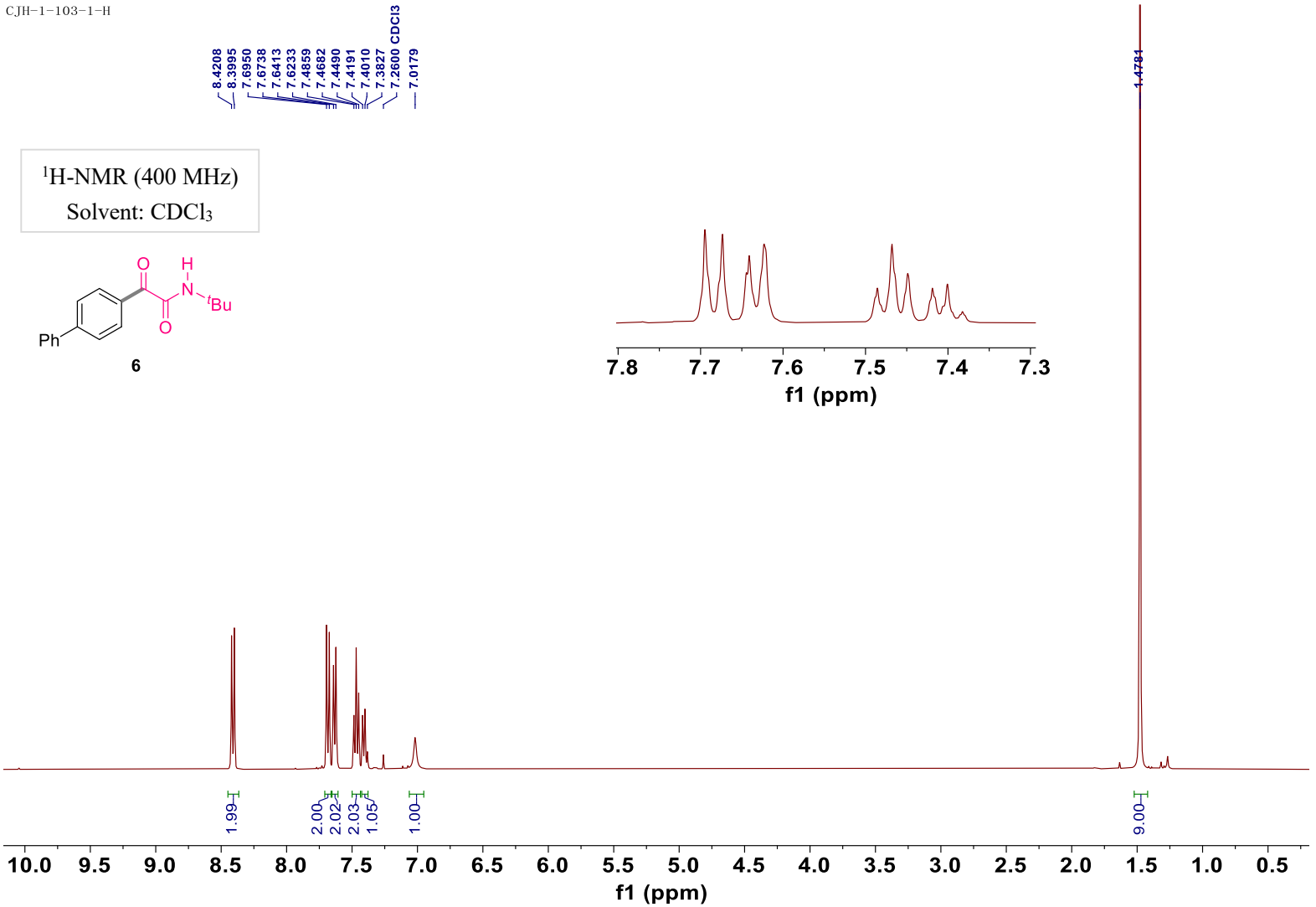

CJH-1-37-1-C
188.68
161.21
134.27
133.49
131.32
128.49
77.48
77.16 CDCl3
76.84
51.79
28.50
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

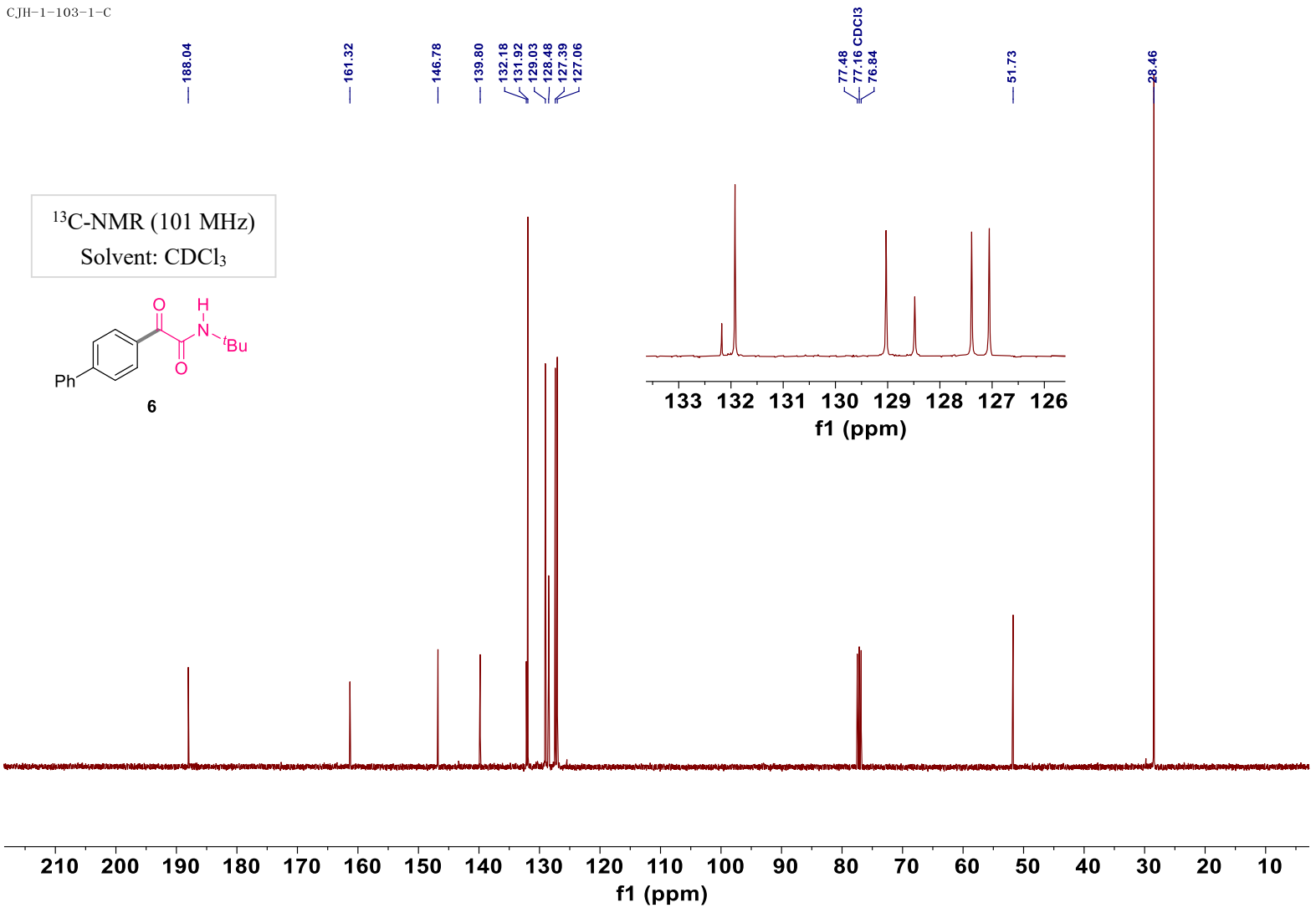

CJH-1-38-1-H
7.6605
7.6423
7.3713
7.3531
7.3349
7.2972
7.2781
7.2600
7.2600 CDCl3
6.1838
1.3927
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
O
N
H
^{t}Bu
4
7.45 7.40 7.35 7.30 7.25 7.20 7.15
f1 (ppm)
6.35 6.30 6.25 6.20 6.15 6.10 6.05
f1 (ppm)
2.00
1.00
2.00
1.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

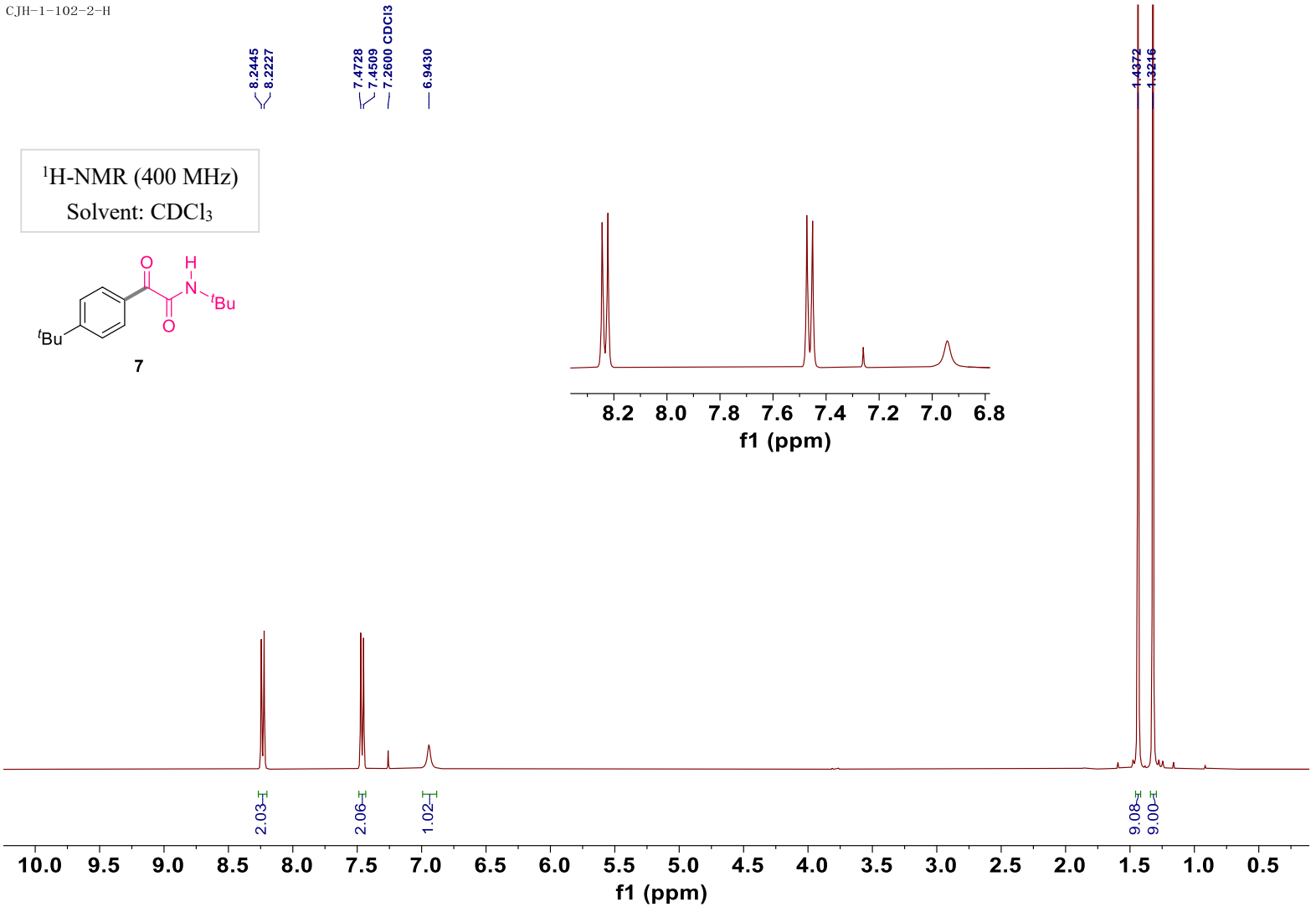

CJH-1-38-1-C
166.89
135.74
130.85
128.23
126.66
77.48
77.16 CDCl3
76.84
51.42
28.71
^{13}C-NMR (101 MHz)
Solvent: $CDCl_3$
O
N
H
^{t}Bu
4
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

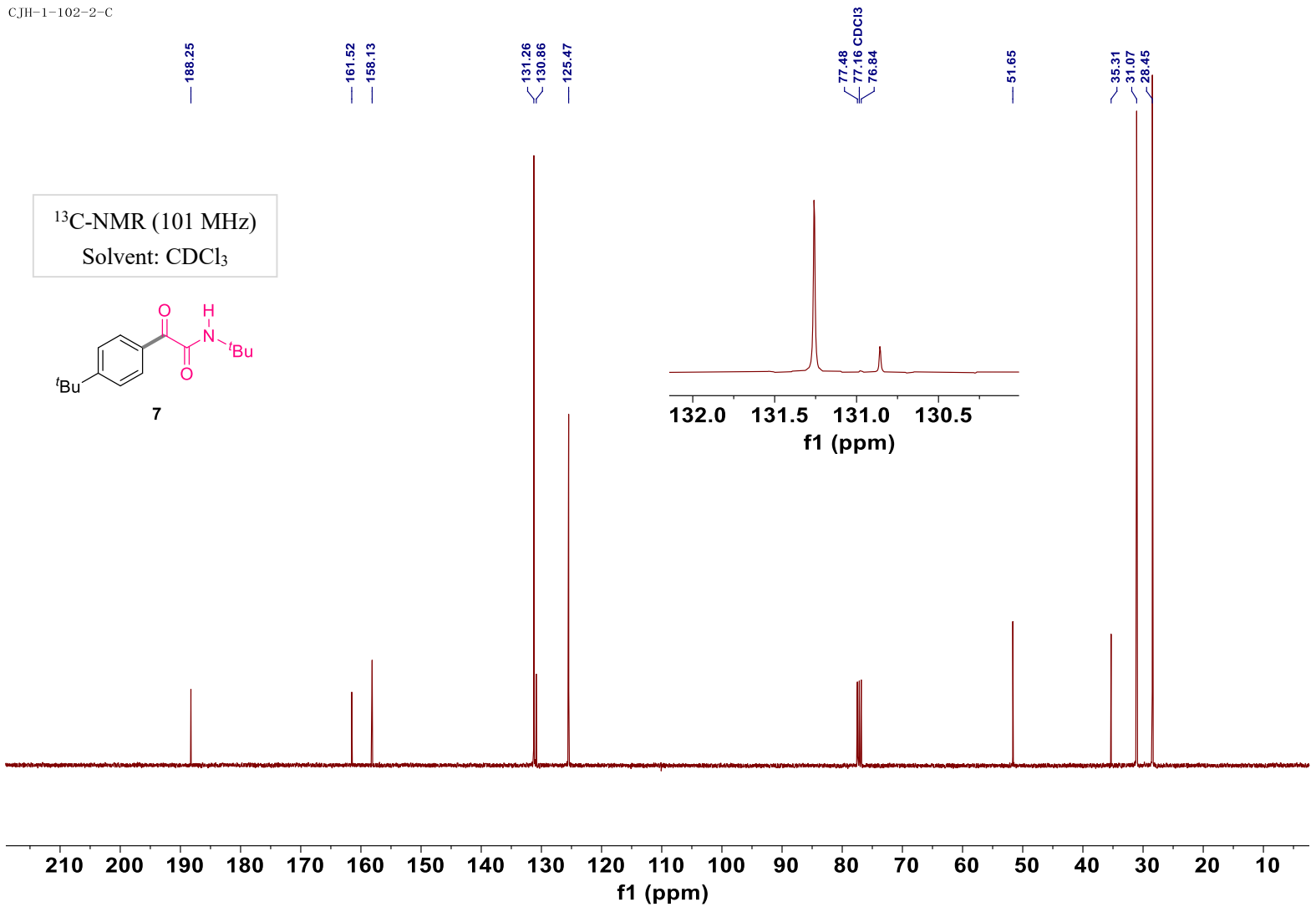

CJH-1-102-3-H
8.3729
8.3503
7.2600 CDCl3
6.9802
6.9223
6.8997
3.8588
1.4306
^{1}H-NMR (400 MHz)
Solvent: CDCl$_3$
O
H
N
tBu
O
MeO
5
2.00
1.01
2.09
3.01
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

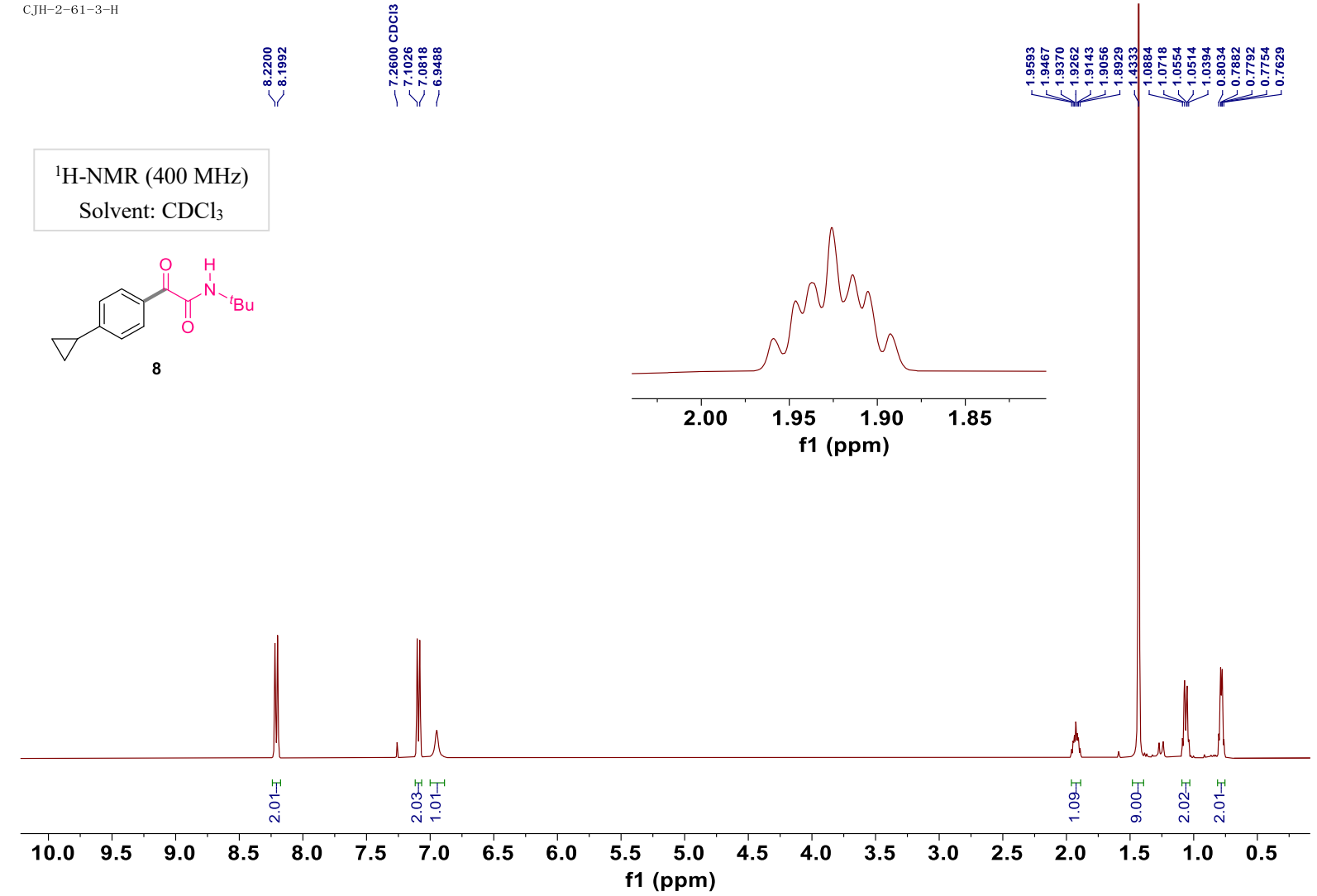

CJH-1-102-3-C
186.63
164.58
161.78
134.01
126.46
113.80
77.48
77.16 CDCl3
76.84
55.63
51.60
28.47
13C-NMR (101 MHz)
Solvent: CDCl3
MeO
O
H
N
tBu
O
5
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

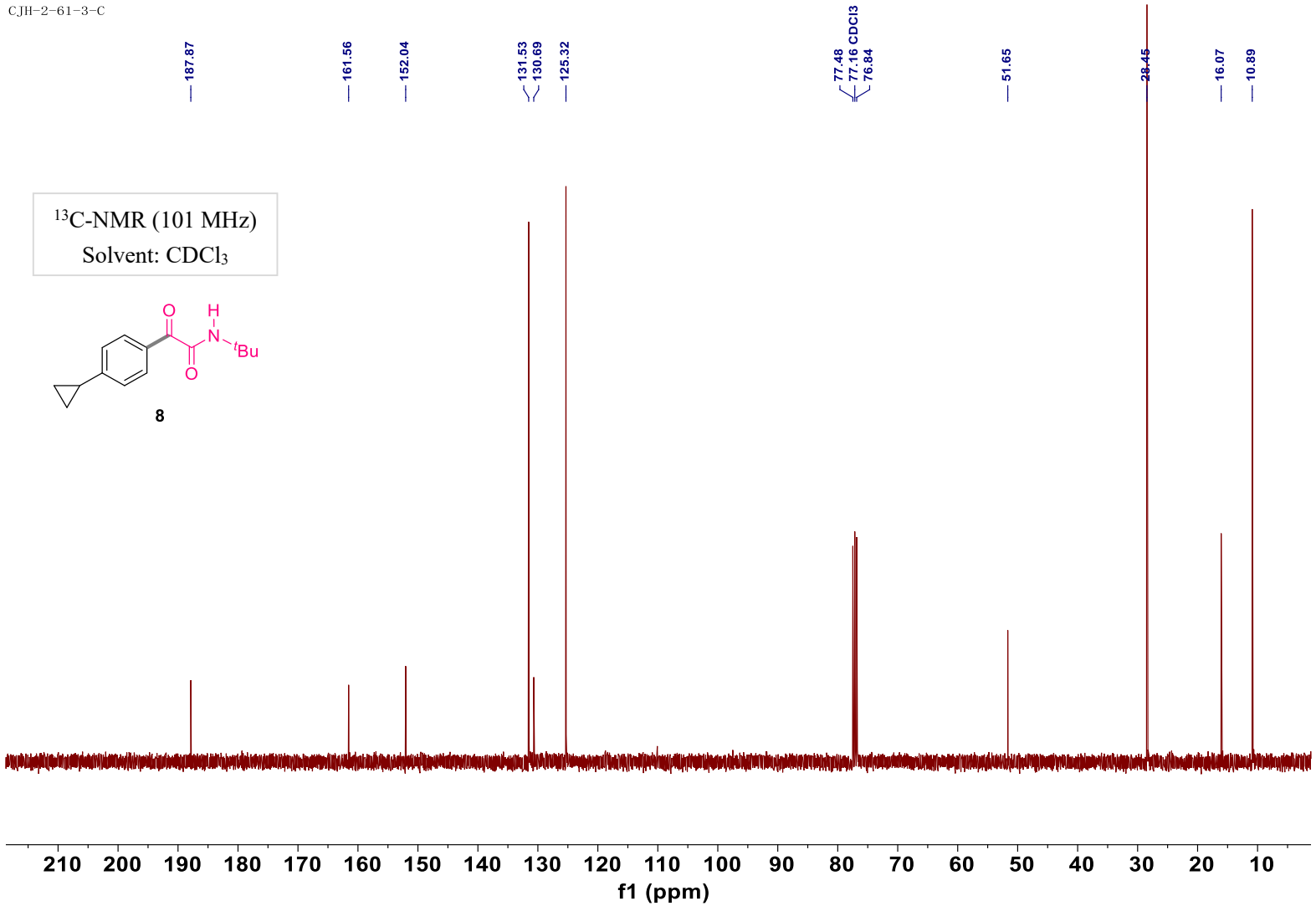

CJH-1-103-1-H
8.4208
8.3995
7.6950
7.6738
7.6413
7.6233
7.4859
7.4682
7.4490
7.4191
7.4010
7.3827
7.2600 CDCl3
7.0179
1.4781
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Ph
6
7.8
7.7
7.6
7.5
7.4
7.3
f1 (ppm)
1.99
2.00
2.02
2.03
1.05
1.00
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

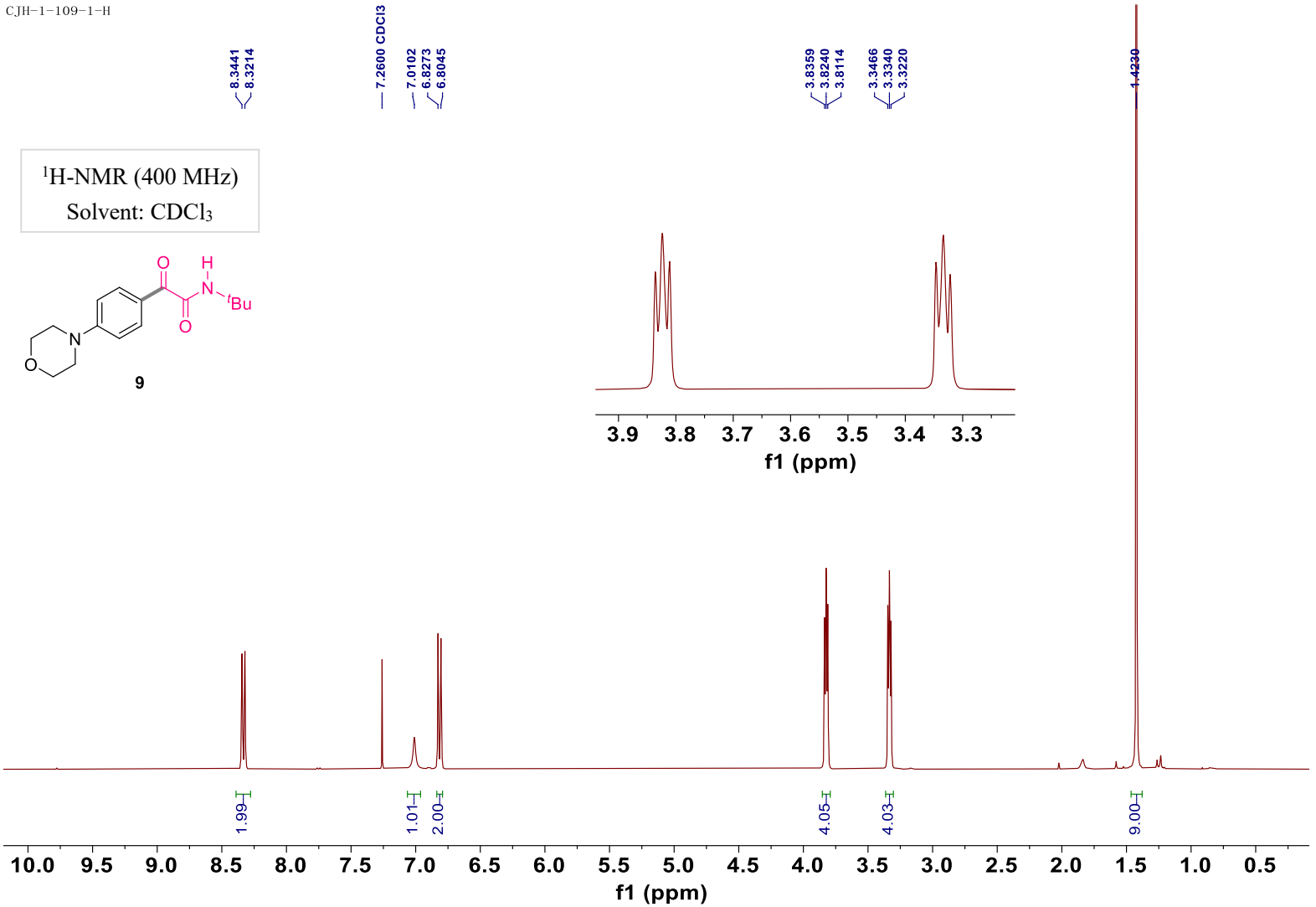

CJH-1-103-1-C
188.04
161.32
146.78
139.80
132.18
131.92
129.03
128.48
127.39
127.06
77.48
77.16 CDCl3
76.84
51.73
28.46
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Ph
6
133 132 131 130 129 128 127 126
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

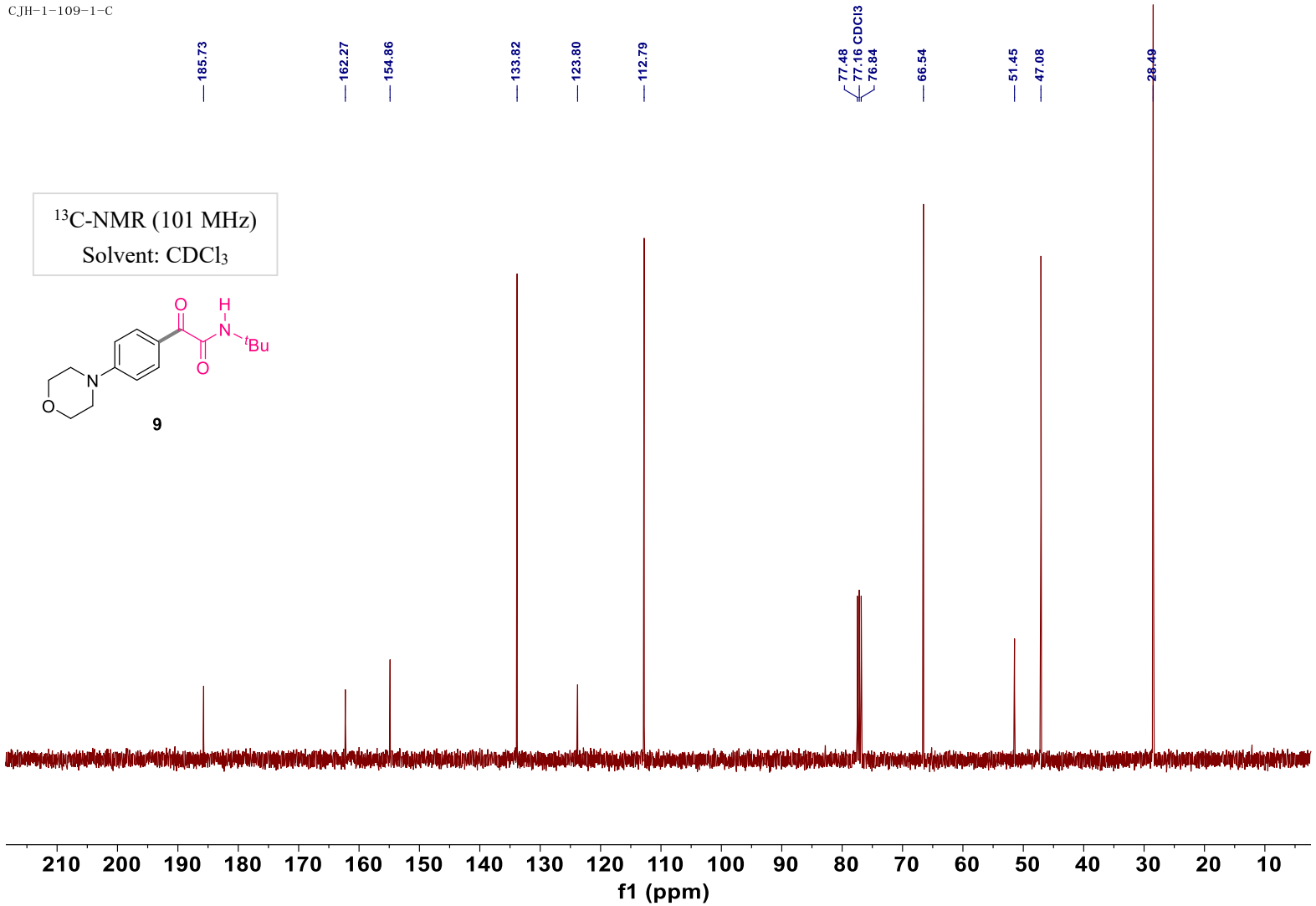

CJH-1-102-2-H
8.2445
8.2227
7.4728
7.4509
7.2600 CDCl3
6.9430
1.4372
1.3216
^{1}H-NMR (400 MHz)
Solvent: CDCl$_3$
O
H
N
^{t}Bu
O
^{t}Bu
7
8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8
f1 (ppm)
2.03
2.06
1.02
9.08
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

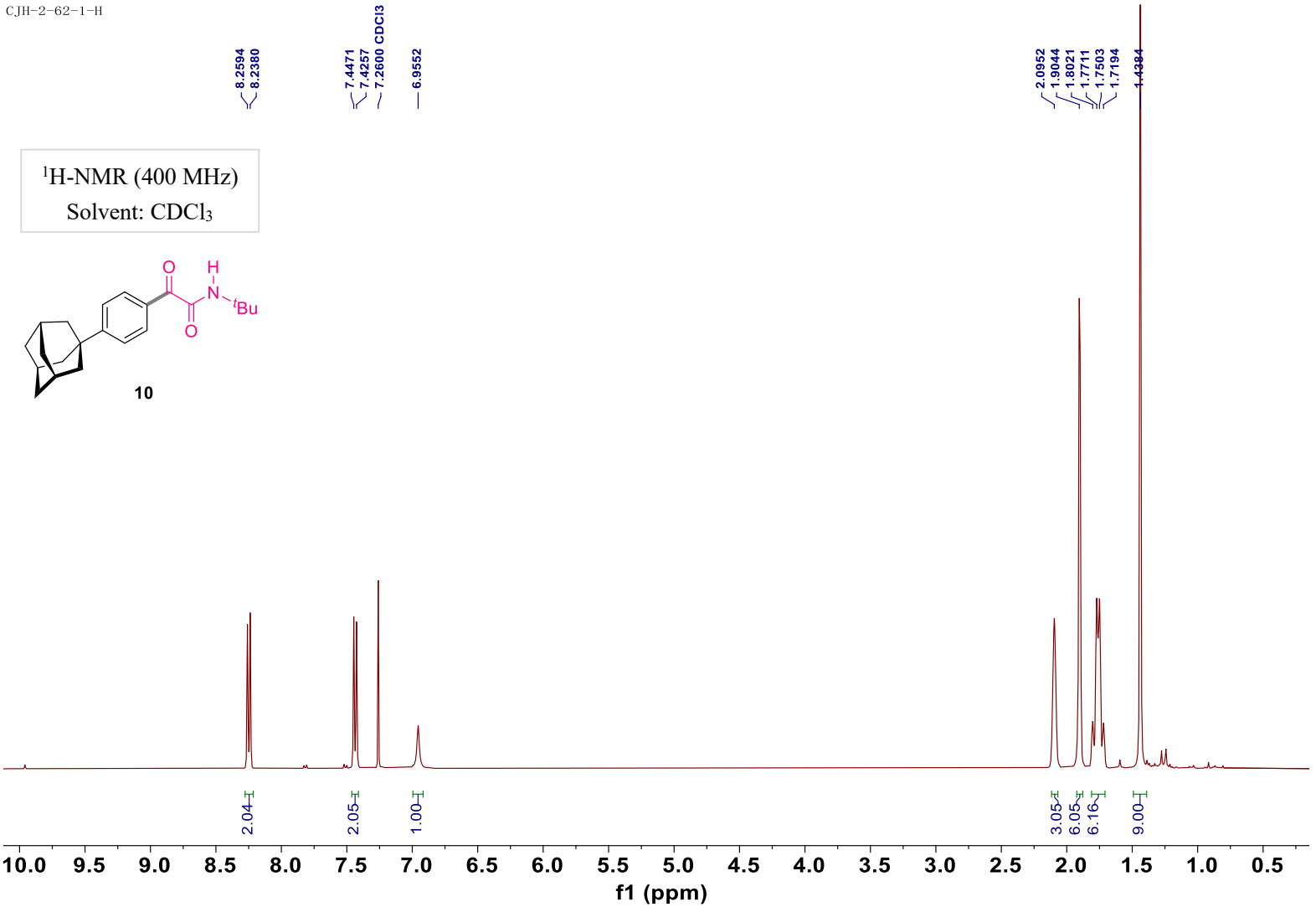

CJH-1-102-2-C
188.25
161.52
158.13
131.26
130.86
125.47
77.48
77.16 CDCl3
76.84
51.65
35.31
31.07
28.45
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
tBu
7
132.0
131.5
131.0
130.5
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

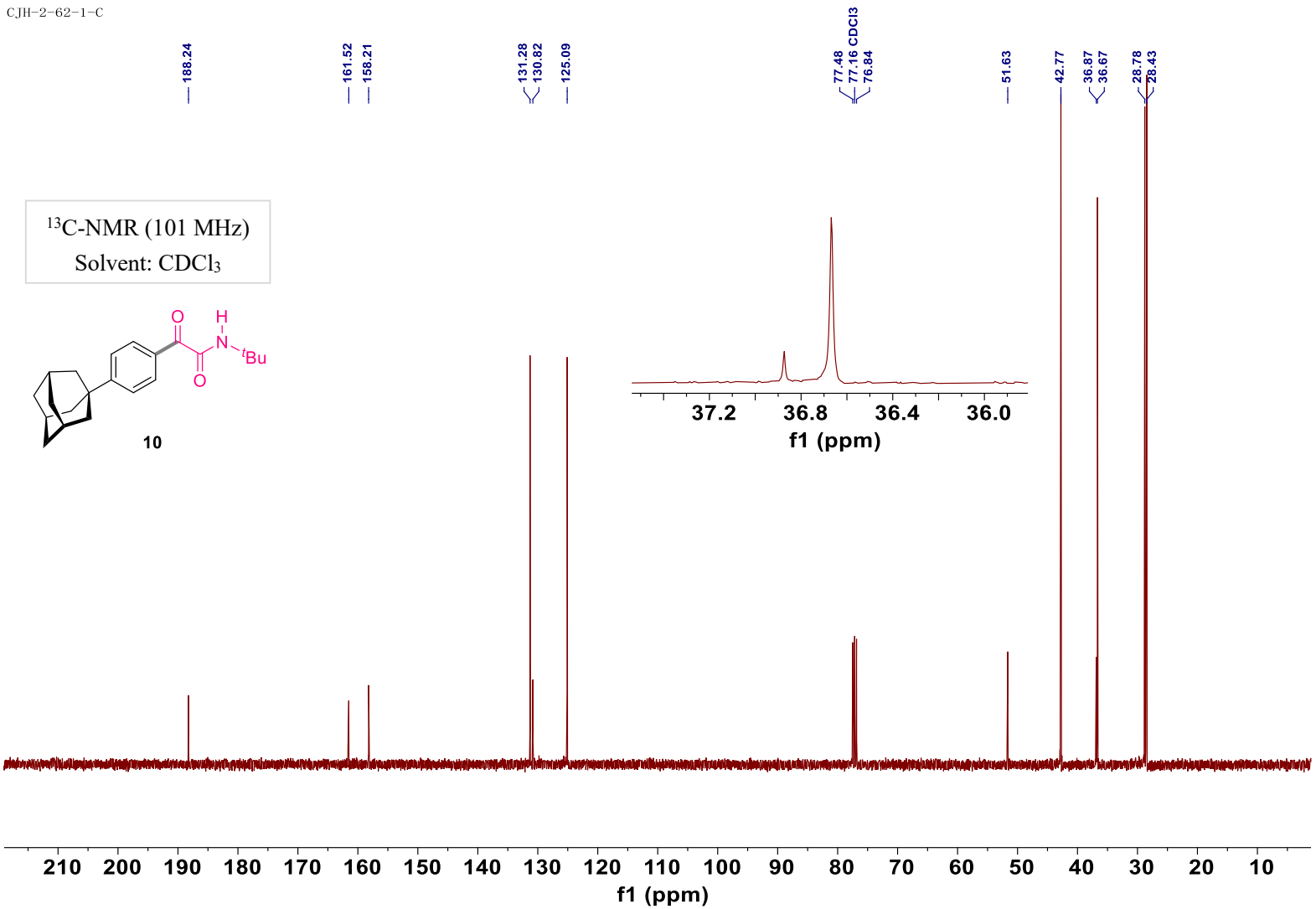

CJH-2-61-3-H
8.2200
8.1992
7.2600 CDCl3
7.1026
7.0818
6.9488
1.9593
1.9467
1.9370
1.9262
1.9143
1.9056
1.8929
1.4333
1.0884
1.0718
1.0554
1.0514
1.0394
0.8034
0.7882
0.7792
0.7754
0.7629
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
8
2.00
1.95
1.90
1.85
f1 (ppm)
2.01
2.03
1.01
1.09
9.00
2.02
2.01
10.0
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
f1 (ppm)

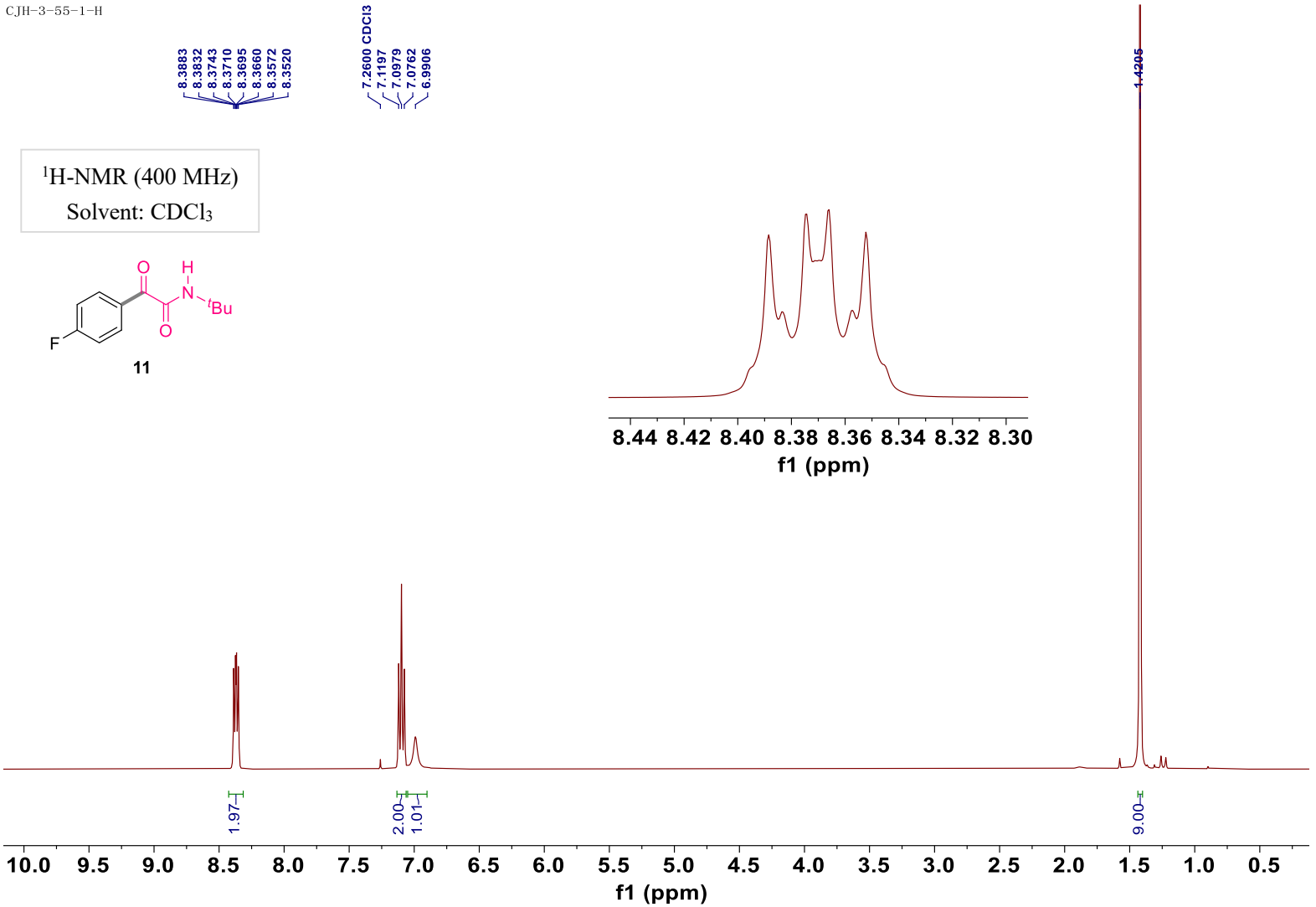

CJH-2-61-3-C
187.87
161.56
152.04
131.53
130.69
125.32
77.48
77.16 CDCl3
76.84
51.65
28.45
16.07
10.89
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
8
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

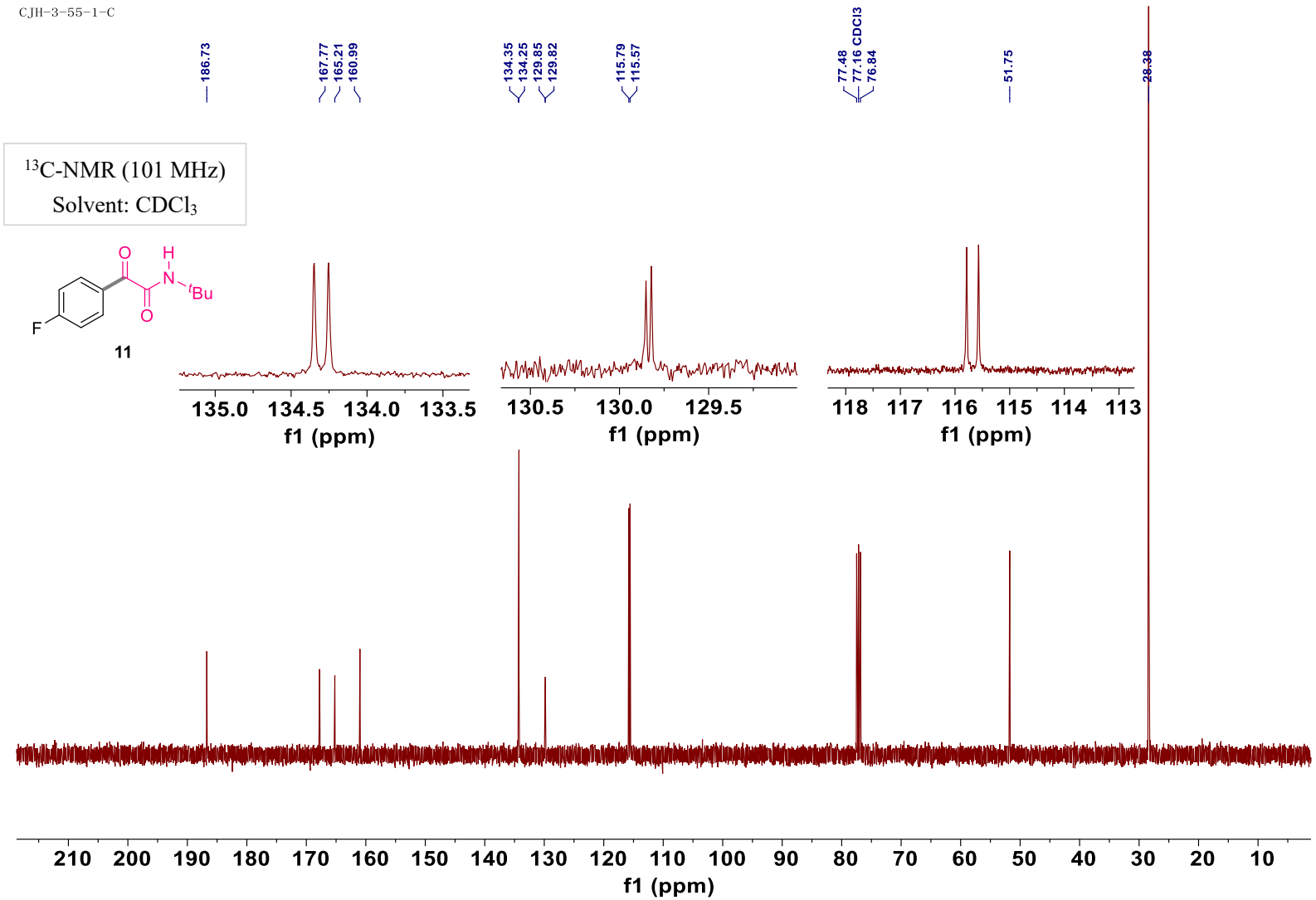

CJH-1-109-1-H
8.3441
8.3214
7.2600 CDCl3
7.0102
6.8273
6.8045
3.8359
3.8240
3.8114
3.3466
3.3340
3.3220
1.4230
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
O
9
3.9 3.8 3.7 3.6 3.5 3.4 3.3
f1 (ppm)
1.99
1.01
2.00
4.05
4.03
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


CJH-1-109-1-C
185.73
162.27
154.86
133.82
123.80
112.79
77.48
77.16 CDCl3
76.84
66.54
51.45
47.08
28.49
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
O
9
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-2-62-1-H
8.2594
8.2380
7.4471
7.4257
7.2600 CDCl3
6.9552
2.0952
1.9044
1.8021
1.7711
1.7503
1.7194
1.4384
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
O
H
N
^{t}Bu
O
10
2.04
2.05
1.00
3.05
6.05
6.16
9.00
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
f1 (ppm)


CJH-2-62-1-C
188.24
161.52
158.21
131.28
130.82
125.09
77.48
77.16 CDCl3
76.84
51.63
42.77
36.87
36.67
28.78
28.43
13C-NMR (101 MHz)
Solvent: CDCl3
10
37.2
36.8
36.4
36.0
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

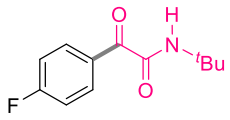

CJH-3-55-1-H
8.3883
8.3832
8.3743
8.3710
8.3695
8.3660
8.3572
8.3520
7.2600 CDCl3
7.1197
7.0979
7.0762
6.9906
1.4205
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
F
11
8.44 8.42 8.40 8.38 8.36 8.34 8.32 8.30
f1 (ppm)
1.97
2.00
1.01
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


CJH-3-55-1-C
186.73
167.77
165.21
160.99
134.35
134.25
129.85
129.82
115.79
115.57
77.48
77.16 CDCl3
76.84
51.75
28.38
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
F
11
135.0 134.5 134.0 133.5
f1 (ppm)
130.5 130.0 129.5
f1 (ppm)
118 117 116 115 114 113
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

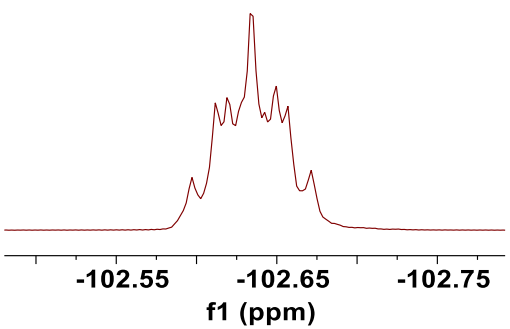
CJH-3-55-1-F

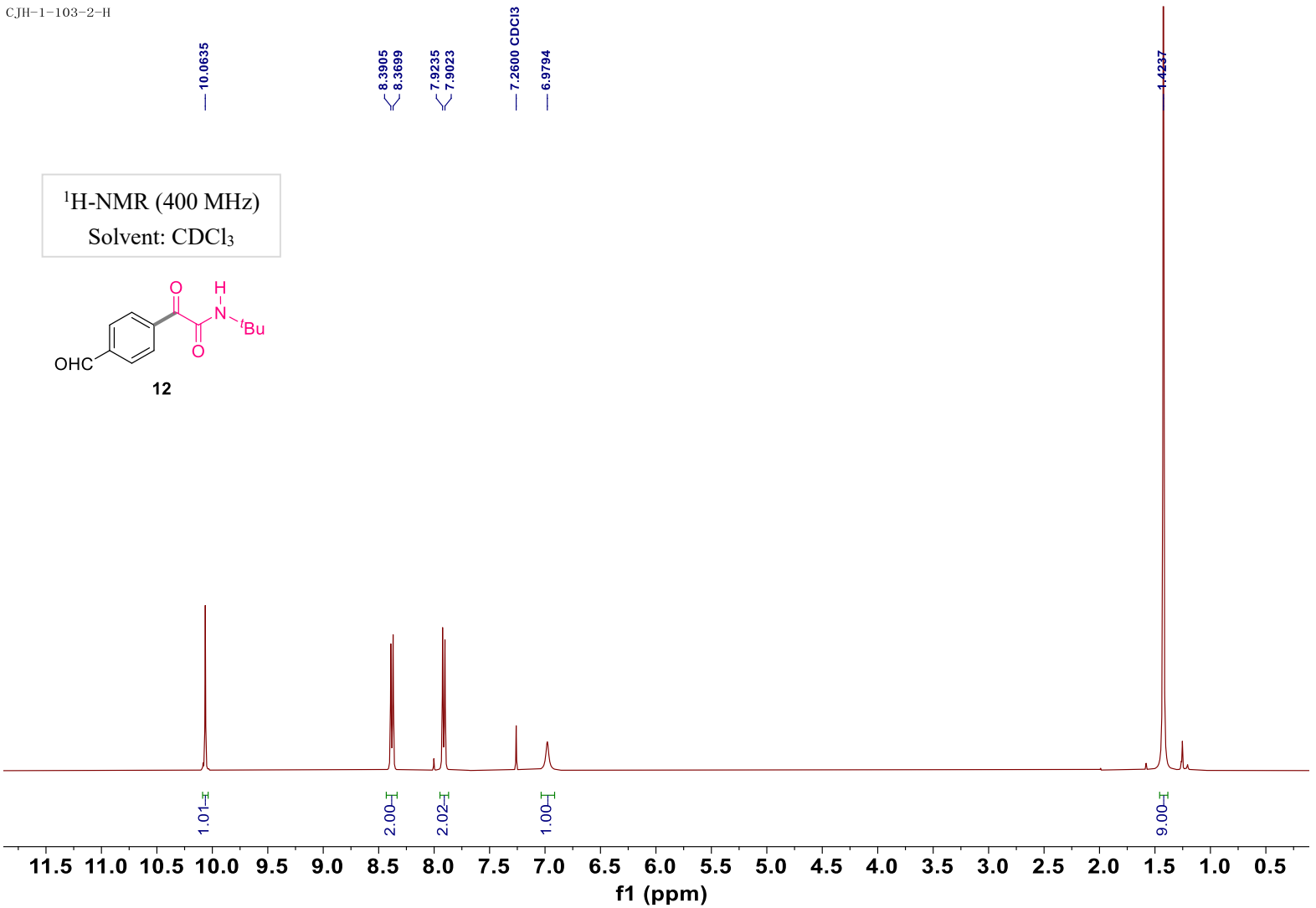
-102.5972
-102.6122
-102.6194
-102.6342
-102.6422
-102.6493
-102.6565
-102.6713

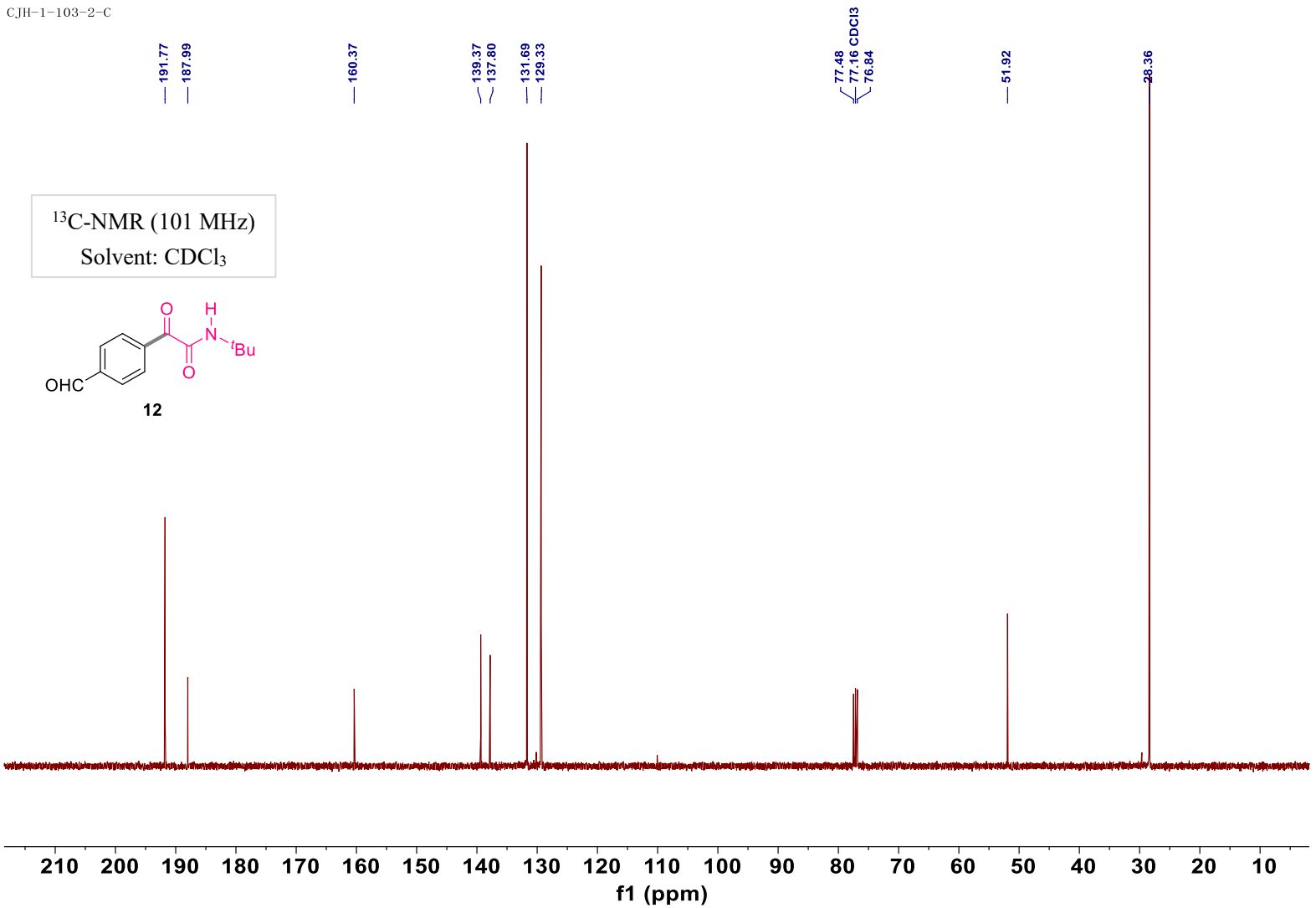
^{19}F-NMR (376 MHz)
Solvent: $CDCl_3$

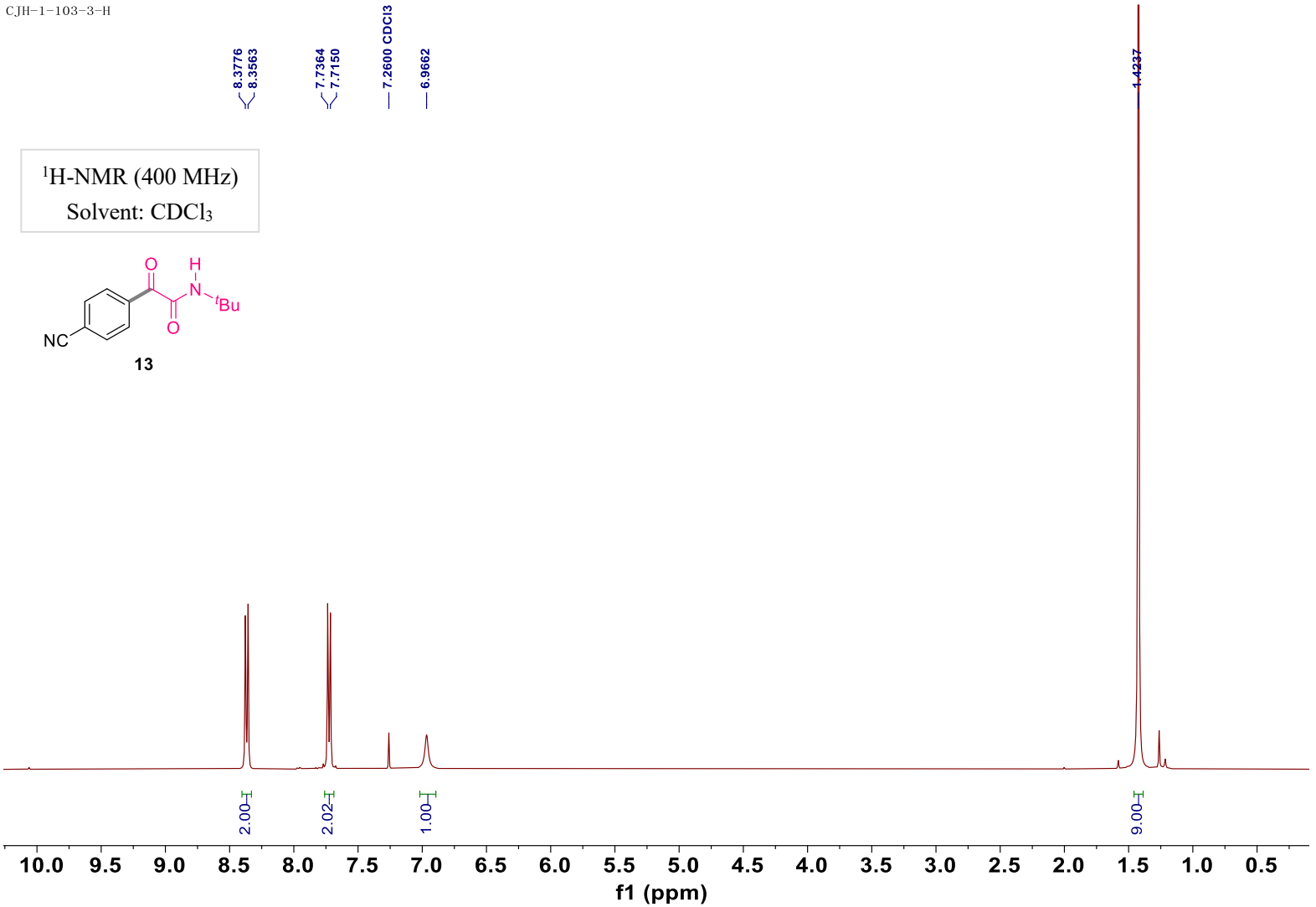


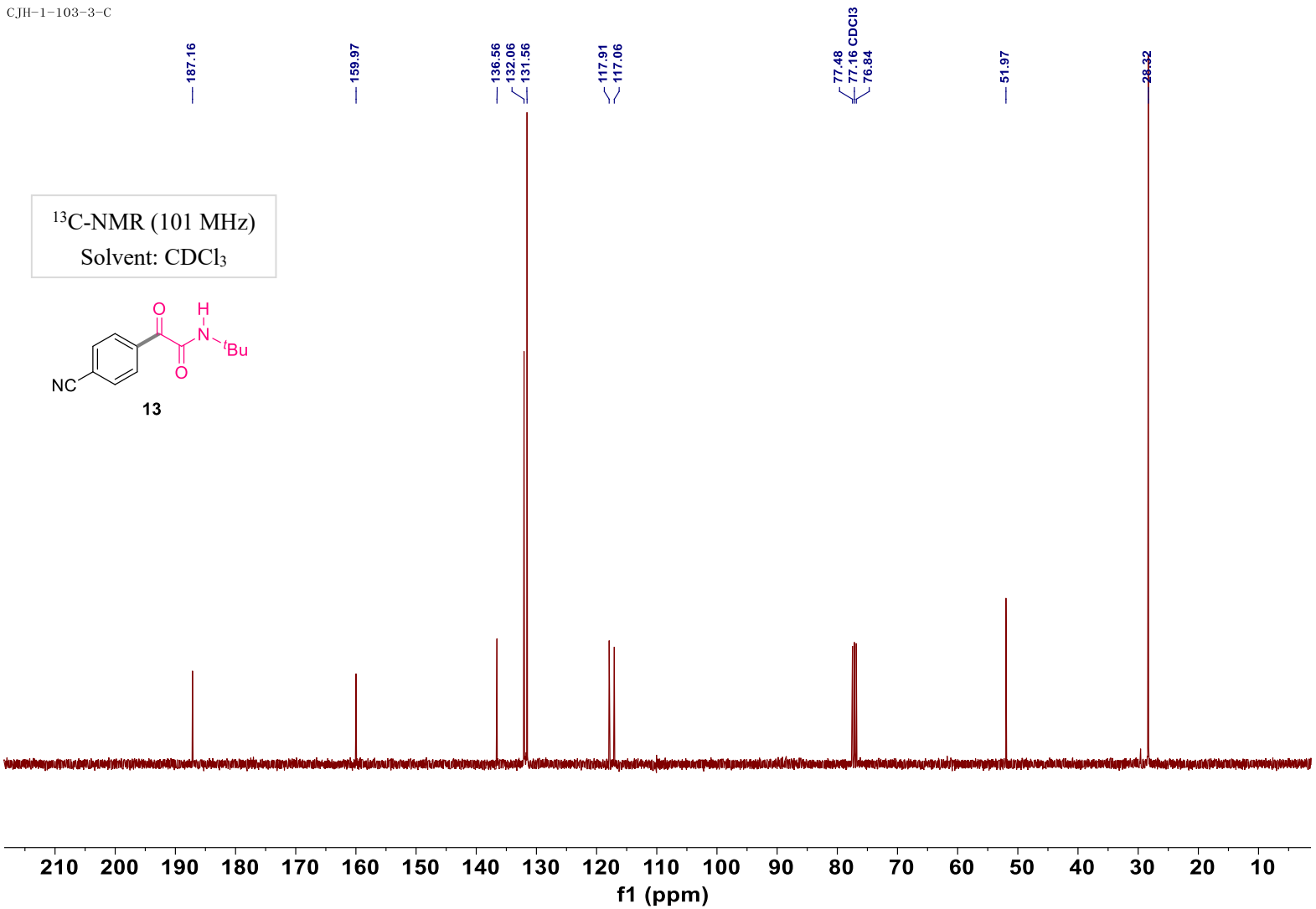
11

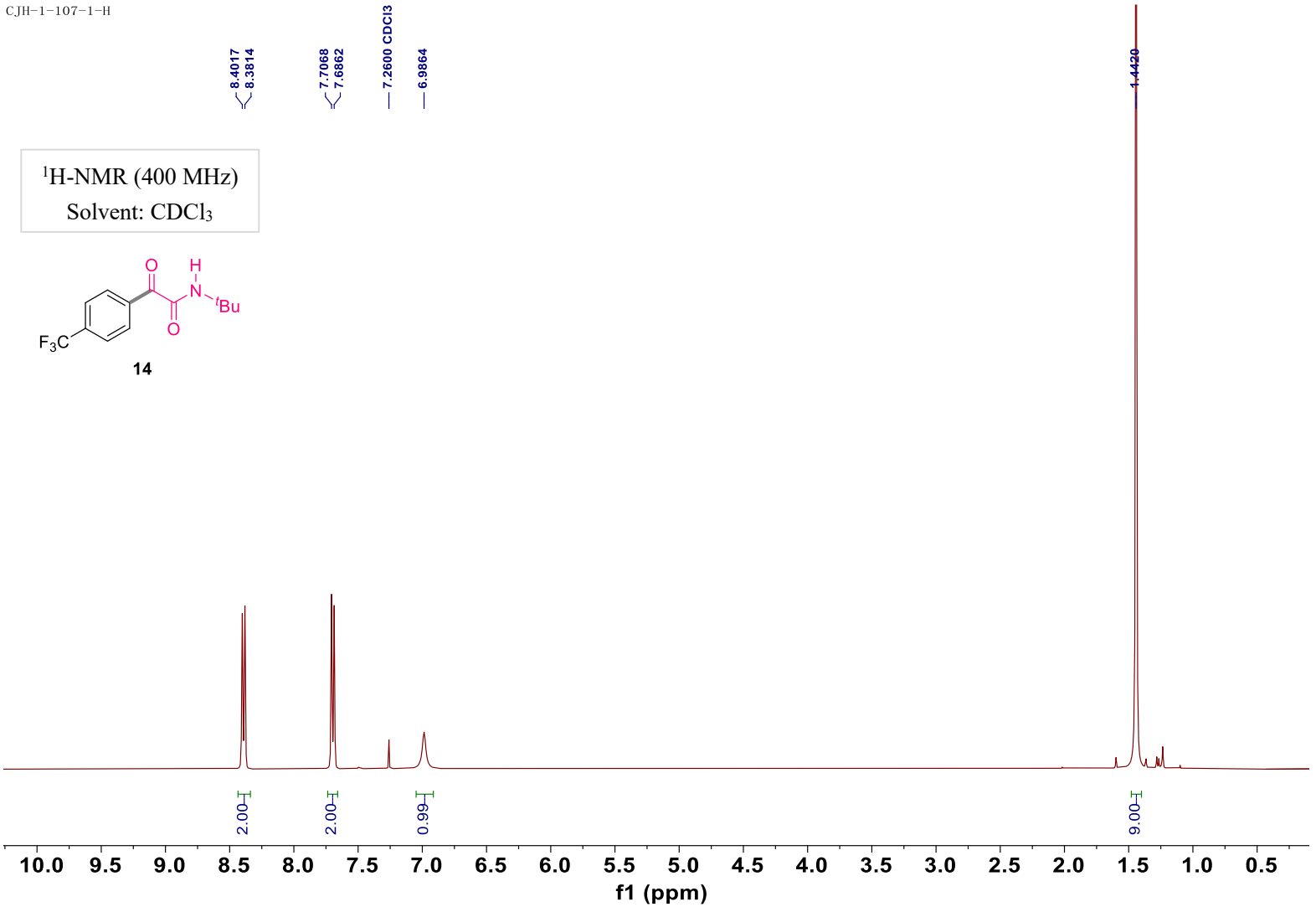


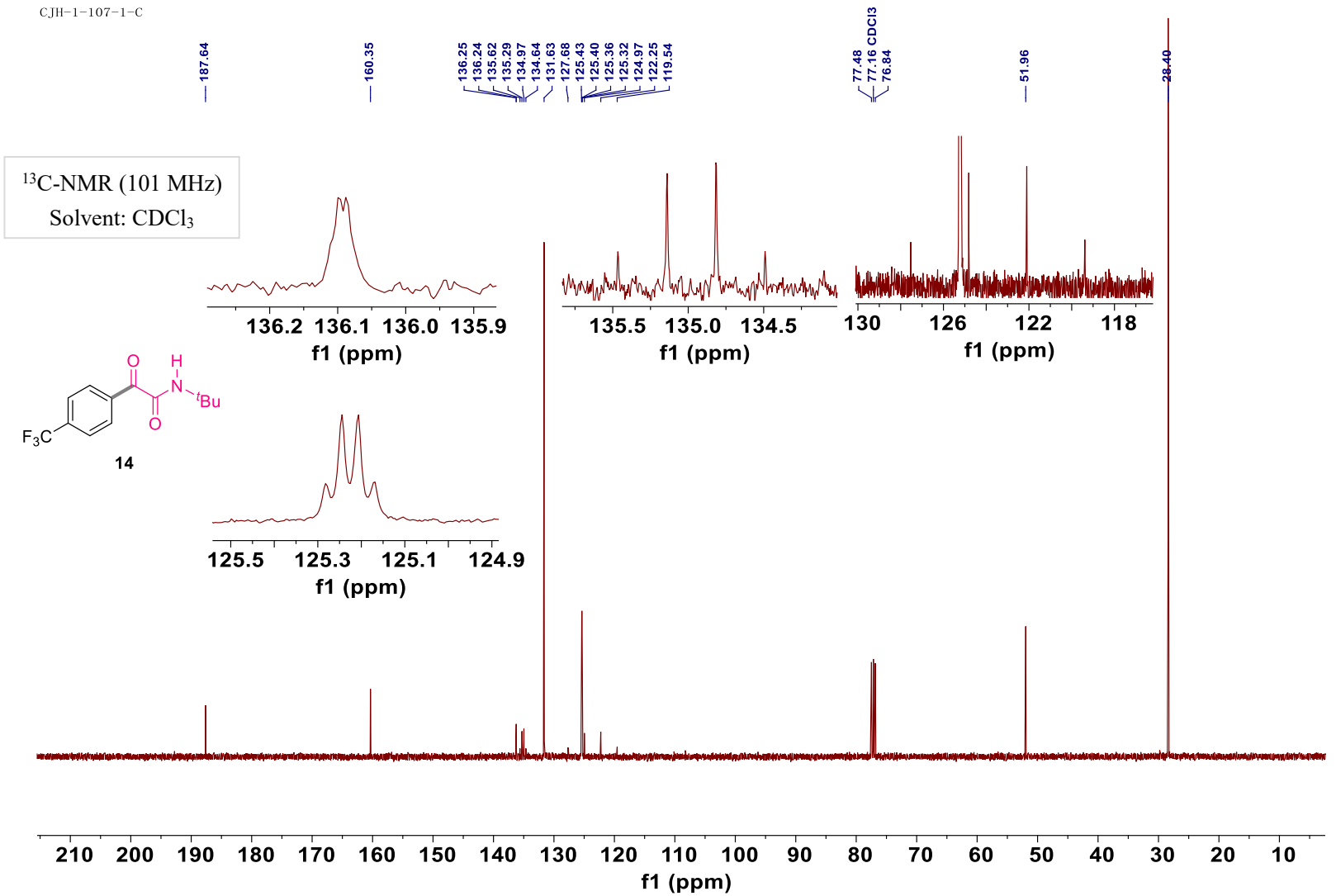

CJH-1-103-2-H
10.0635
8.3905
8.3699
7.9235
7.9023
7.2600 CDCl3
6.9794
1.4237
^{1}H-NMR (400 MHz)
Solvent: CDCl$_3$
O
H
N
^{t}Bu
O
OHC
12
1.01
2.00
2.02
1.00
9.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

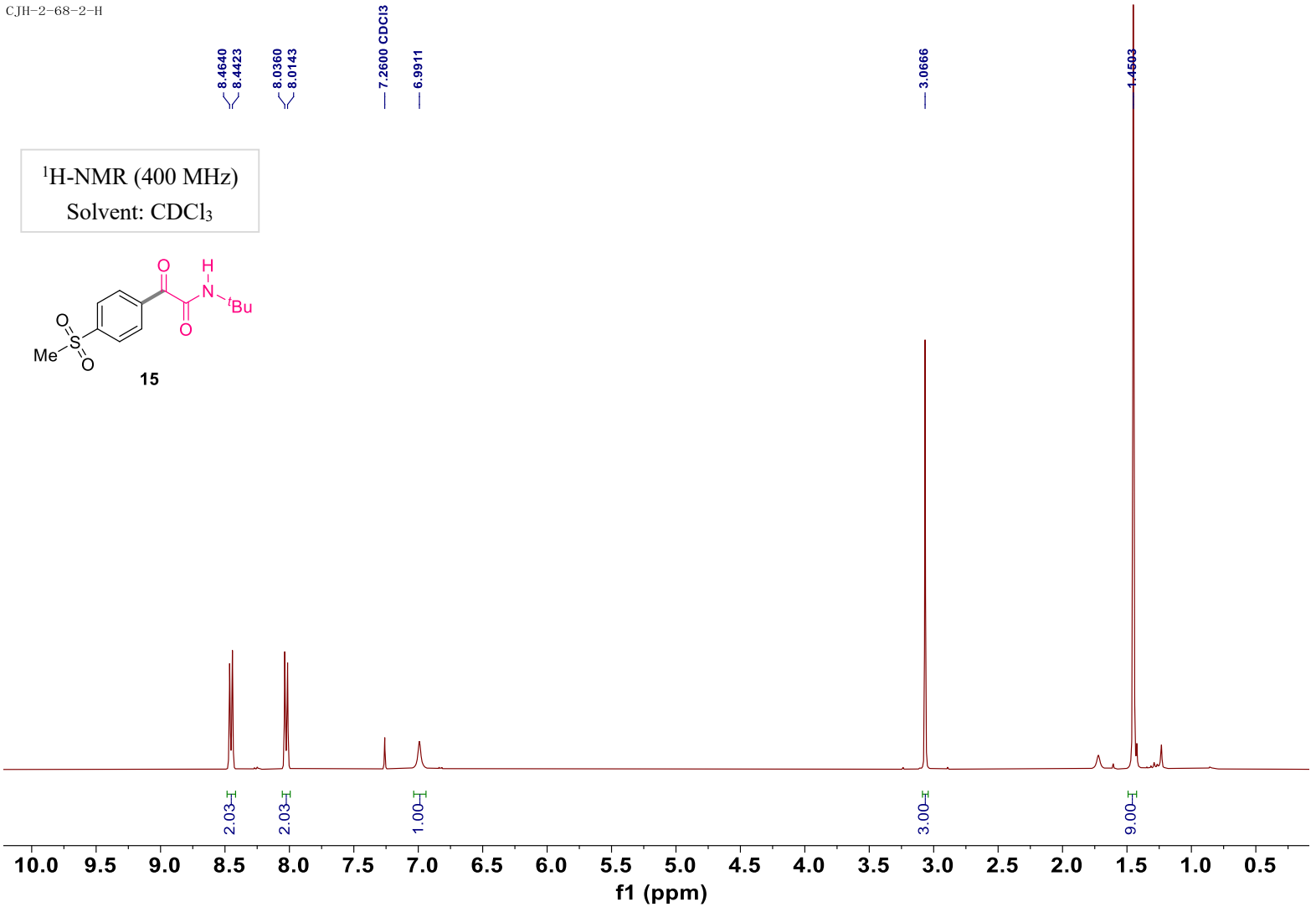

CJH-1-103-2-C
191.77
187.99
160.37
139.37
137.80
131.69
129.33
77.48
77.16 CDCl3
76.84
51.92
28.36
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
OHC
12
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

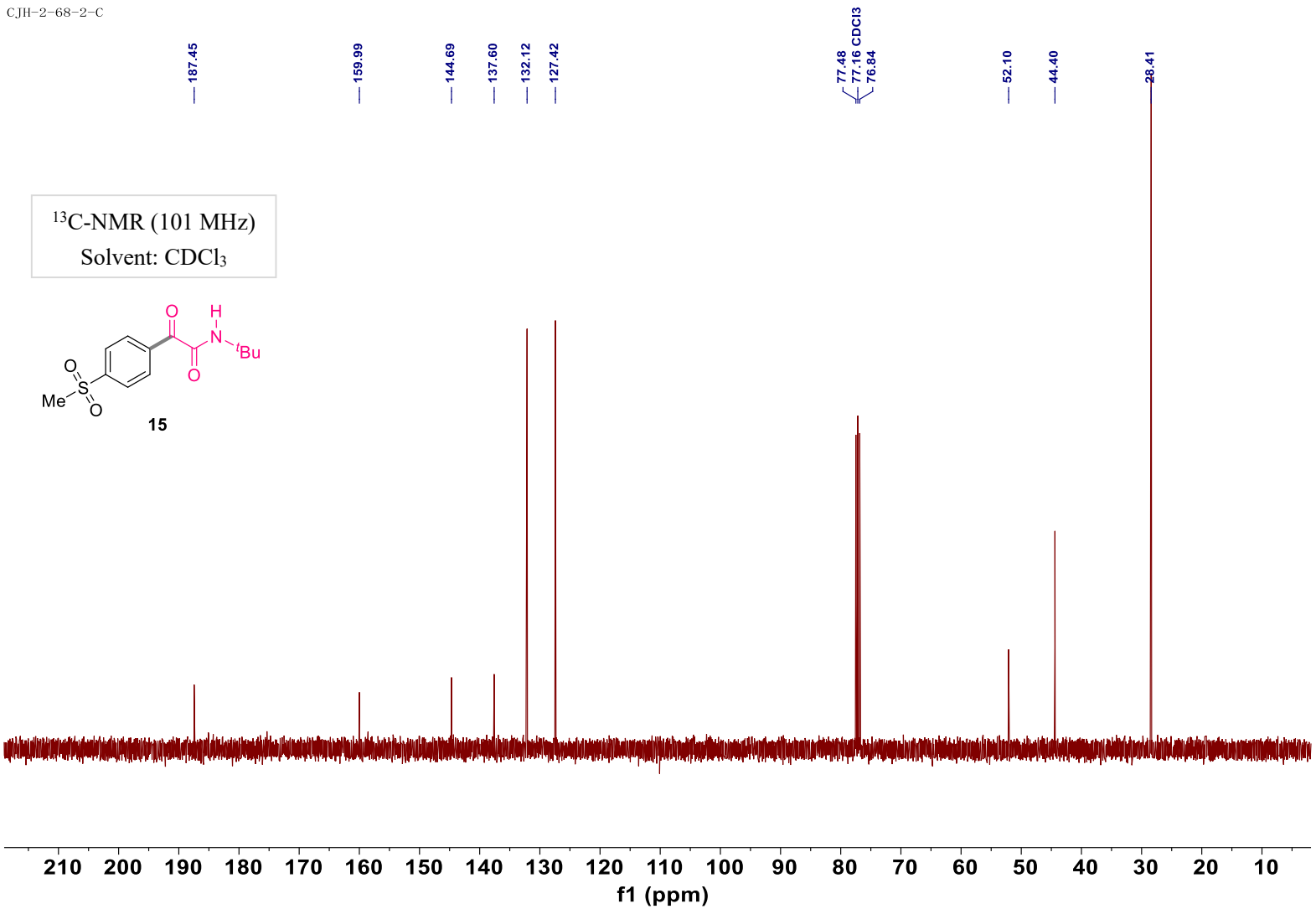

CJH-1-103-3-H
8.3776
8.3563
7.7364
7.7150
7.2600 CDCl3
6.9662
1.4237
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
O
H
N
^{t}Bu
O
NC
13
2.00
2.02
1.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

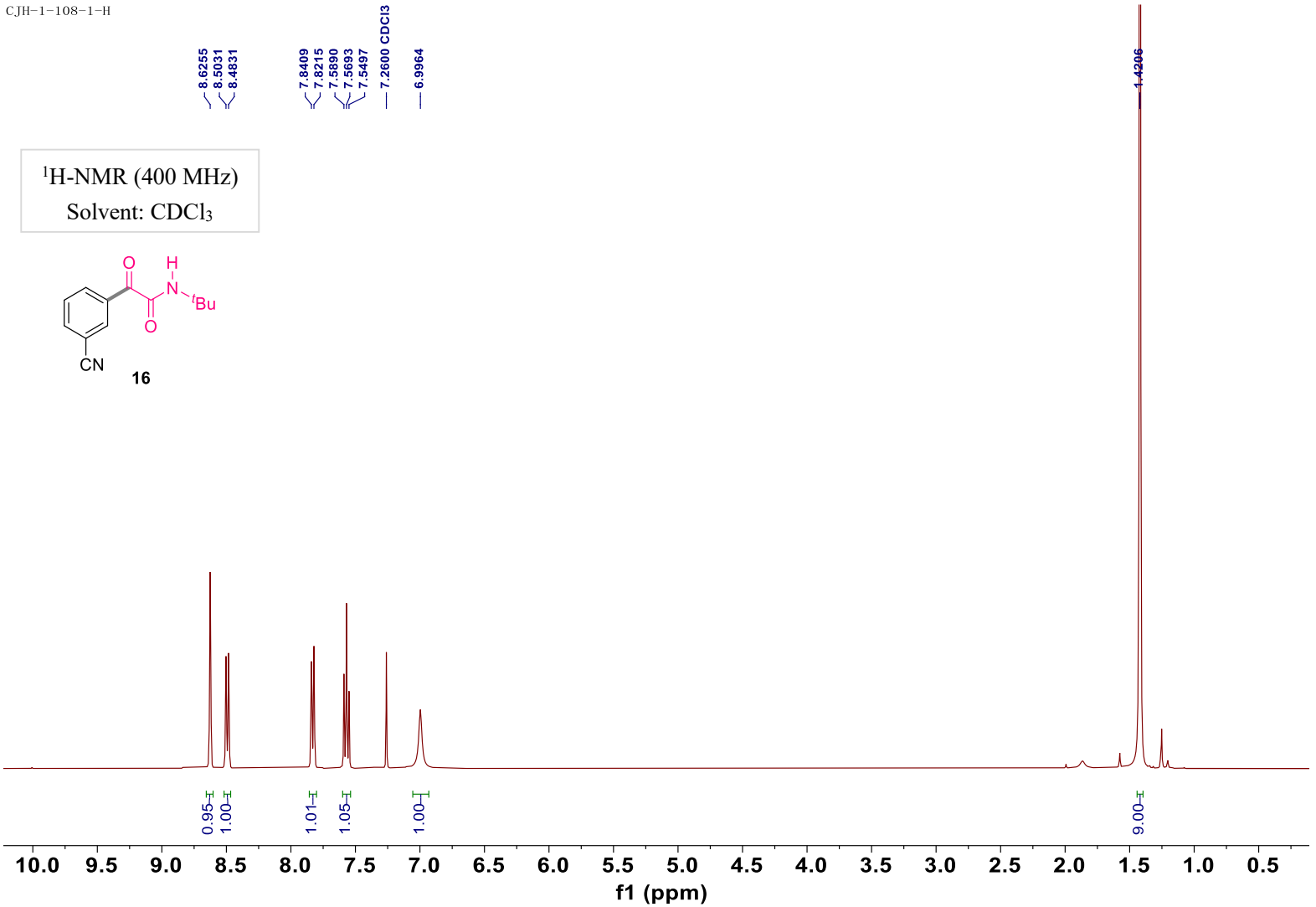

CJH-1-103-3-C
187.16
159.97
136.56
132.06
131.56
117.91
117.06
77.48
77.16 CDCl3
76.84
51.97
28.32
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
NC
13
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

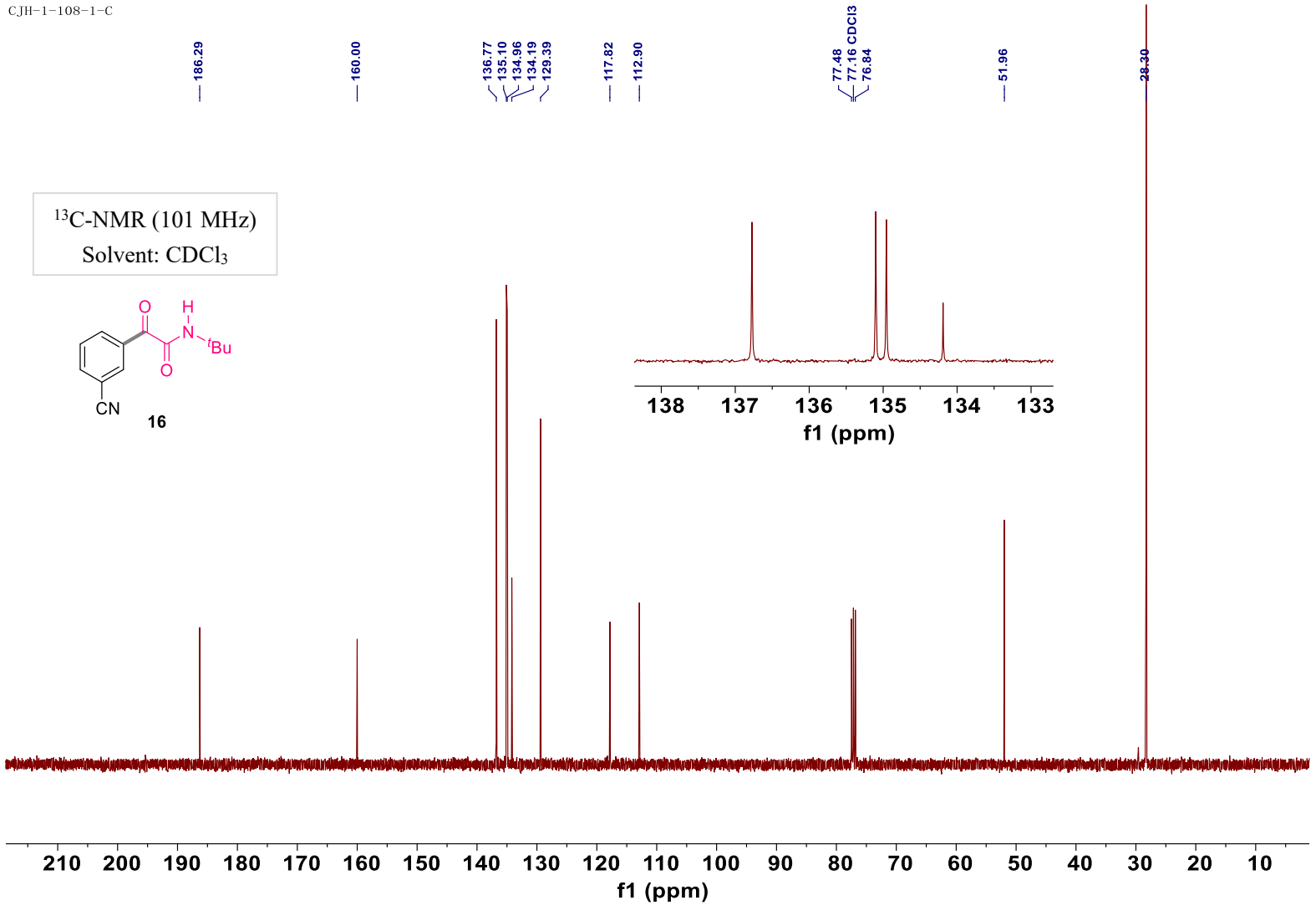

CJH-1-107-1-H
8.4017
8.3814
7.7068
7.6862
7.2600 CDCl3
6.9864
1.4420
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
F3C
14
2.00
2.00
0.99
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

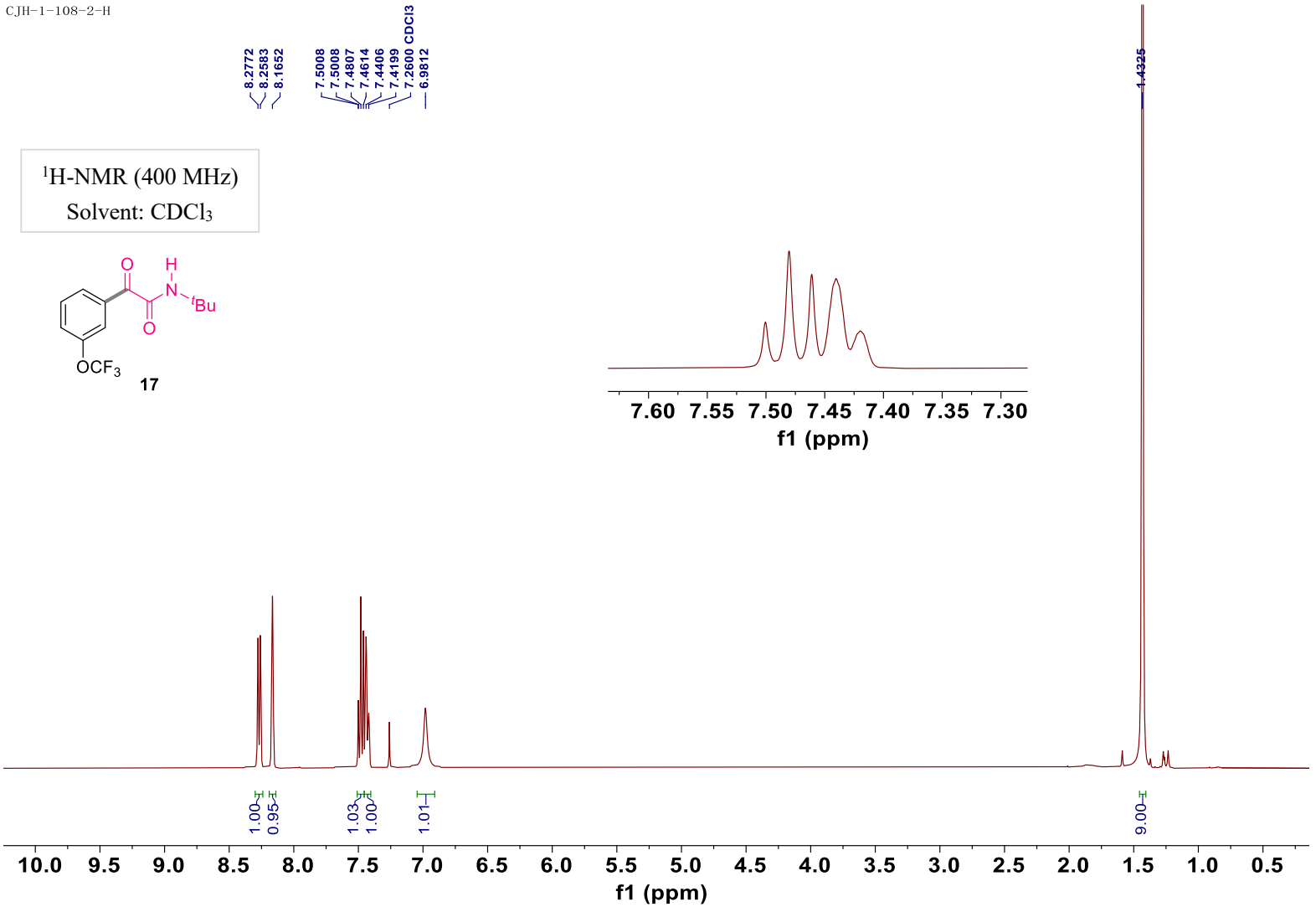

CJH-1-107-1-C
187.64
160.35
136.25
136.24
135.62
135.29
134.97
134.64
131.63
127.68
125.43
125.40
125.36
125.32
124.97
122.25
119.54
77.48
77.16 CDCl3
76.84
51.96
28.40
13C-NMR (101 MHz)
Solvent: CDCl3
136.2 136.1 136.0 135.9
f1 (ppm)
135.5 135.0 134.5
f1 (ppm)
130 126 122 118
f1 (ppm)
O
H
N
tBu
O
F3C
14
125.5 125.3 125.1 124.9
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

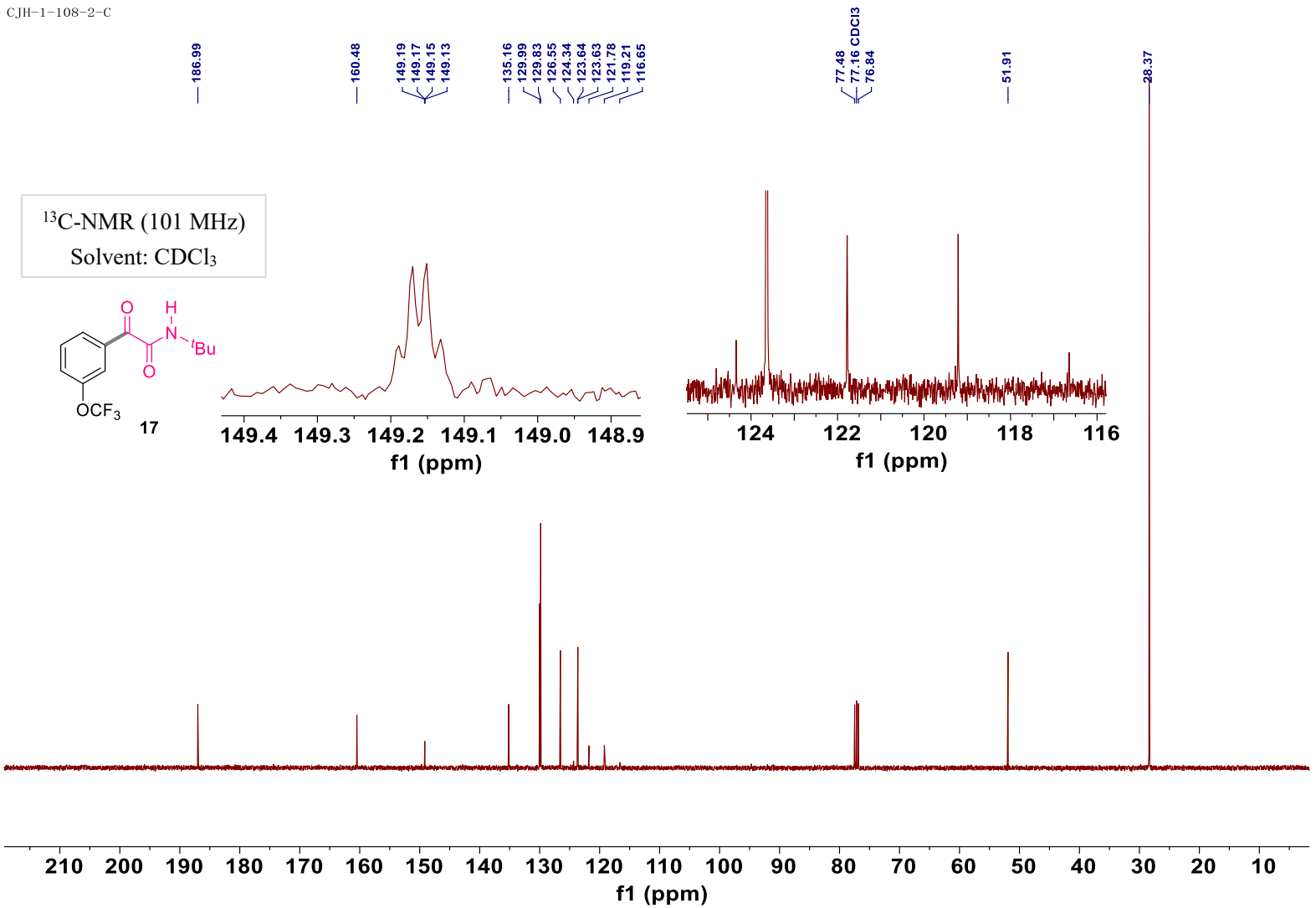

CJH-2-68-2-H
8.4640
8.4423
8.0360
8.0143
7.2600 CDCl3
6.9911
3.0666
1.4503
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
15
2.03
2.03
1.00
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

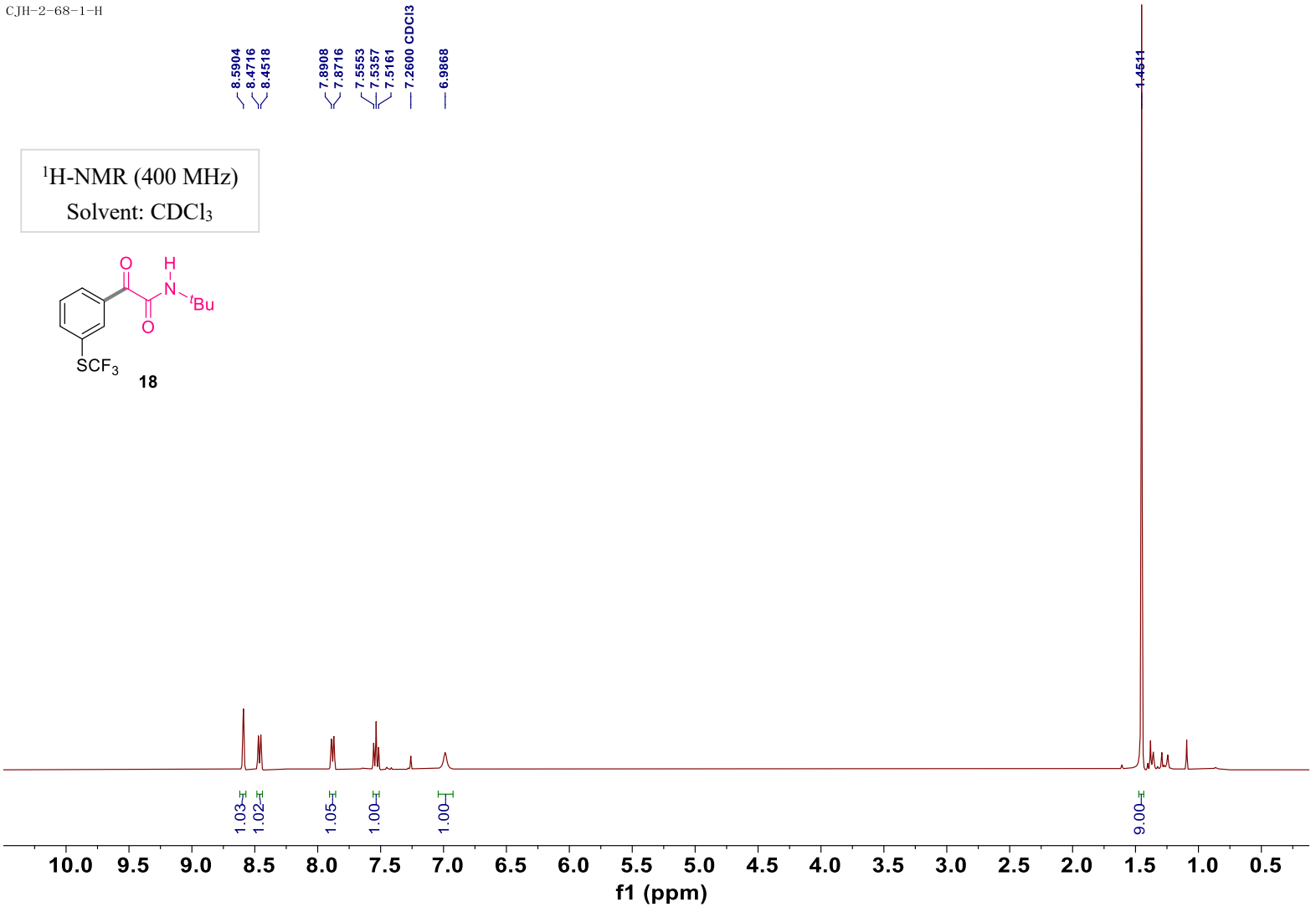

CJH-2-68-2-C
187.45
159.99
144.69
137.60
132.12
127.42
77.48
77.16 CDCl3
76.84
52.10
44.40
28.41
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
O
S
Me
O
15
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

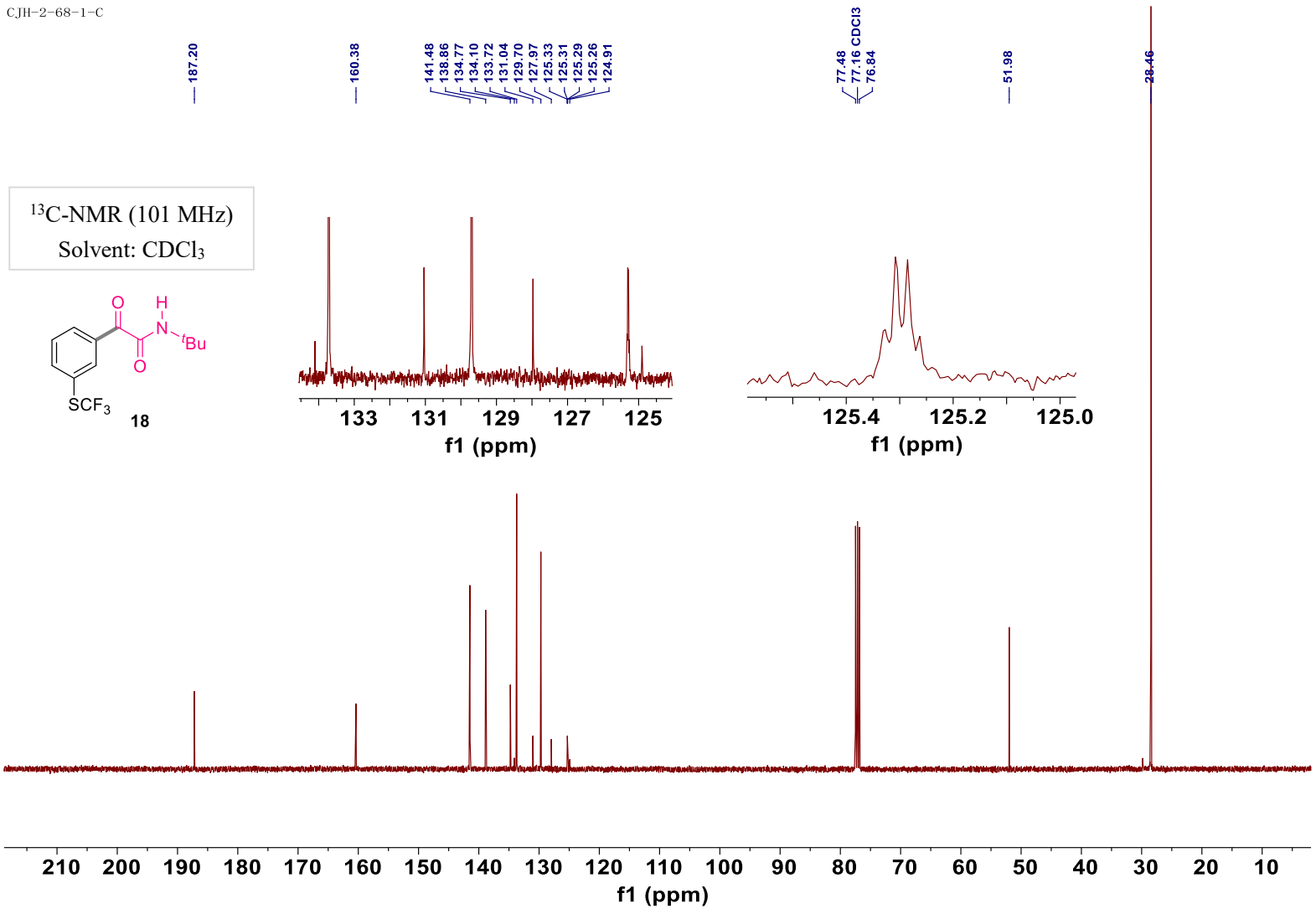

CJH-1-108-1-H
8.6255
8.5031
8.4831
7.8409
7.8215
7.5890
7.5693
7.5497
7.2600 CDCl3
6.9964
1.4206
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
CN
16
0.95
1.00
1.01
1.05
1.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

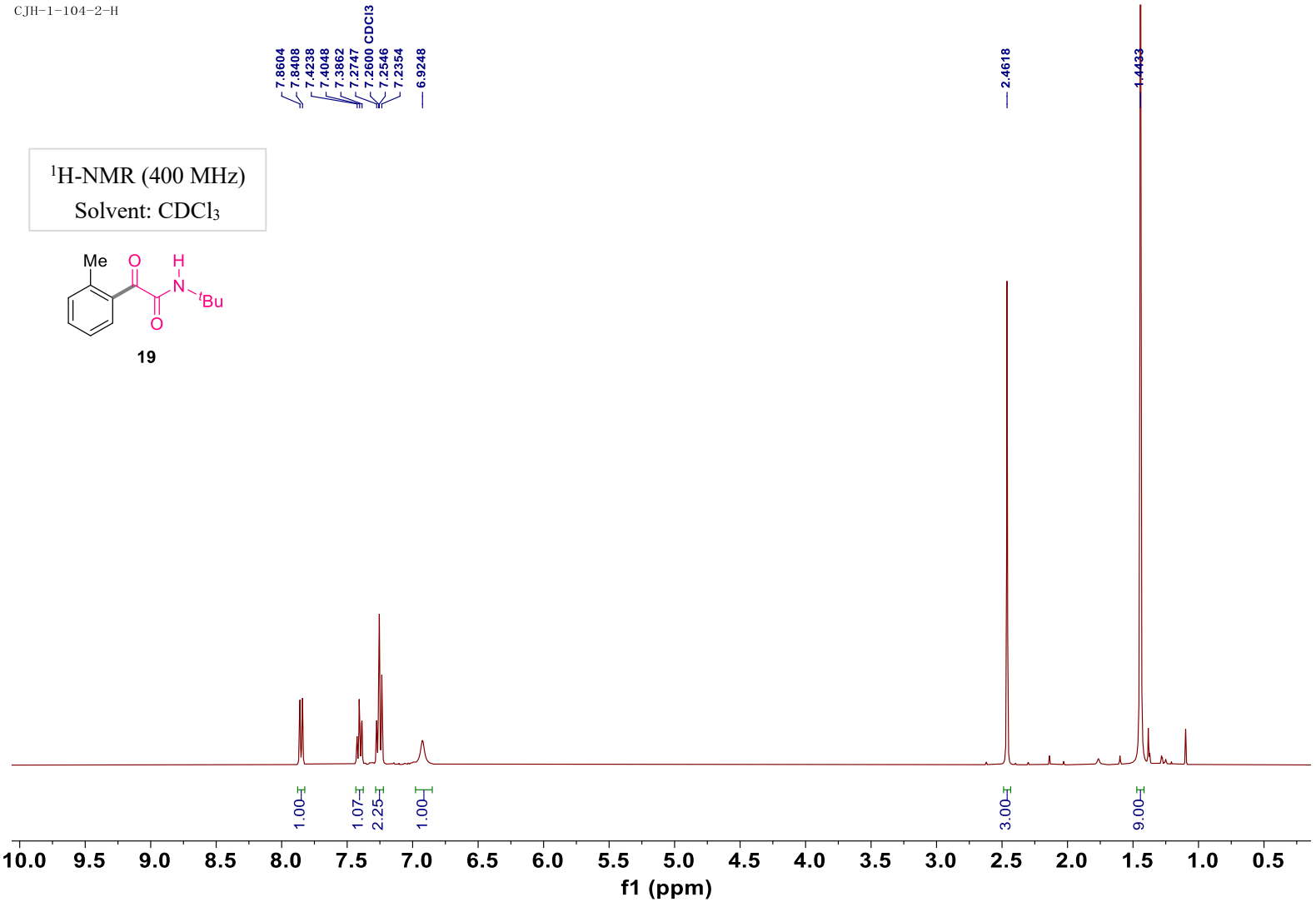

CJH-1-108-1-C
186.29
160.00
136.77
135.10
134.96
134.19
129.39
117.82
112.90
77.48
77.16 CDCl3
76.84
51.96
28.30
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
CN
16
138
137
136
135
134
133
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

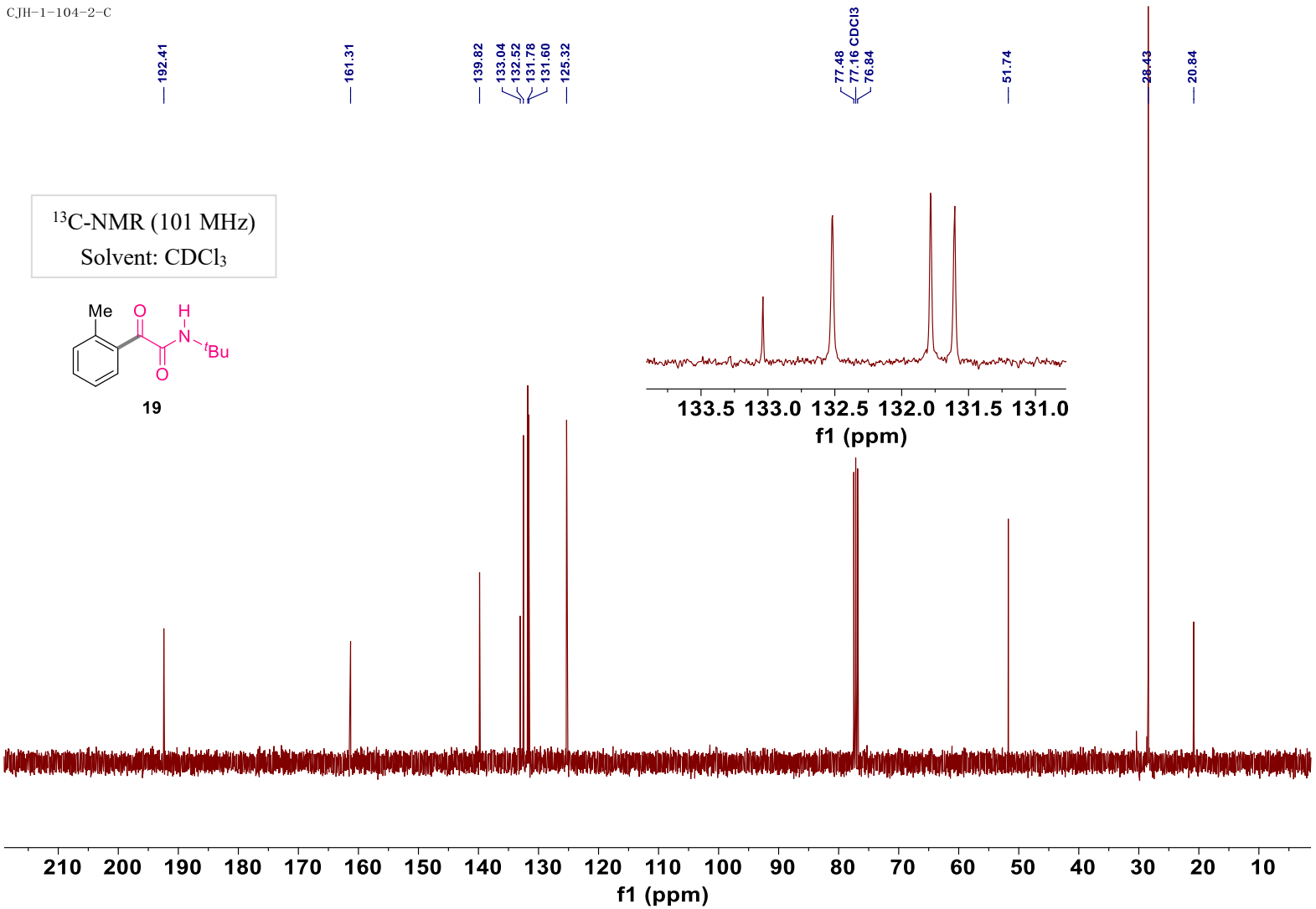

CJH-1-108-2-H
8.2772
8.2583
8.1652
7.5008
7.5008
7.4807
7.4614
7.4406
7.4199
7.2600 CDCl3
6.9812
1.4325
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
OCF3
17
7.60 7.55 7.50 7.45 7.40 7.35 7.30
f1 (ppm)
1.00
0.95
1.03
1.00
1.01
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

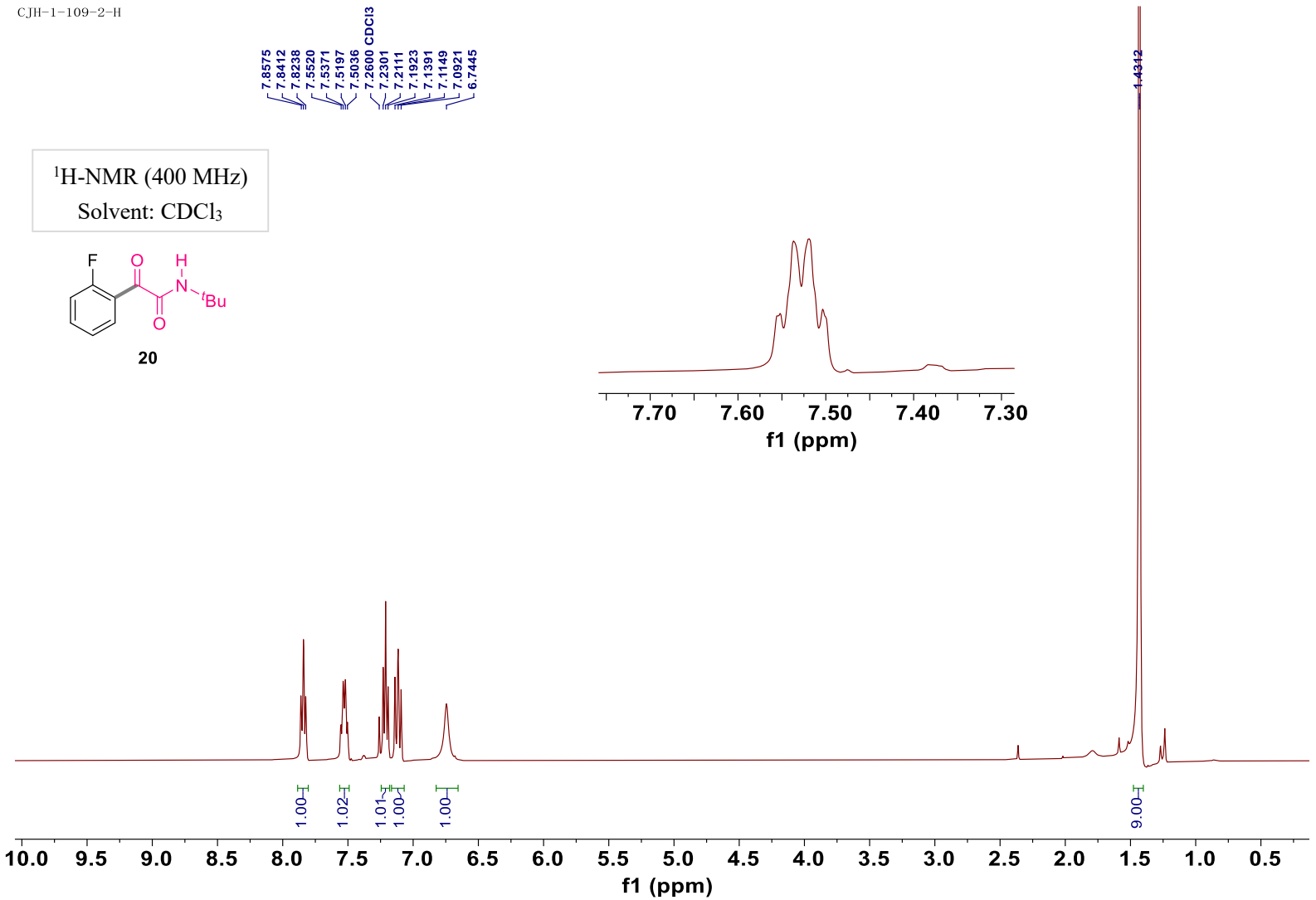

CJH-1-108-2-C
186.99
160.48
149.19
149.17
149.15
149.13
135.16
129.99
129.83
126.55
124.34
123.64
123.63
121.78
119.21
116.65
77.48
77.16 CDCl3
76.84
51.91
28.37
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
OCF3
17
149.4 149.3 149.2 149.1 149.0 148.9
f1 (ppm)
124 122 120 118 116
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

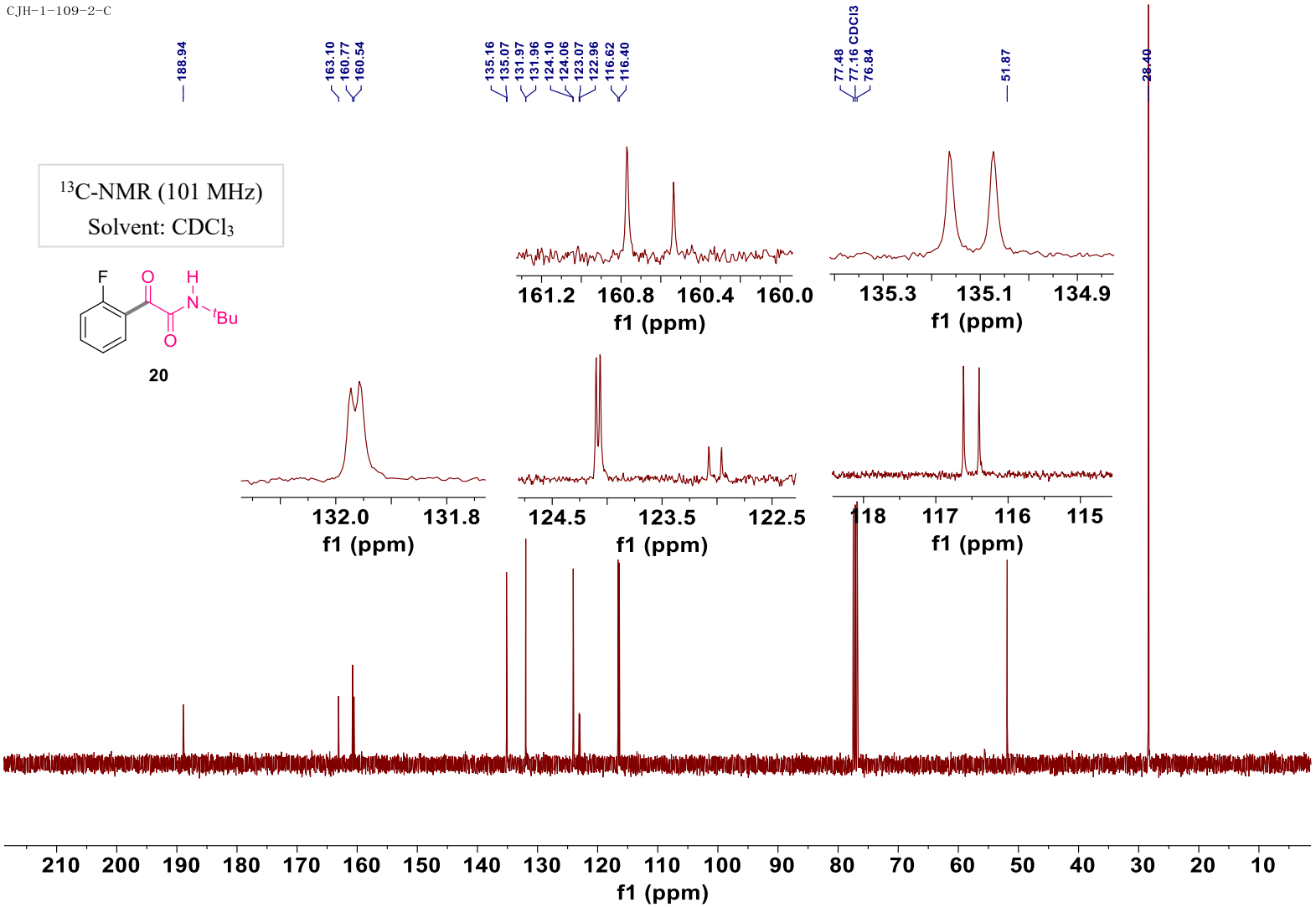

CJH-2-68-1-H
8.5904
8.4716
8.4518
7.8908
7.8716
7.5553
7.5357
7.5161
7.2600 CDCl3
6.9868
1.4611
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
SCF3
18
1.03
1.02
1.05
1.00
1.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

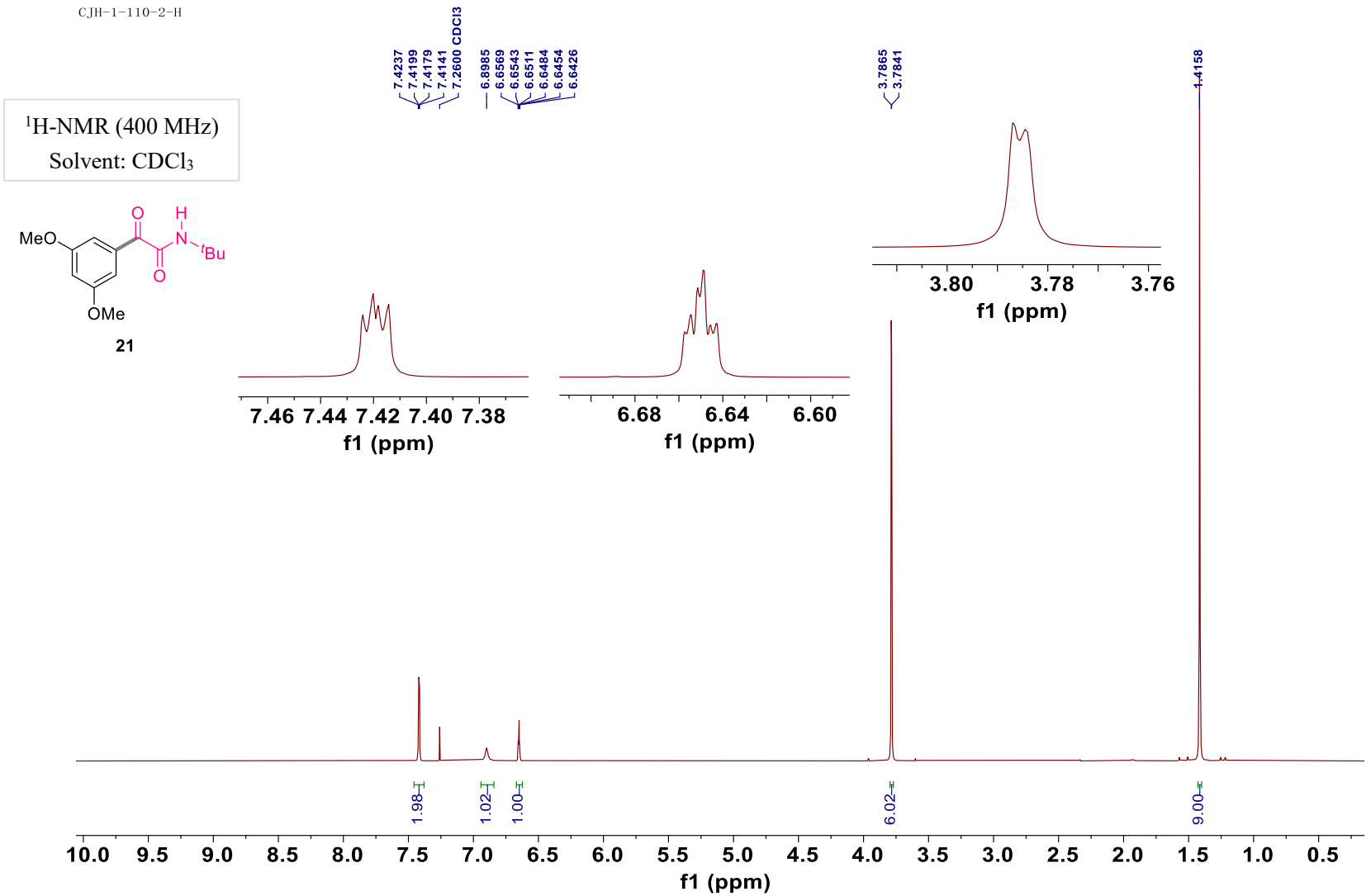

CJH-2-68-1-C
187.20
160.38
141.48
138.86
134.77
134.10
133.72
131.04
129.70
127.97
125.33
125.31
125.29
125.26
124.91
77.48
77.16 CDCl3
76.84
51.98
28.46
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
SCF3
18
133
131
129
127
125
f1 (ppm)
125.4
125.2
125.0
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

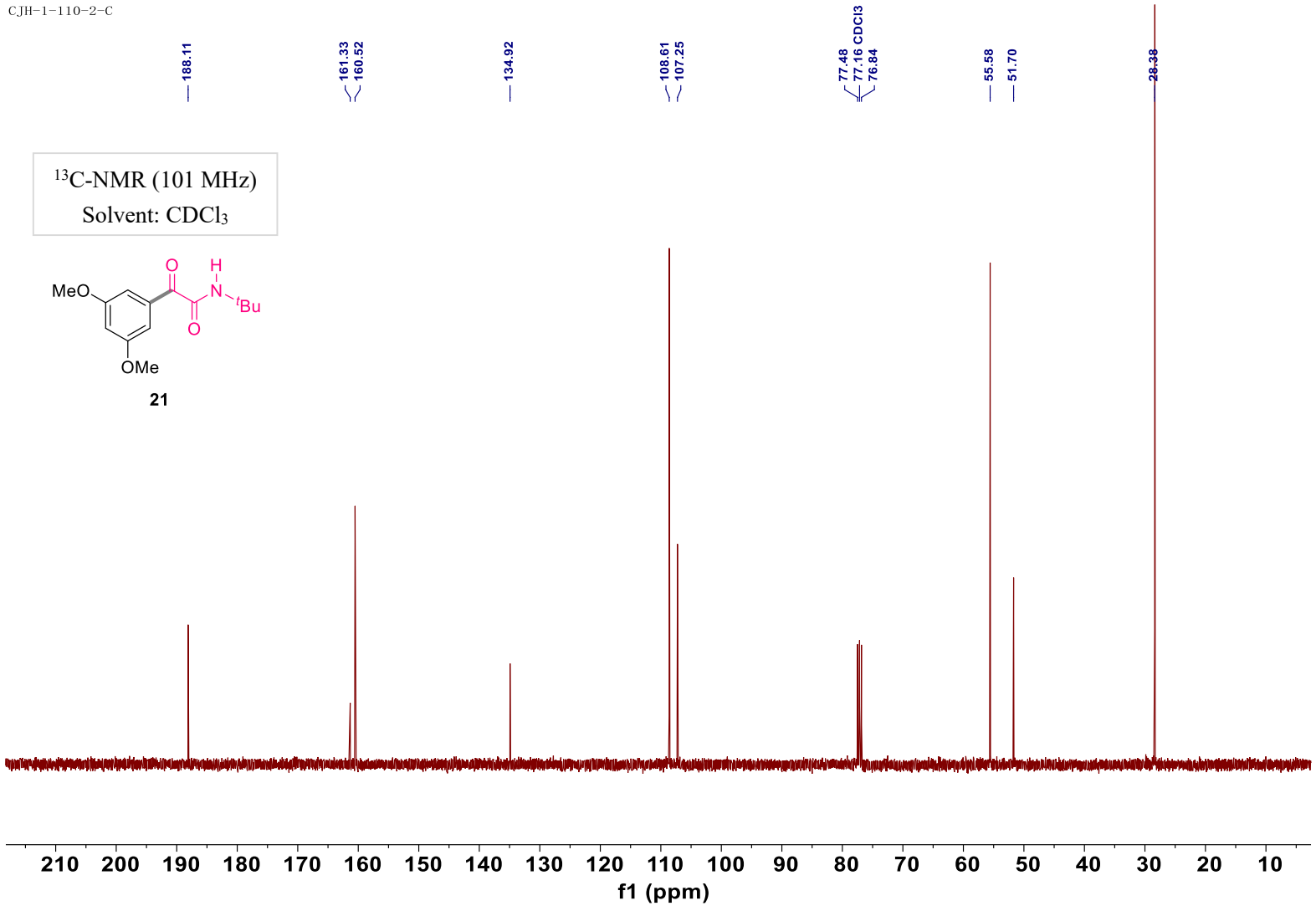

CJH-1-104-2-H
7.8604
7.8408
7.4238
7.4048
7.3862
7.2747
7.2600 CDCl3
7.2546
7.2354
6.9248
2.4618
1.4433
1H-NMR (400 MHz)
Solvent: CDCl3
Me
O
H
N
tBu
O
19
1.00
1.07
2.25
1.00
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

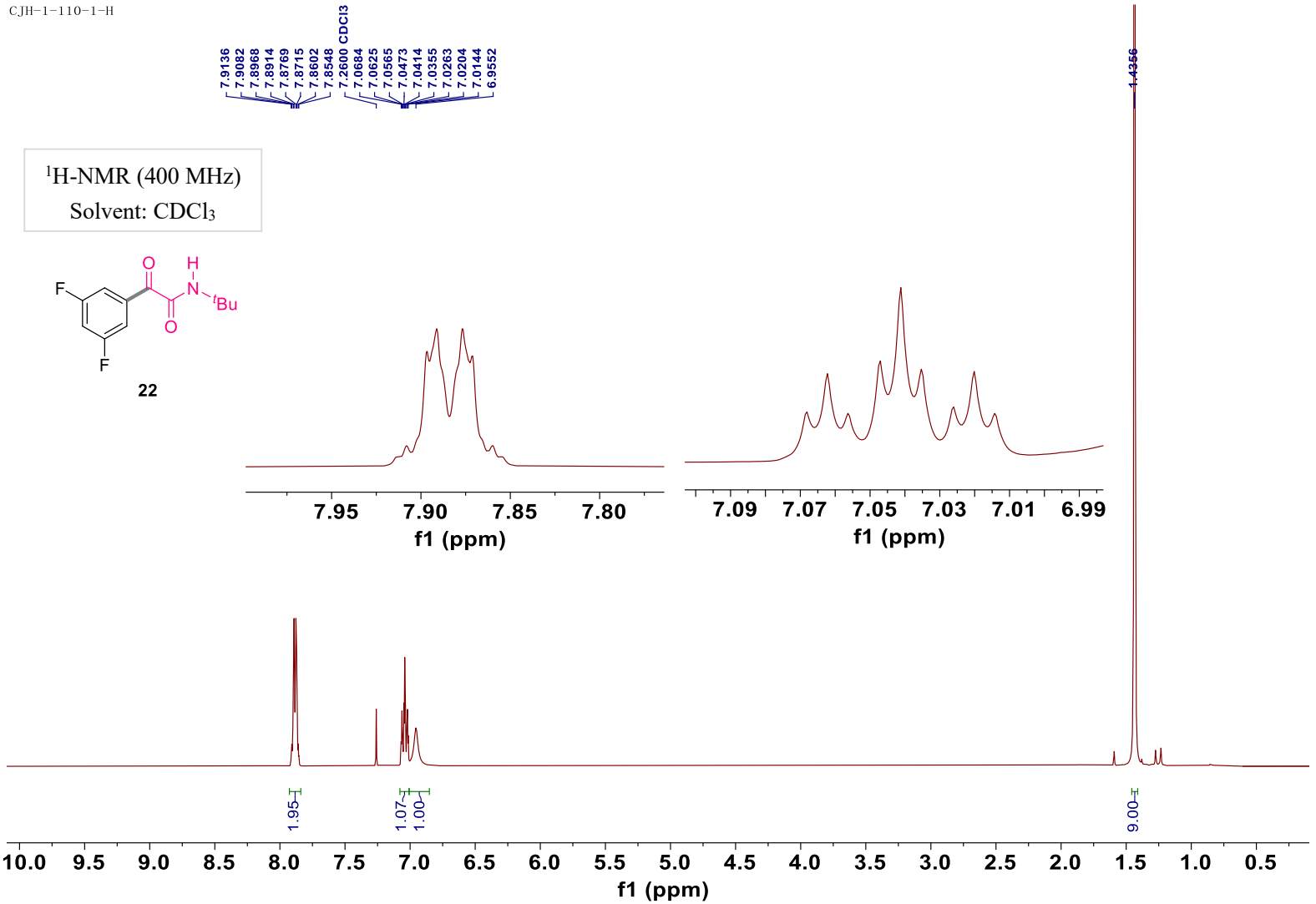

CJH-1-104-2-C
192.41
161.31
139.82
133.04
132.52
131.78
131.60
125.32
77.48
77.16 CDCl3
76.84
51.74
28.43
20.84
13C-NMR (101 MHz)
Solvent: CDCl3
Me
O
H
N
tBu
O
19
133.5 133.0 132.5 132.0 131.5 131.0
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

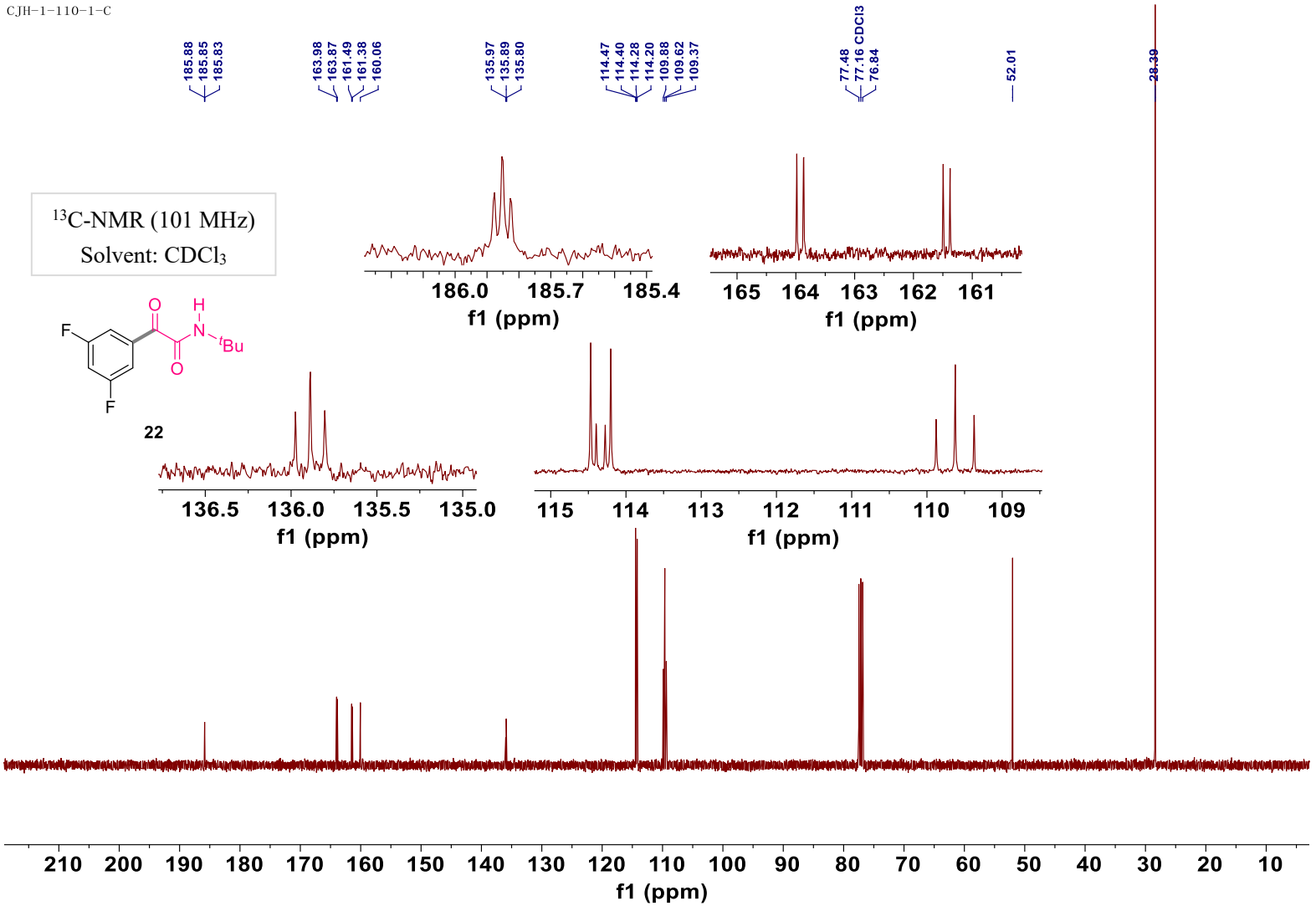

CJH-1-109-2-H
7.8575
7.8412
7.8238
7.5520
7.5371
7.5197
7.5036
7.2600 CDCl3
7.2301
7.2111
7.1923
7.1391
7.1149
7.0921
6.7445
1.4312
1H-NMR (400 MHz)
Solvent: CDCl3
F
O
H
N
tBu
O
20
7.70
7.60
7.50
7.40
7.30
f1 (ppm)
1.00
1.02
1.01
1.00
1.00
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

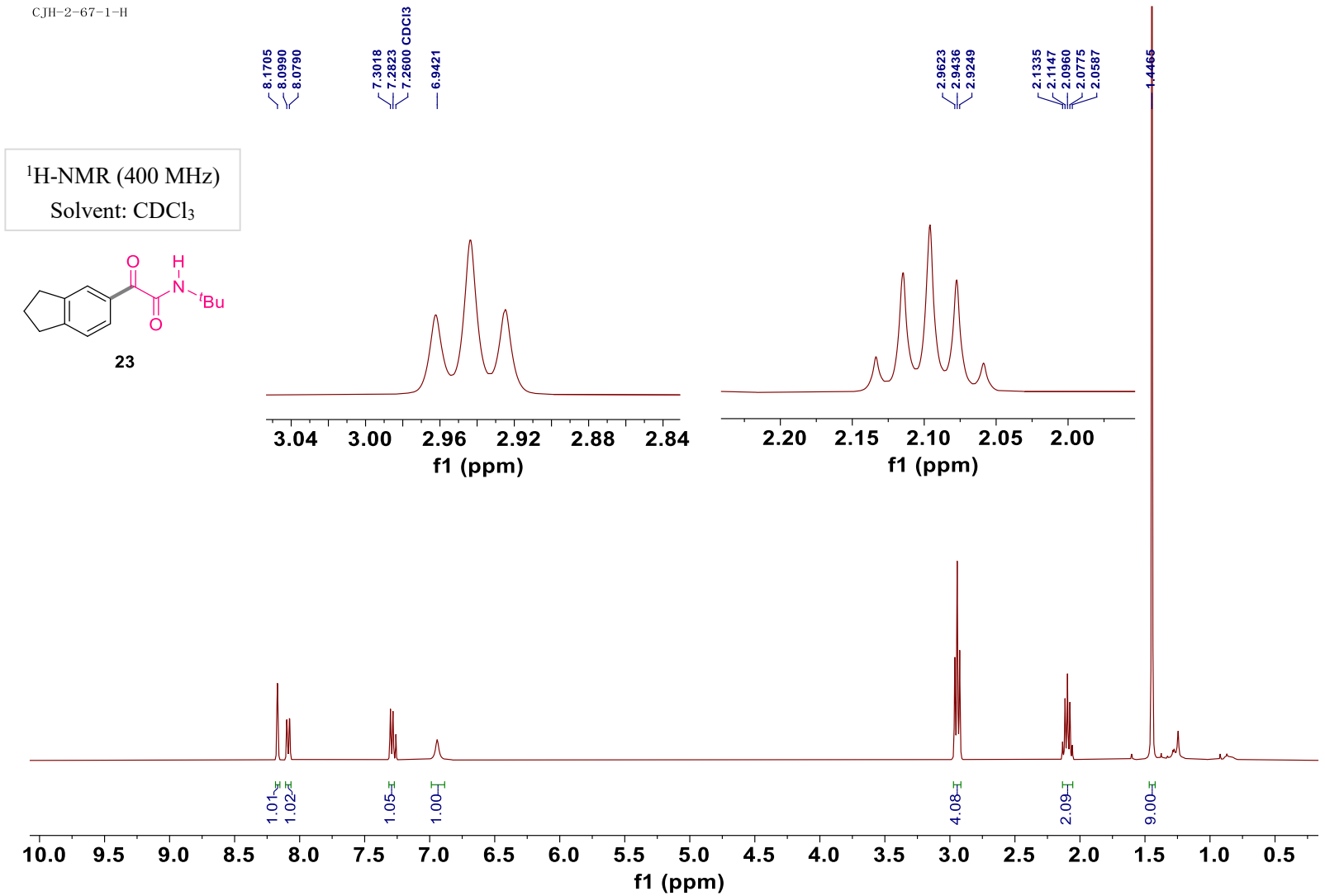

CJH-1-109-2-C
188.94
163.10
160.77
160.54
135.16
135.07
131.97
131.96
124.10
124.06
123.07
122.96
116.62
116.40
77.48
77.16 CDCl3
76.84
51.87
28.40
13C-NMR (101 MHz)
Solvent: CDCl3
F
O
H
N
tBu
O
20
161.2 160.8 160.4 160.0
f1 (ppm)
135.3 135.1 134.9
f1 (ppm)
132.0 131.8
f1 (ppm)
124.5 123.5 122.5
f1 (ppm)
118 117 116 115
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

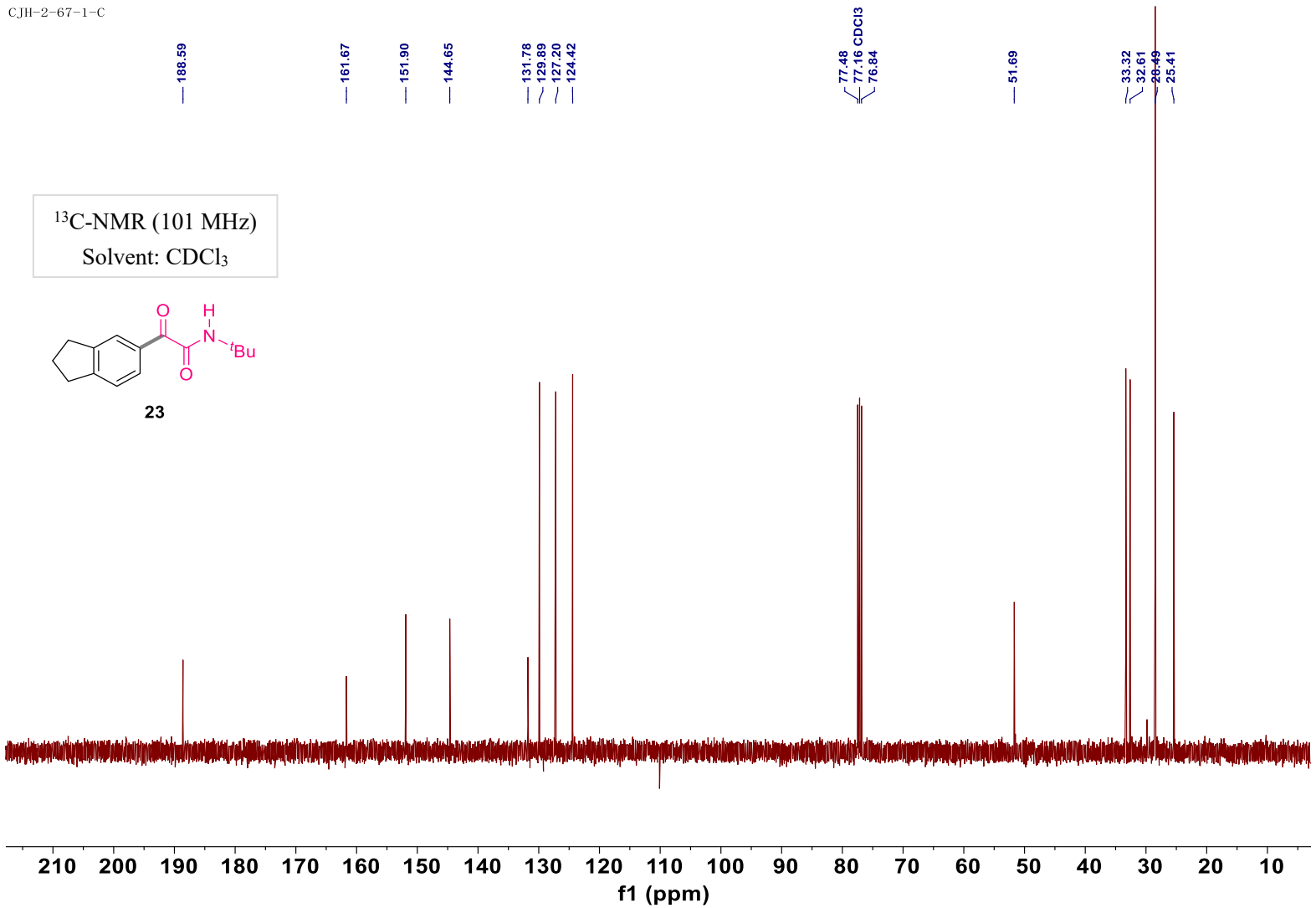

CJH-1-110-2-H
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
MeO
OMe
O
H
N
^{t}Bu
21
7.4237
7.4199
7.4179
7.4141
7.2600 CDCl3
6.8985
6.6569
6.6543
6.6511
6.6484
6.6454
6.6426
3.7865
3.7841
1.4158
7.46 7.44 7.42 7.40 7.38
f1 (ppm)
6.68 6.64 6.60
f1 (ppm)
3.80 3.78 3.76
f1 (ppm)
1.98
1.02
1.00
6.02
9.00
10.0 9.5 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
f1 (ppm)

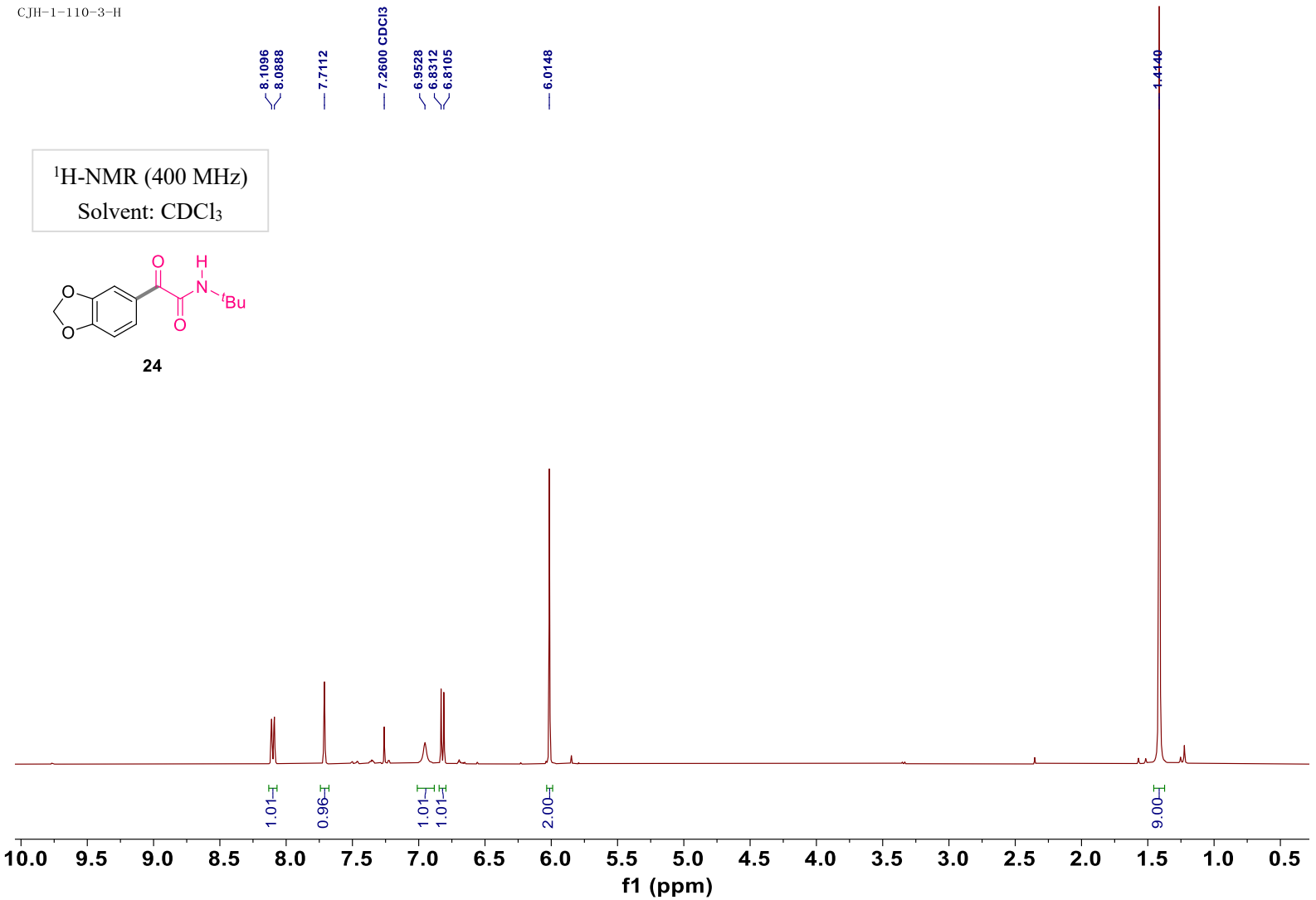

CJH-1-110-2-C
188.11
161.33
160.52
134.92
108.61
107.25
77.48
77.16 CDCl3
76.84
55.58
51.70
28.38
13C-NMR (101 MHz)
Solvent: CDCl3
MeO
OMe
O
H
N
tBu
21
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

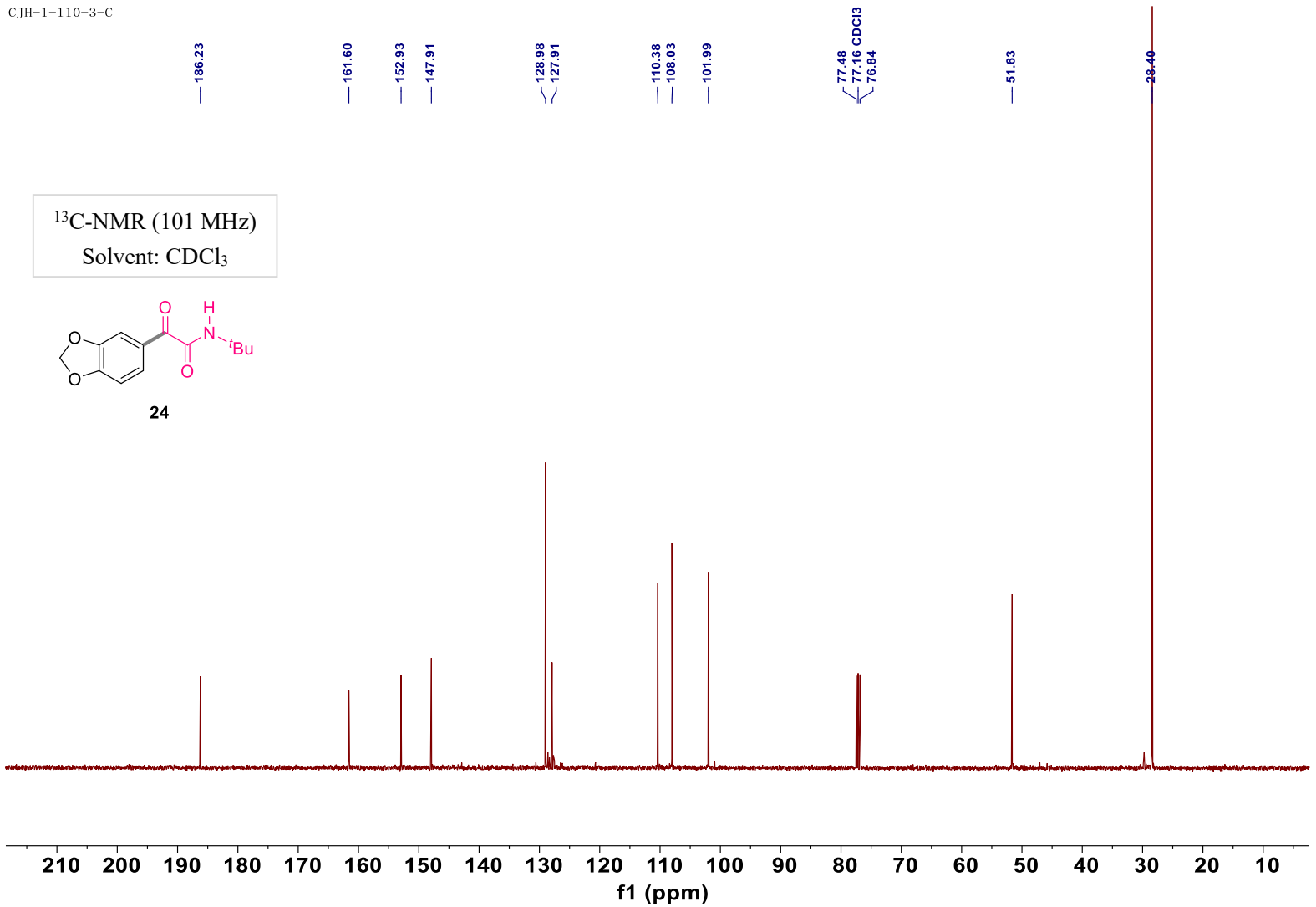

CJH-1-110-1-H
7.9136
7.9082
7.8968
7.8914
7.8769
7.8715
7.8602
7.8548
7.2600 CDCl3
7.0684
7.0625
7.0565
7.0473
7.0414
7.0355
7.0263
7.0204
7.0144
6.9552
1.4356
1H-NMR (400 MHz)
Solvent: CDCl3
F
O
H
N
tBu
O
F
22
7.95
7.90
7.85
7.80
f1 (ppm)
7.09
7.07
7.05
7.03
7.01
6.99
f1 (ppm)
1.95
1.07
1.00
9.00
10.0
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
f1 (ppm)

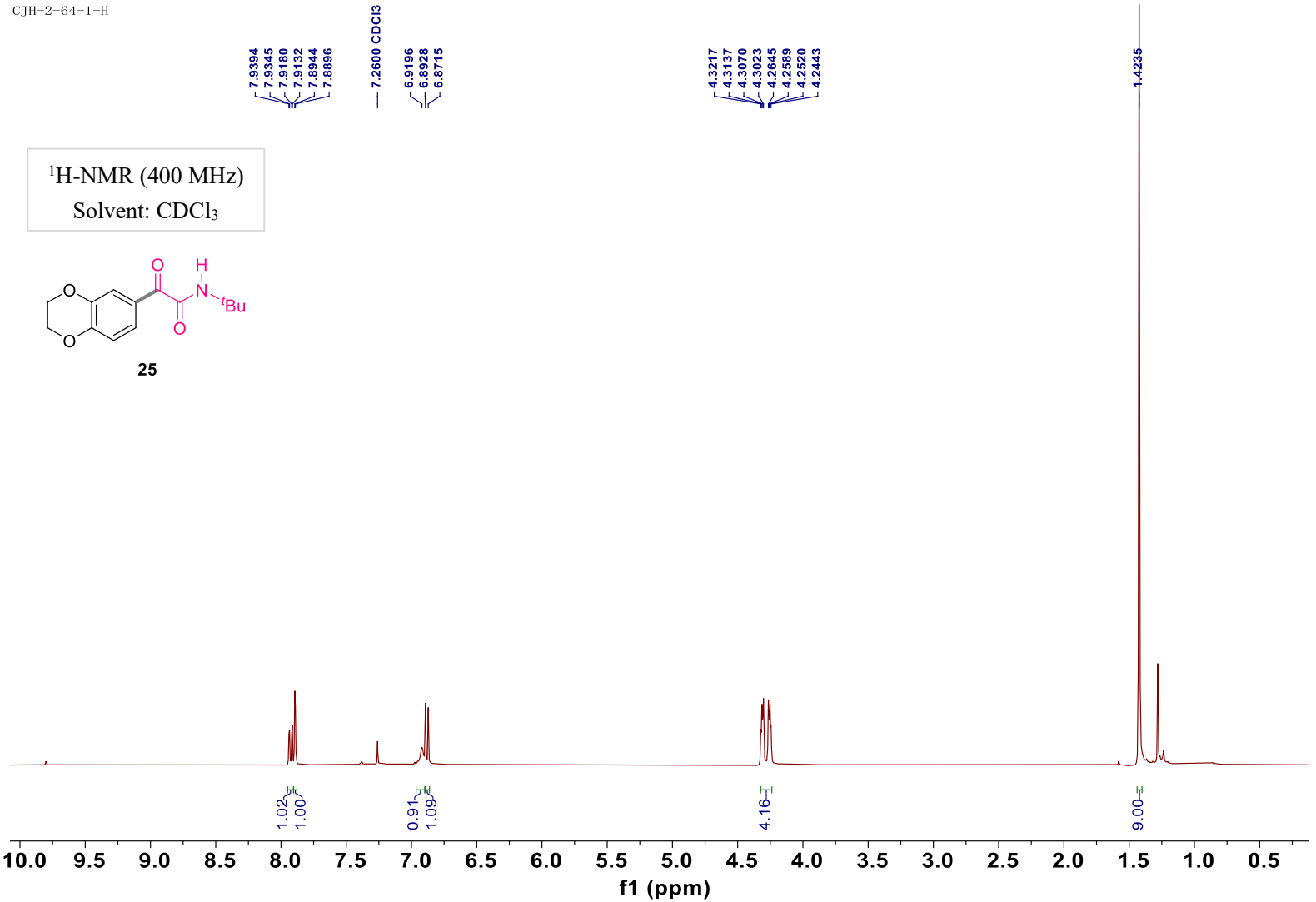

CJH-1-110-1-C
185.88
185.85
185.83
163.98
163.87
161.49
161.38
160.06
135.97
135.89
135.80
114.47
114.40
114.28
114.20
109.88
109.62
109.37
77.48
77.16 CDCl3
76.84
52.01
28.39
13C-NMR (101 MHz)
Solvent: CDCl3
F
O
H
N
tBu
O
F
22
186.0
185.7
185.4
f1 (ppm)
165
164
163
162
161
f1 (ppm)
136.5
136.0
135.5
135.0
f1 (ppm)
115
114
113
112
111
110
109
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

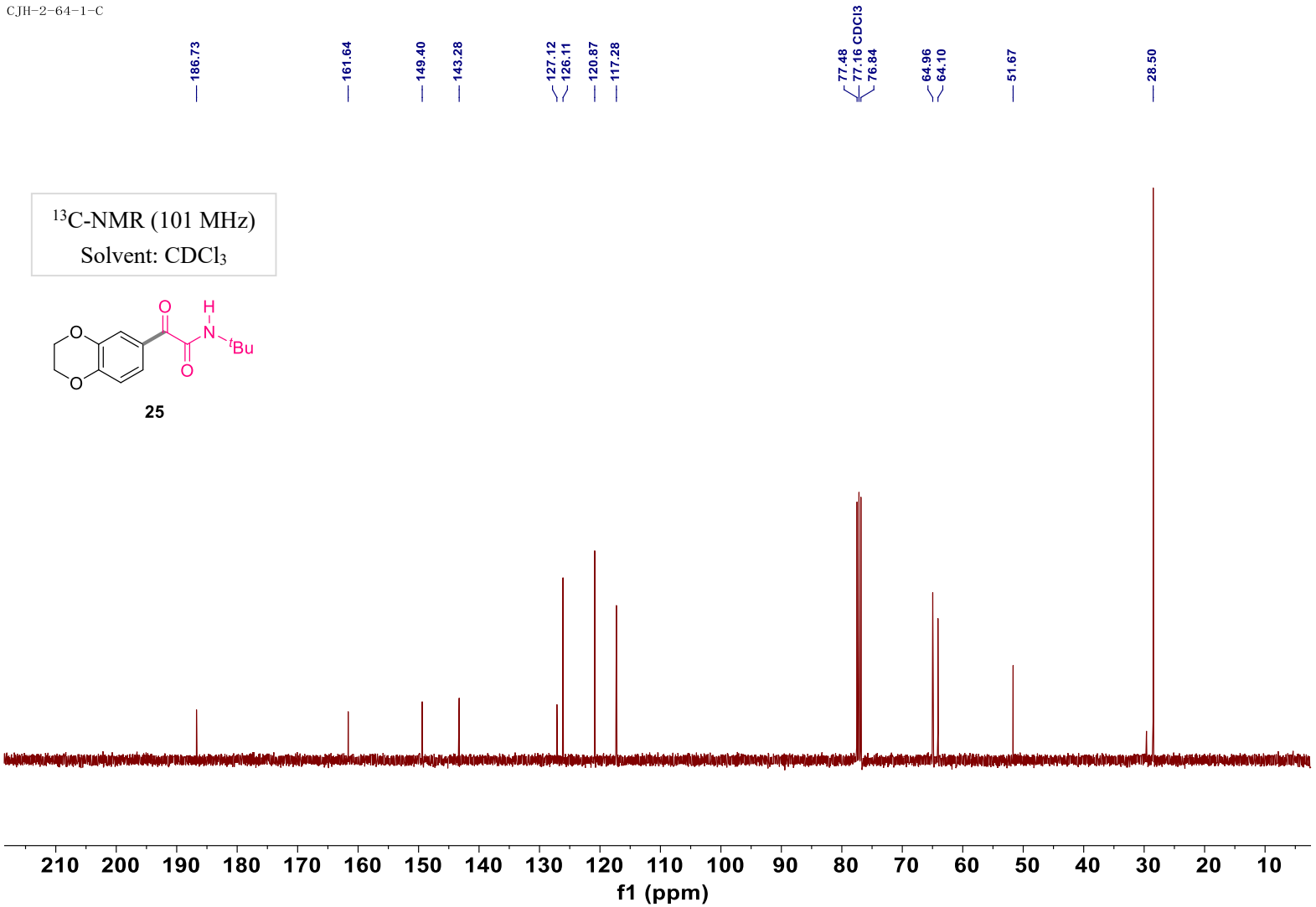

CJH-2-67-1-H
8.1705
8.0990
8.0790
7.3018
7.2823
7.2600 CDCl3
6.9421
2.9623
2.9436
2.9249
2.1335
2.1147
2.0960
2.0775
2.0587
1.4465
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
23
3.04
3.00
2.96
2.92
2.88
2.84
f1 (ppm)
2.20
2.15
2.10
2.05
2.00
f1 (ppm)
1.01
1.02
1.05
1.00
4.08
2.09
9.00
10.0
9.5
9.0
8.5
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
f1 (ppm)

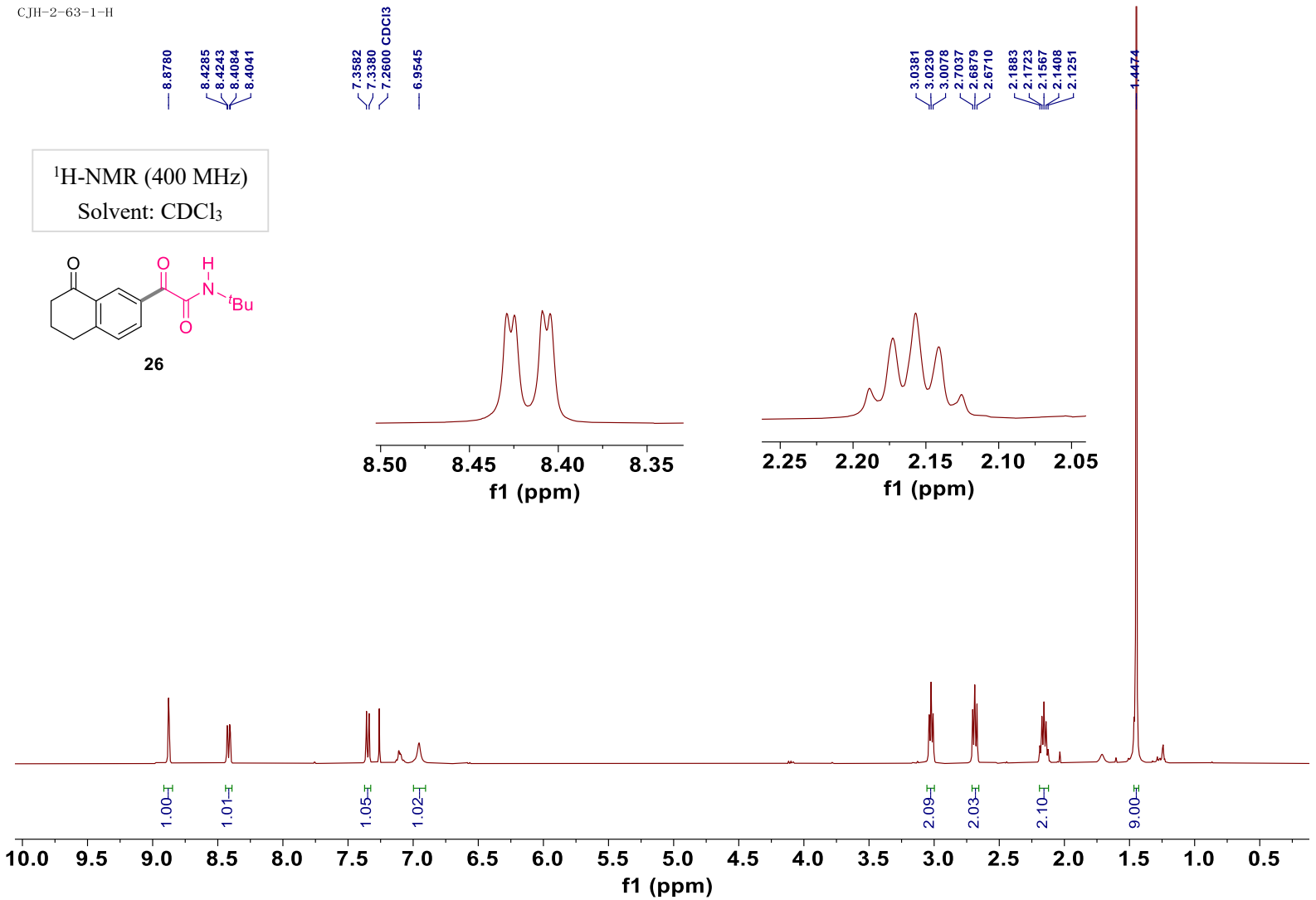

CJH-2-67-1-C
188.59
161.67
151.90
144.65
131.78
129.89
127.20
124.42
77.48
77.16 CDCl3
76.84
51.69
33.32
32.61
28.49
25.41
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
23
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-1-110-3-H
8.1096
8.0888
7.7112
7.2600 CDCl3
6.9528
6.8312
6.8105
6.0148
1.4440
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
O
H
N
^{t}Bu
O
O
O
24
1.01
0.96
1.01
1.01
2.00
9.00
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
f1 (ppm)


CJH-1-110-3-C
186.23
161.60
152.93
147.91
128.98
127.91
110.38
108.03
101.99
77.48
77.16 CDCl3
76.84
51.63
28.40
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
O
O
24
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-2-64-1-H
7.9394
7.9345
7.9180
7.9132
7.8944
7.8896
7.2600 CDCl3
6.9196
6.8928
6.8715
4.3217
4.3137
4.3070
4.3023
4.2645
4.2589
4.2520
4.2443
1.4235
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
O
O
25
1.02
1.00
0.91
1.09
4.16
9.00
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
f1 (ppm)

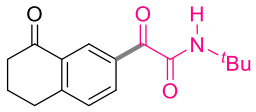

CJH-2-64-1-C
186.73
161.64
149.40
143.28
127.12
126.11
120.87
117.28
77.48
77.16 CDCl3
76.84
64.96
64.10
51.67
28.50
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
O
O
25
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-2-63-1-H
8.8780
8.4285
8.4243
8.4084
8.4041
7.3582
7.3380
7.2600 CDCl3
6.9545
3.0381
3.0230
3.0078
2.7037
2.6879
2.6710
2.1883
2.1723
2.1567
2.1408
2.1251
1.4474
1H-NMR (400 MHz)
Solvent: CDCl3
O
O
H
N
tBu
O
26
8.50
8.45
8.40
8.35
f1 (ppm)
2.25
2.20
2.15
2.10
2.05
f1 (ppm)
1.00
1.01
1.05
1.02
2.09
2.03
2.10
9.00
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
f1 (ppm)

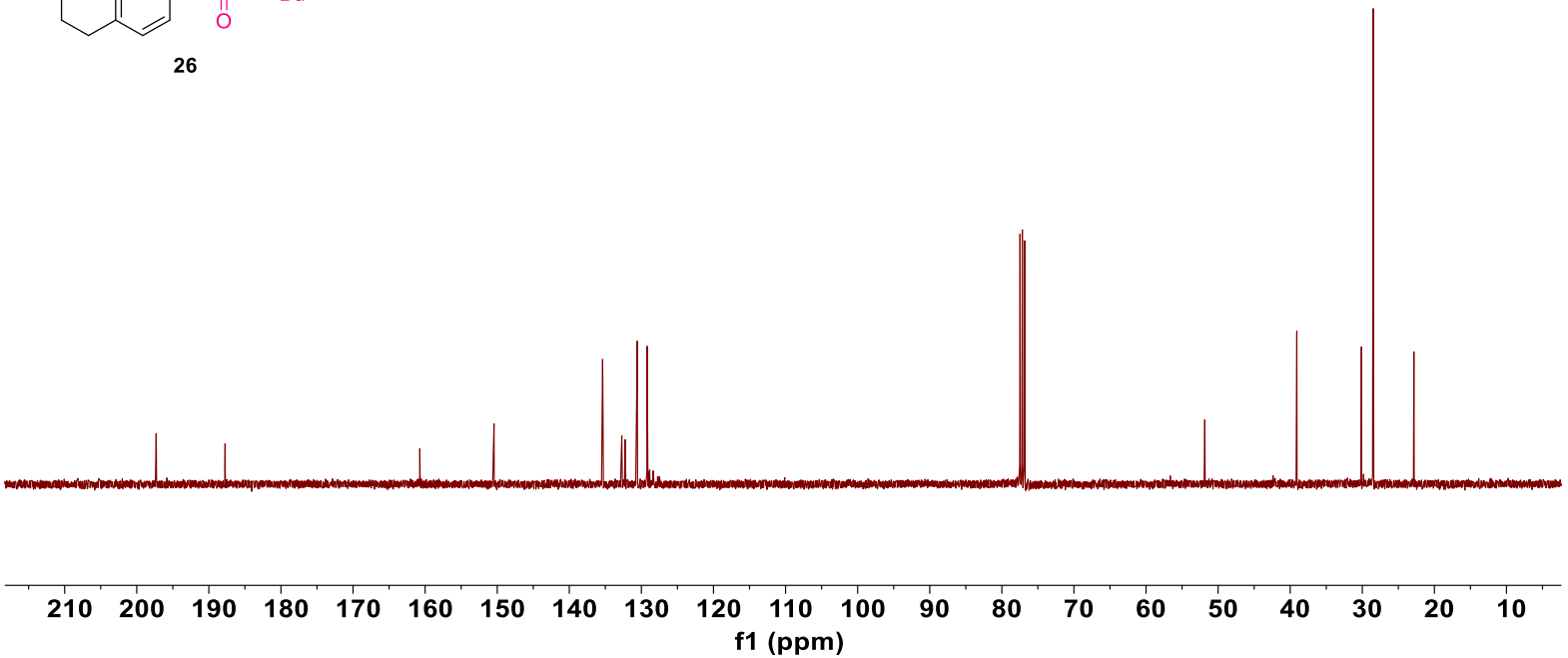
CJH-2-63-1-C

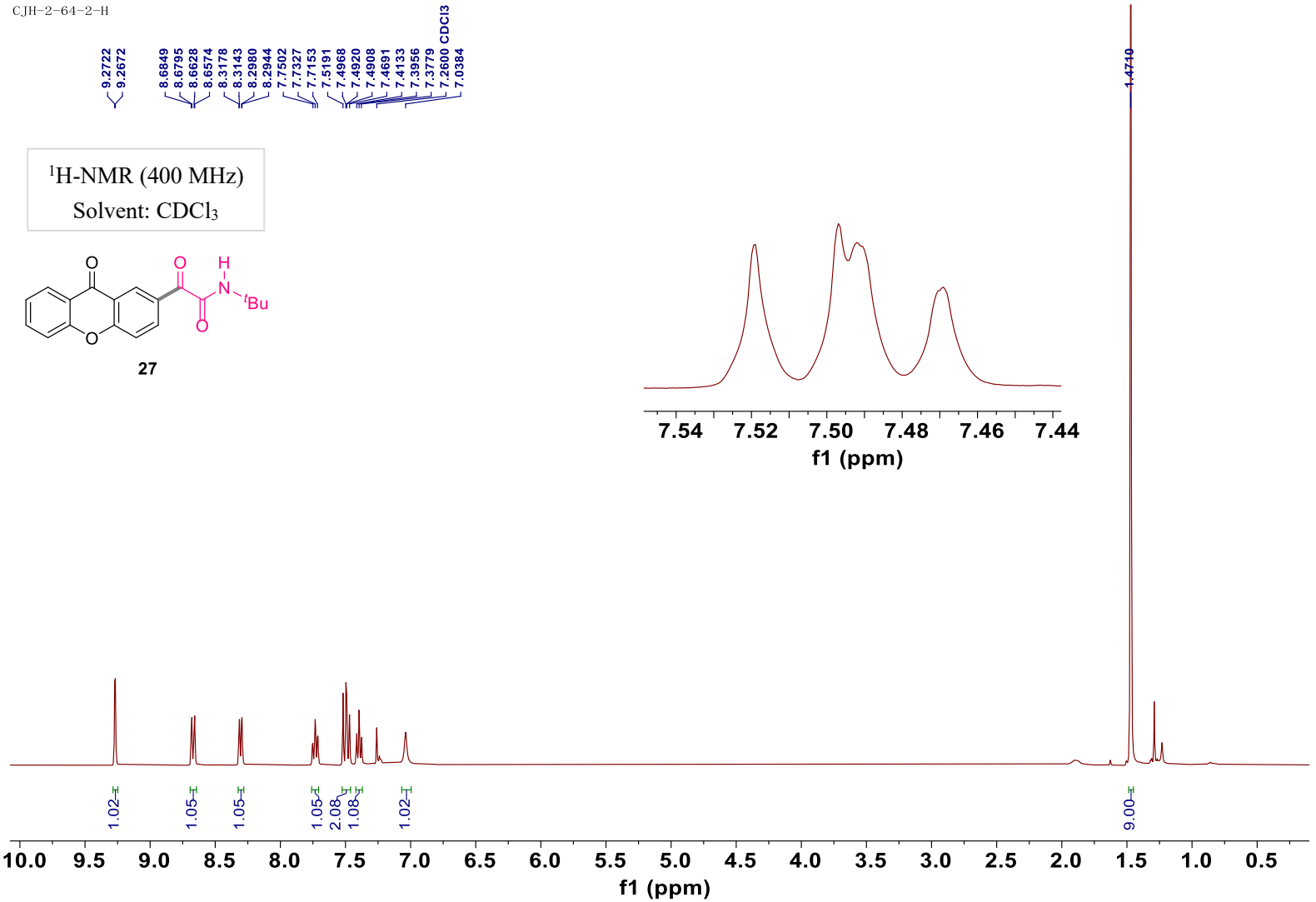
197.31
187.74
160.74
150.45
135.38
132.72
132.25
130.57
129.20
77.48
77.16 CDCl3
76.84
51.85
39.08
30.12
28.47
22.84

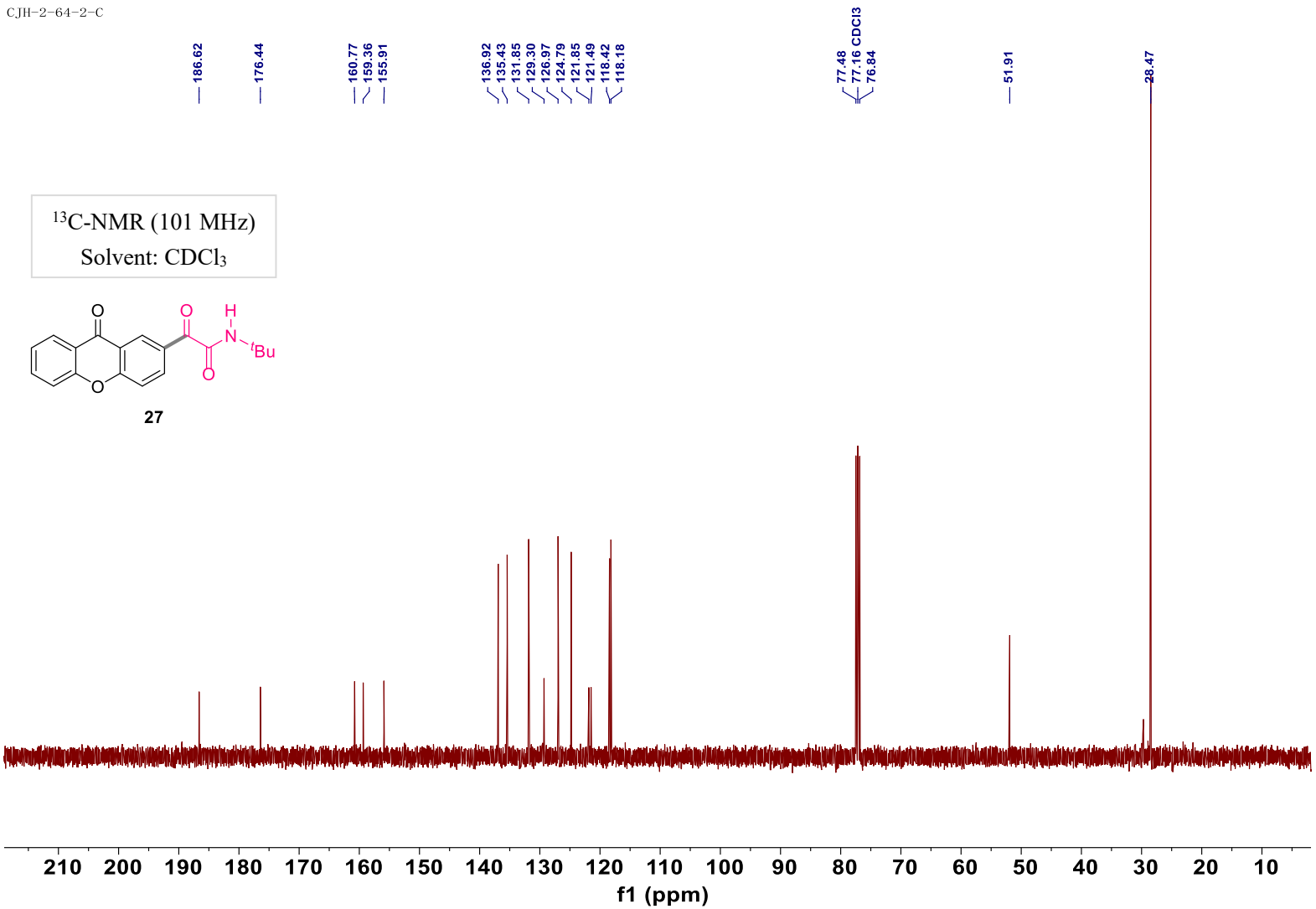
^{13}C-NMR (101 MHz)
Solvent: $CDCl_3$

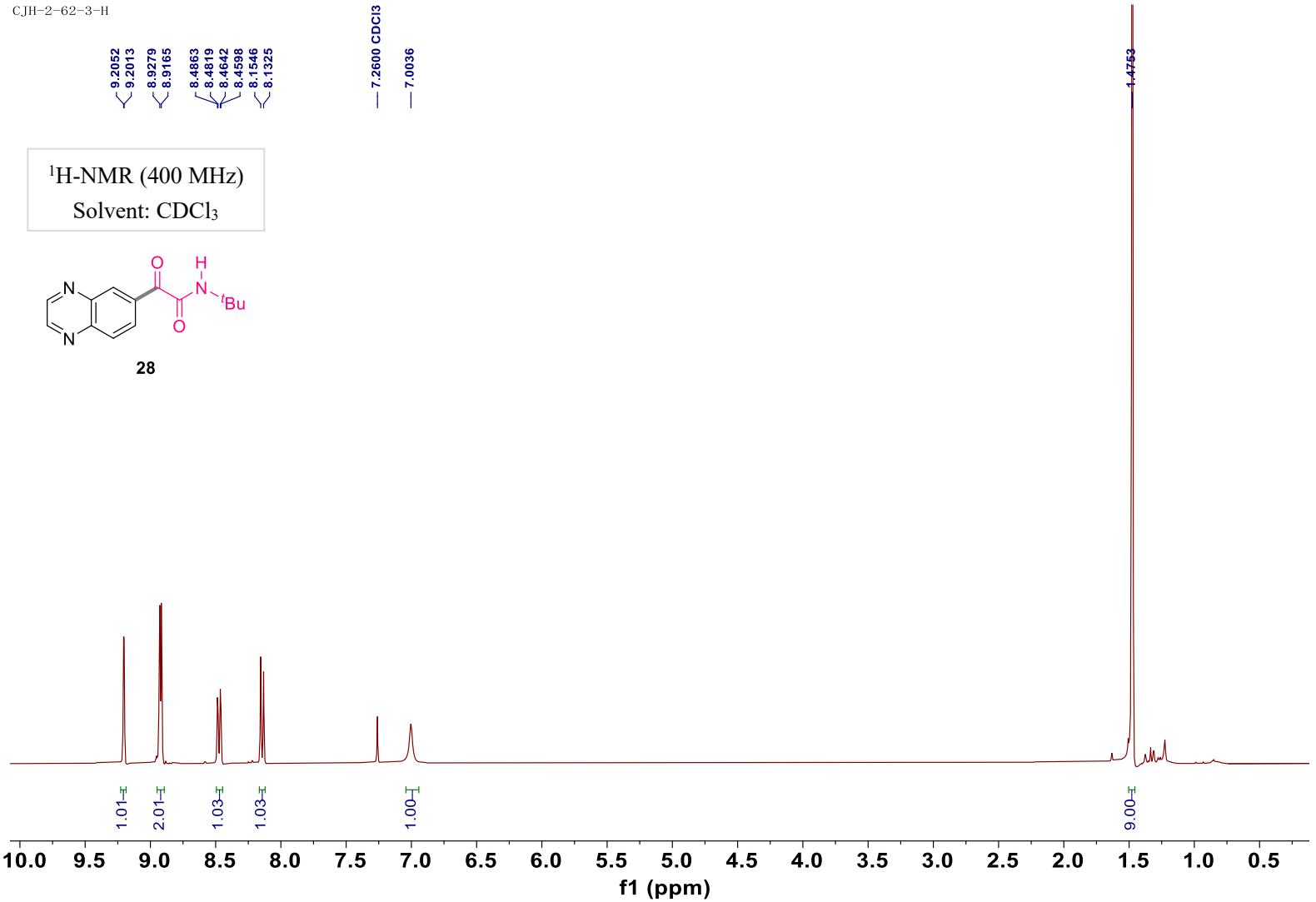


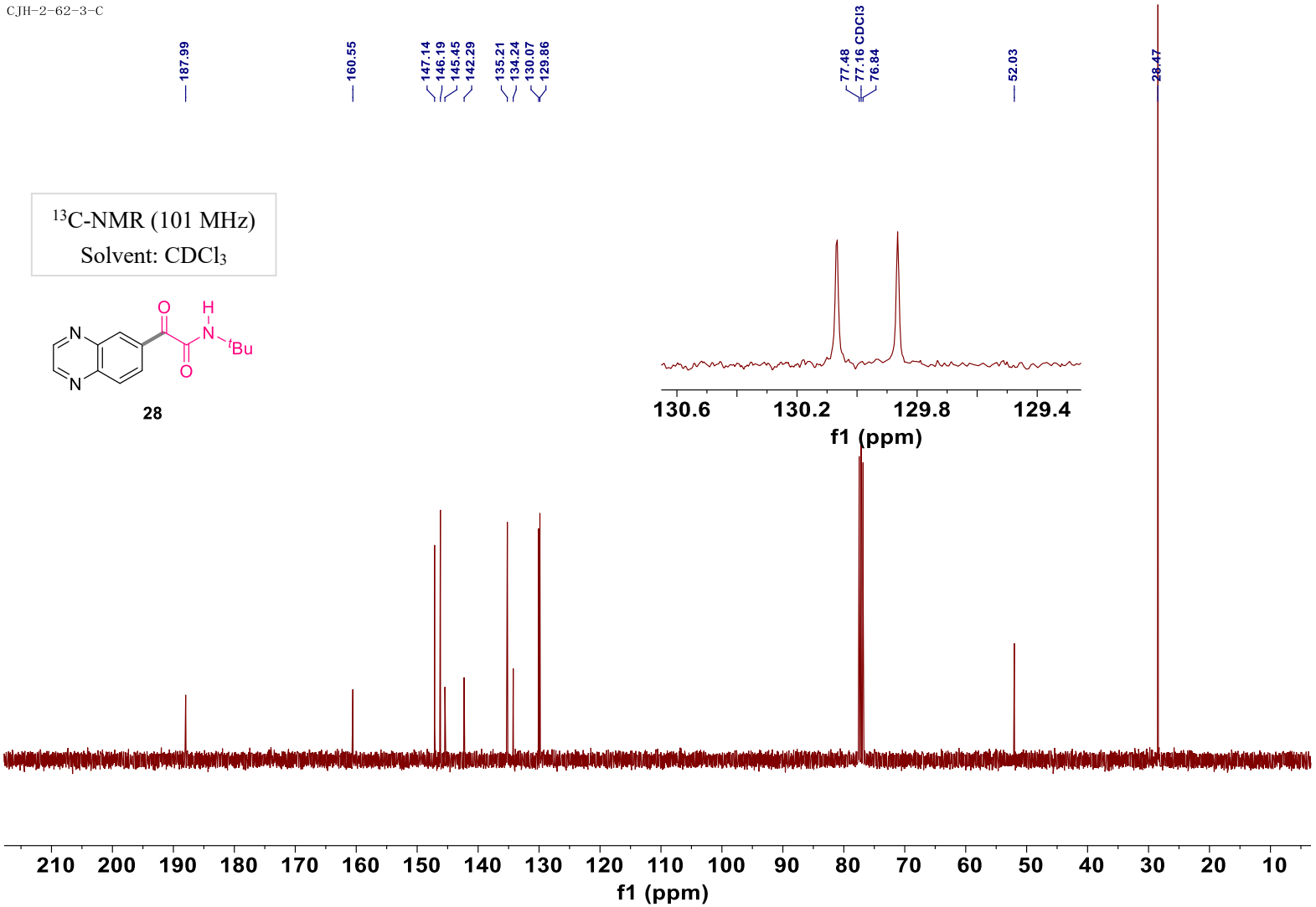
26

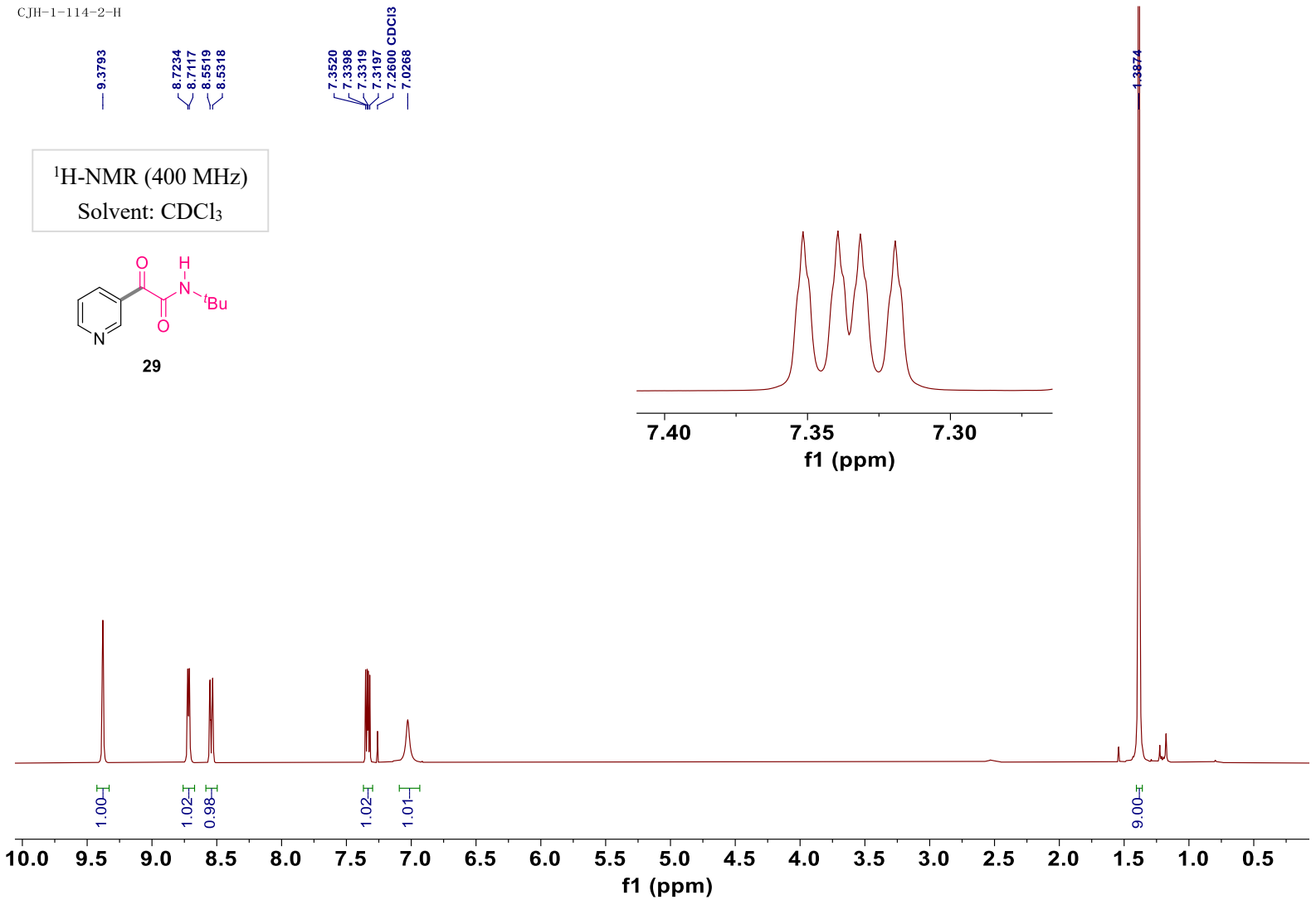


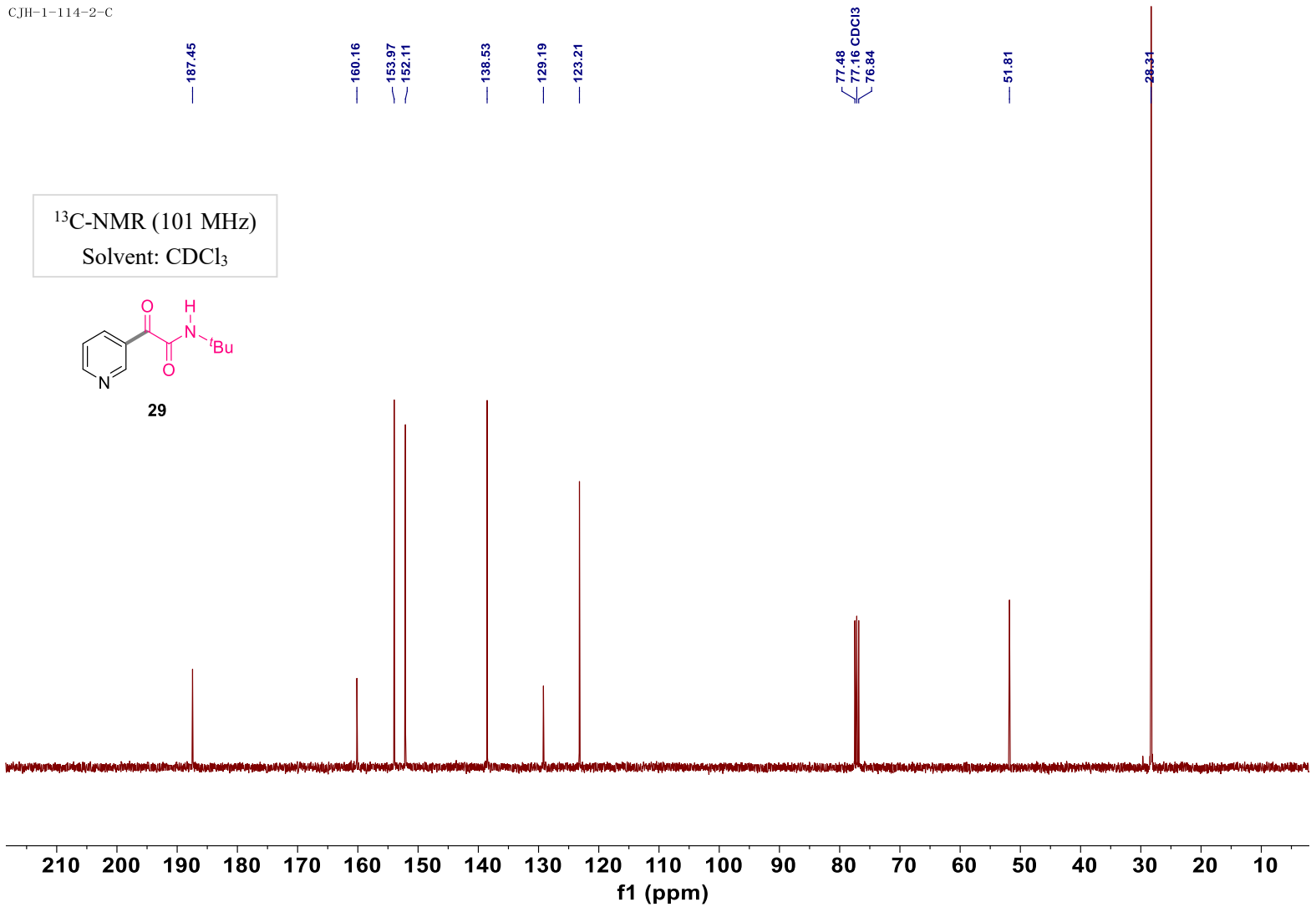

CJH-2-64-2-H
9.2722
9.2672
8.6849
8.6795
8.6628
8.6574
8.3178
8.3143
8.2980
8.2944
7.7502
7.7327
7.7153
7.5191
7.4968
7.4920
7.4908
7.4691
7.4133
7.3956
7.3779
7.2600 CDCl3
7.0384
1.4710
1H-NMR (400 MHz)
Solvent: CDCl3
O
O
H
N
tBu
O
O
27
7.54
7.52
7.50
7.48
7.46
7.44
f1 (ppm)
1.02
1.05
1.05
1.05
2.08
1.08
1.02
9.00
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
f1 (ppm)

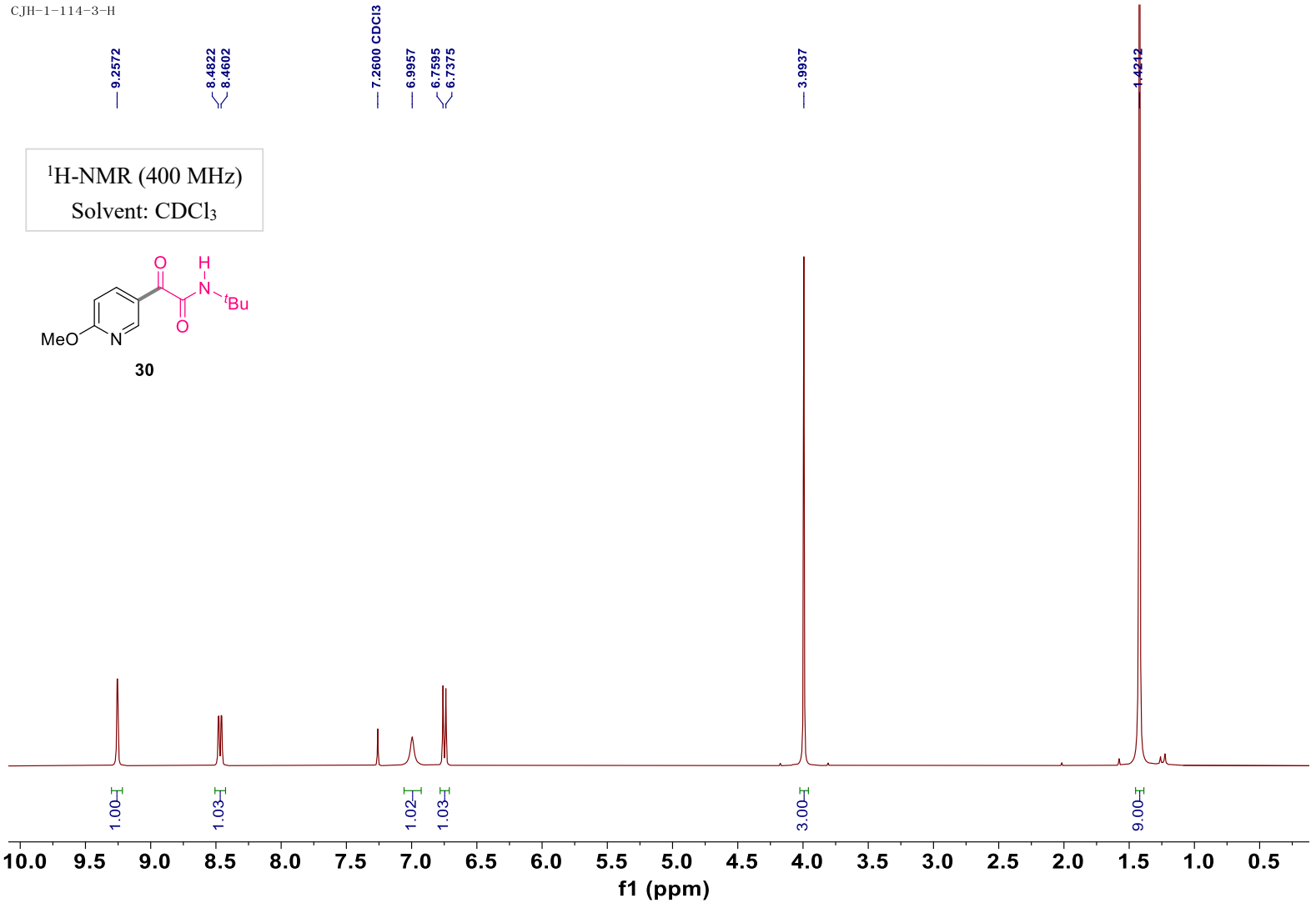

CJH-2-64-2-C
186.62
176.44
160.77
159.36
155.91
136.92
135.43
131.85
129.30
126.97
124.79
121.85
121.49
118.42
118.18
77.48
77.16 CDCl3
76.84
51.91
28.47
13C-NMR (101 MHz)
Solvent: CDCl3
O
O
H
N
tBu
O
O
27
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

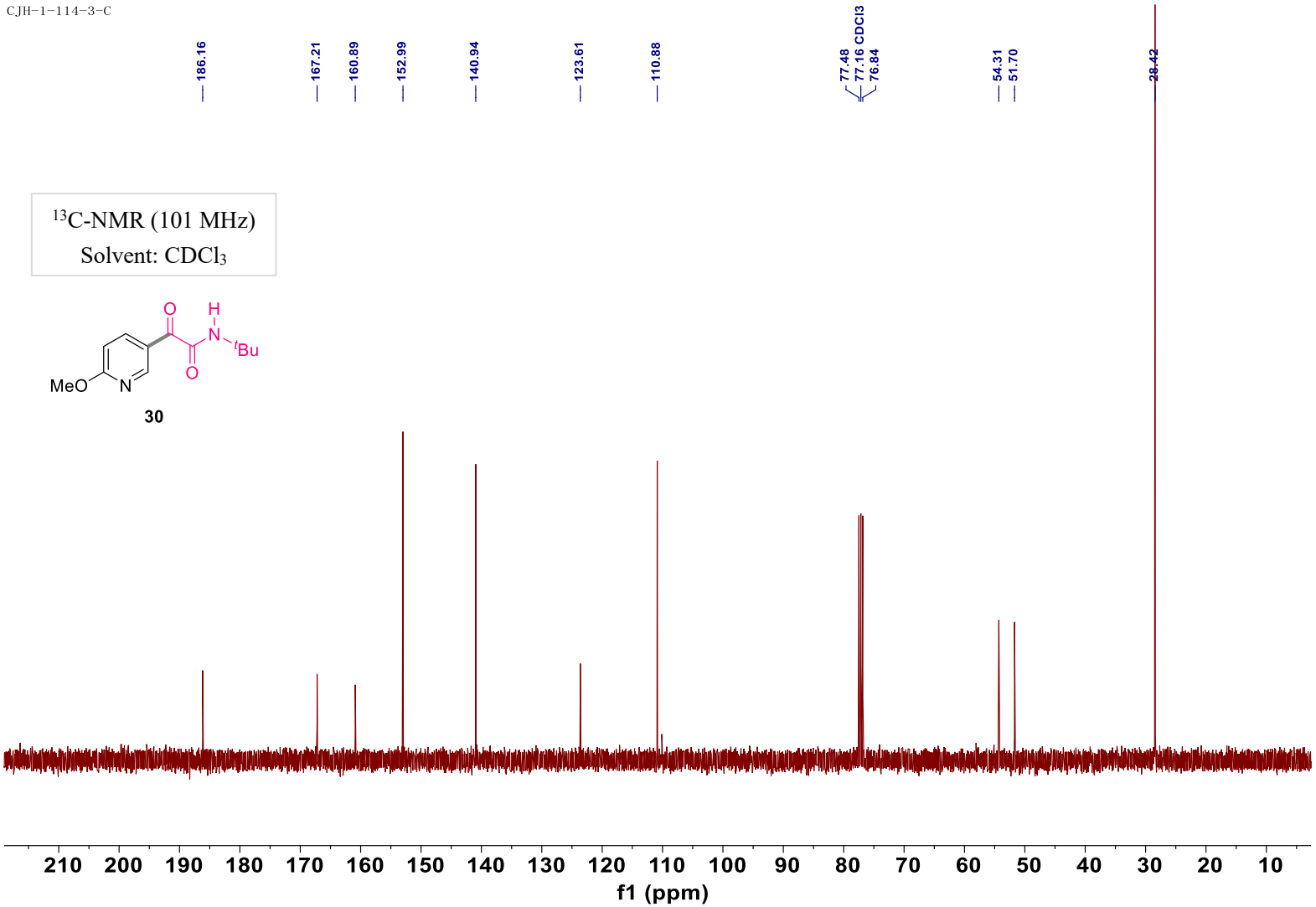

CJH-2-62-3-H
9.2052
9.2013
8.9279
8.9165
8.4863
8.4819
8.4642
8.4598
8.1546
8.1325
7.2600 CDCl3
7.0036
1.4753
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
N
N
O
28
1.01
2.01
1.03
1.03
1.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

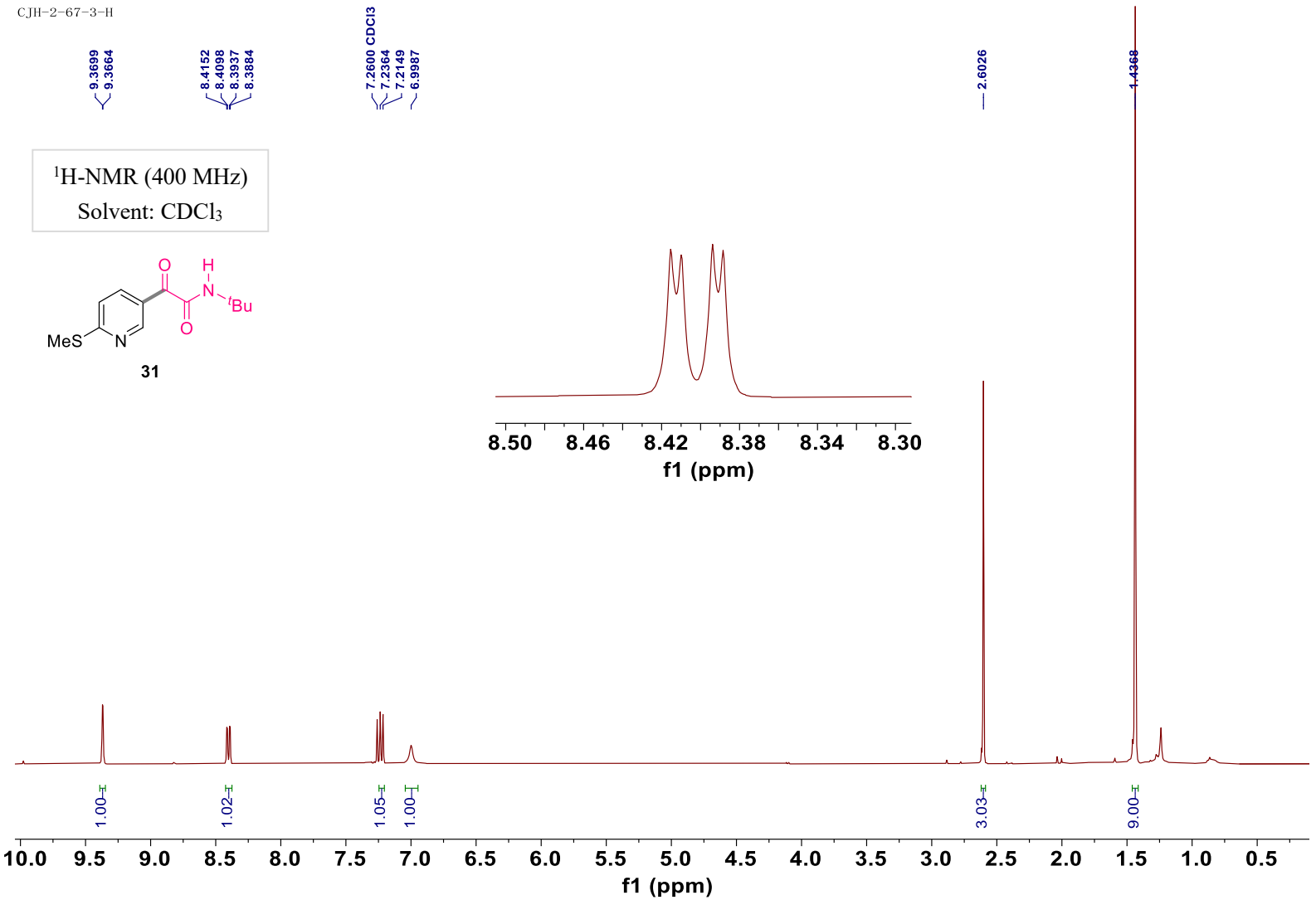

CJH-2-62-3-C
187.99
160.55
147.14
146.19
145.45
142.29
135.21
134.24
130.07
129.86
77.48
77.16 CDCl3
76.84
52.03
28.47
13C-NMR (101 MHz)
Solvent: CDCl3
28
130.6
130.2
129.8
129.4
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

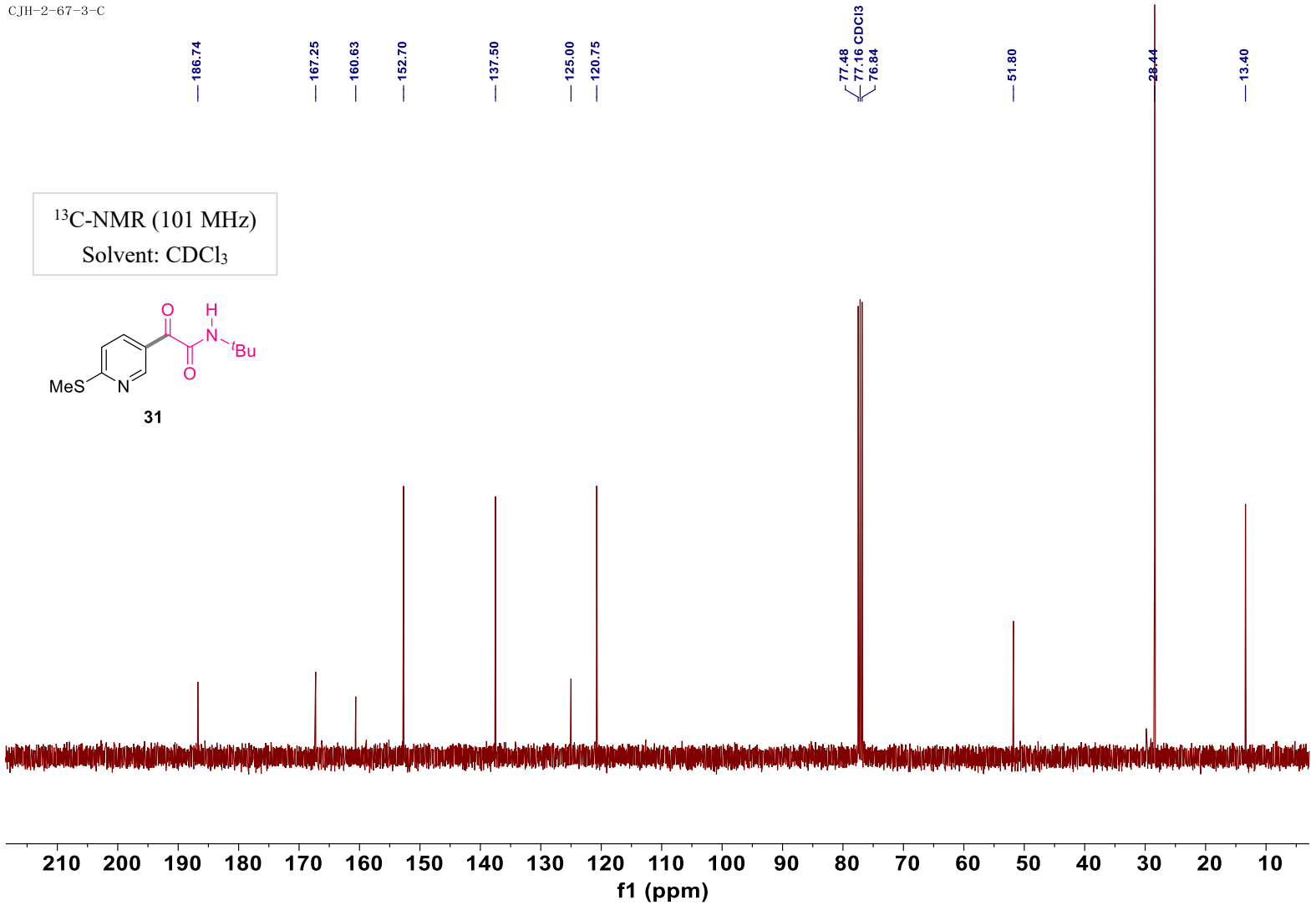

CJH-1-114-2-H
9.3793
8.7234
8.7117
8.5519
8.5318
7.3520
7.3398
7.3319
7.3197
7.2600 CDCl3
7.0268
1.3874
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
29
7.40
7.35
7.30
f1 (ppm)
1.00
1.02
0.98
1.02
1.01
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

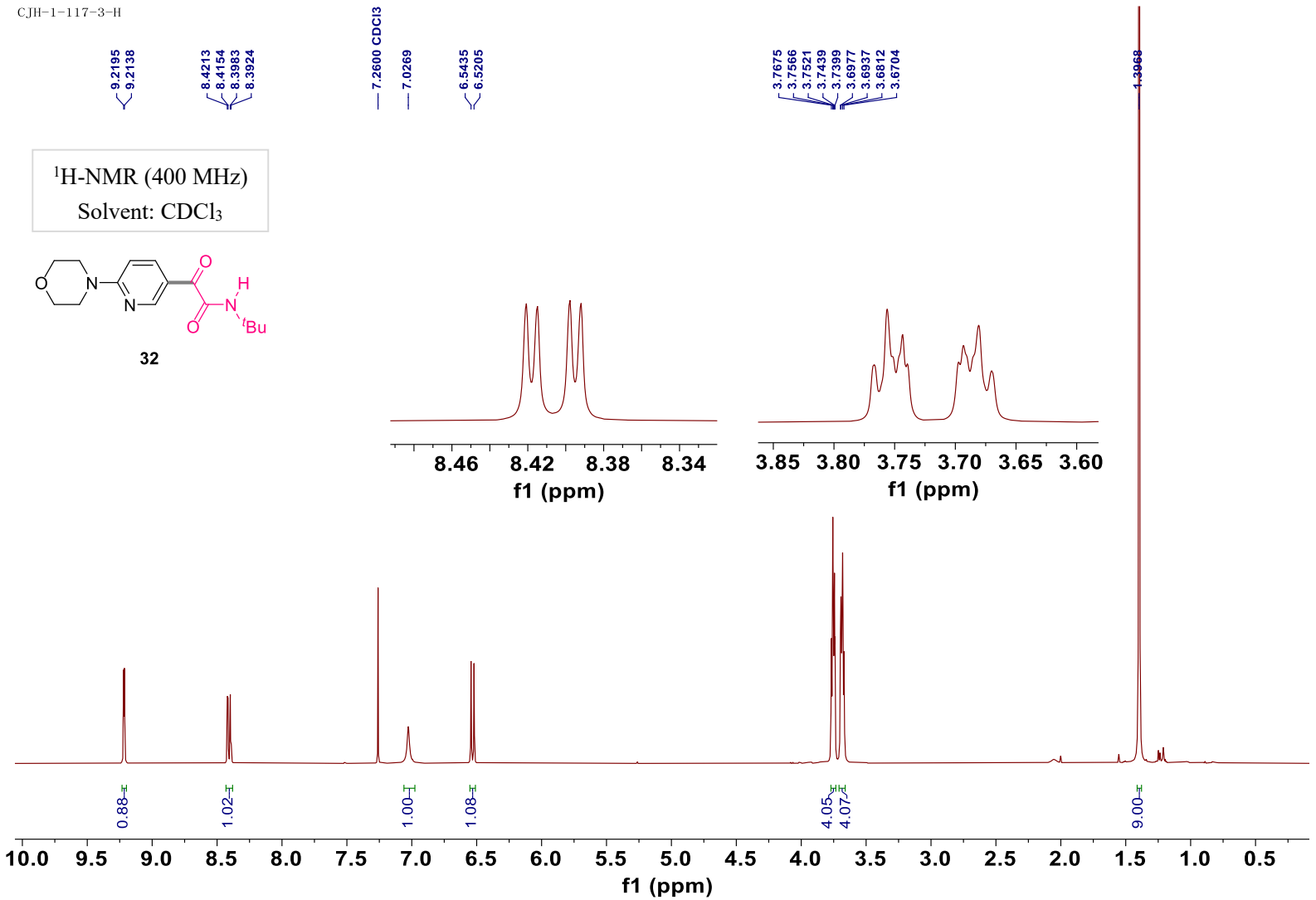

CJH-1-114-2-C
187.45
160.16
153.97
152.11
138.53
129.19
123.21
77.48
77.16 CDCl3
76.84
51.81
28.31
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
29
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

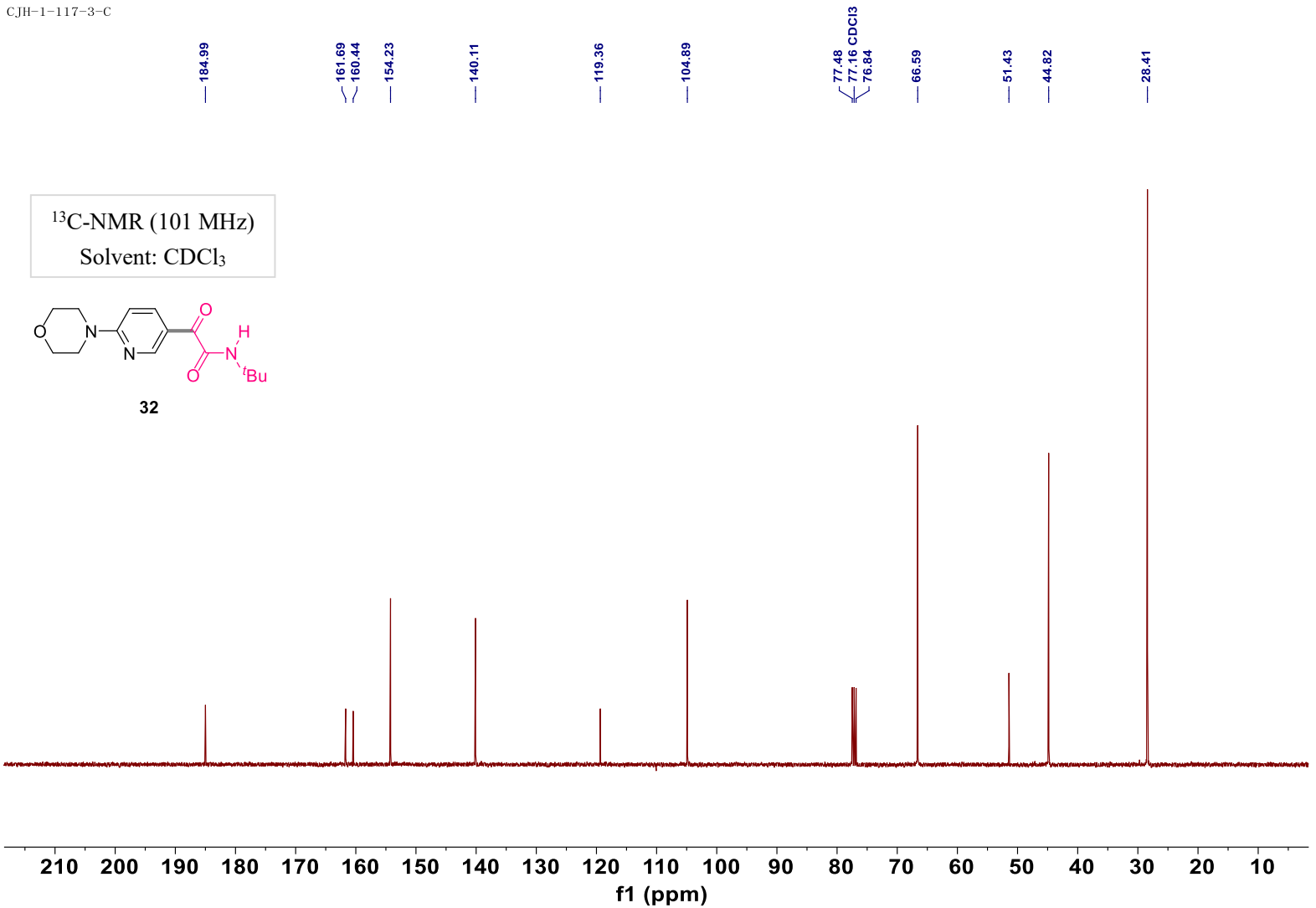

CJH-1-114-3-H
9.2572
8.4822
8.4602
7.2600 CDCl3
6.9957
6.7595
6.7375
3.9937
1.4212
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
MeO
N
30
1.00
1.03
1.02
1.03
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

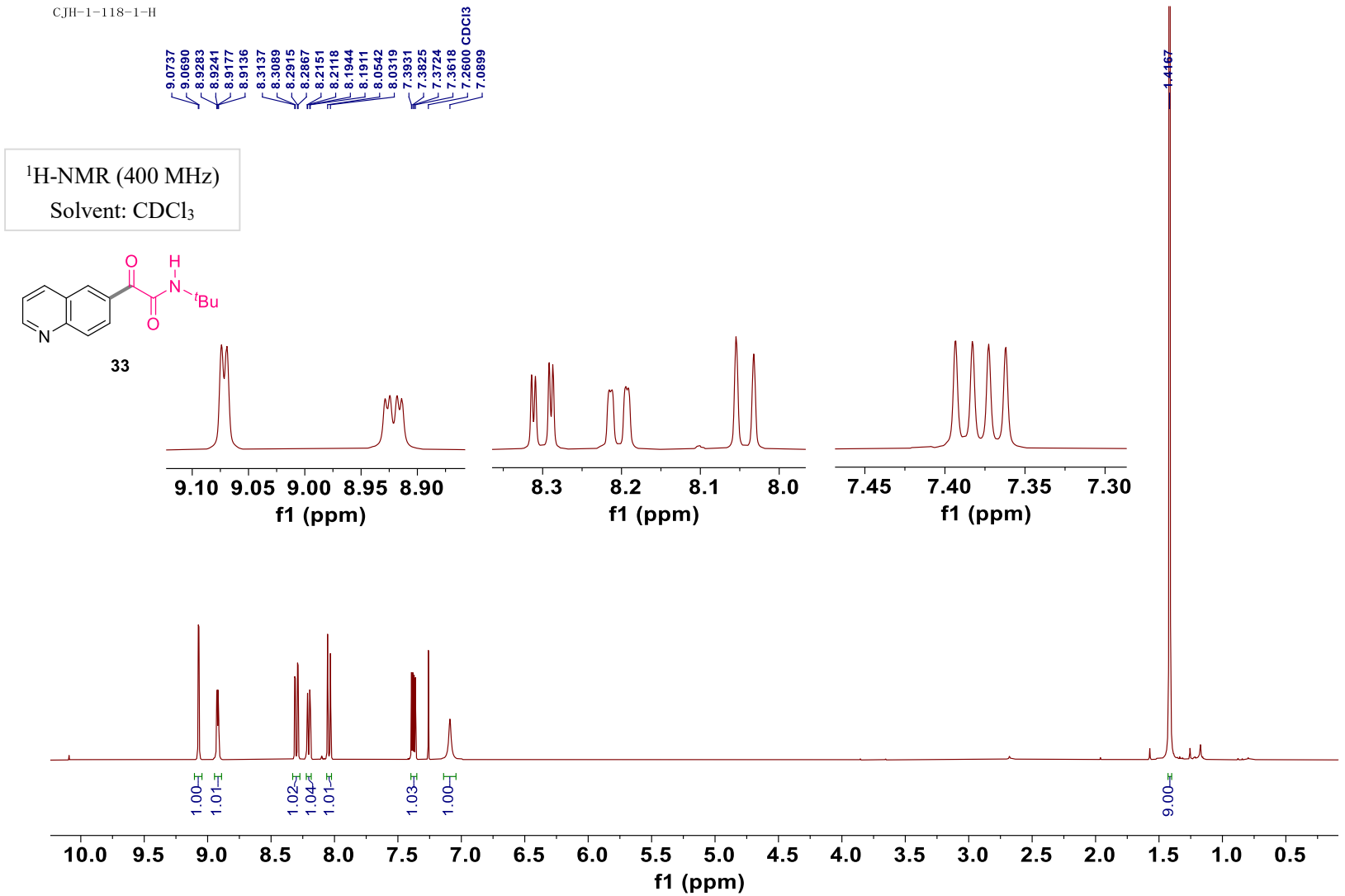

CJH-1-114-3-C
186.16
167.21
160.89
152.99
140.94
123.61
110.88
77.48
77.16 CDCl3
76.84
54.31
51.70
28.42
13C-NMR (101 MHz)
Solvent: CDCl3
MeO
N
O
H
N
tBu
O
30
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-2-67-3-H
9.3699
9.3664
8.4152
8.4098
8.3937
8.3884
7.2600 CDCl3
7.2364
7.2149
6.9987
2.6026
1.4368
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
MeS
N
31
8.50
8.46
8.42
8.38
8.34
8.30
f1 (ppm)
1.00
1.02
1.05
1.00
3.03
9.00
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
f1 (ppm)


CJH-2-67-3-C
186.74
167.25
160.63
152.70
137.50
125.00
120.75
77.48
77.16 CDCl3
76.84
51.80
28.44
13.40
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
MeS
N
31
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-1-117-3-H
9.2195
9.2138
8.4213
8.4154
8.3983
8.3924
7.2600 CDCl3
7.0269
6.5435
6.5205
3.7675
3.7566
3.7521
3.7439
3.7399
3.6977
3.6937
3.6812
3.6704
1.3968
1H-NMR (400 MHz)
Solvent: CDCl3
O
N
N
O
H
N
tBu
32
8.46
8.42
8.38
8.34
f1 (ppm)
3.85
3.80
3.75
3.70
3.65
3.60
f1 (ppm)
0.88
1.02
1.00
1.08
4.05
4.07
9.00
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
f1 (ppm)

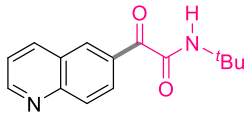

CJH-1-117-3-C
184.99
161.69
160.44
154.23
140.11
119.36
104.89
77.48
77.16 CDCl3
76.84
66.59
51.43
44.82
28.41
13C-NMR (101 MHz)
Solvent: CDCl3
O
N
N
O
N
H
tBu
32
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-1-118-1-H
9.0737
9.0690
8.9283
8.9241
8.9177
8.9136
8.3137
8.3089
8.2915
8.2867
8.2151
8.2118
8.1944
8.1911
8.0542
8.0319
7.3931
7.3825
7.3724
7.3618
7.2600 CDCl3
7.0899
1.4467
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
33
9.10 9.05 9.00 8.95 8.90
f1 (ppm)
8.3 8.2 8.1 8.0
f1 (ppm)
7.45 7.40 7.35 7.30
f1 (ppm)
1.00
1.01
1.02
1.04
1.01
1.03
1.00
9.00
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
f1 (ppm)

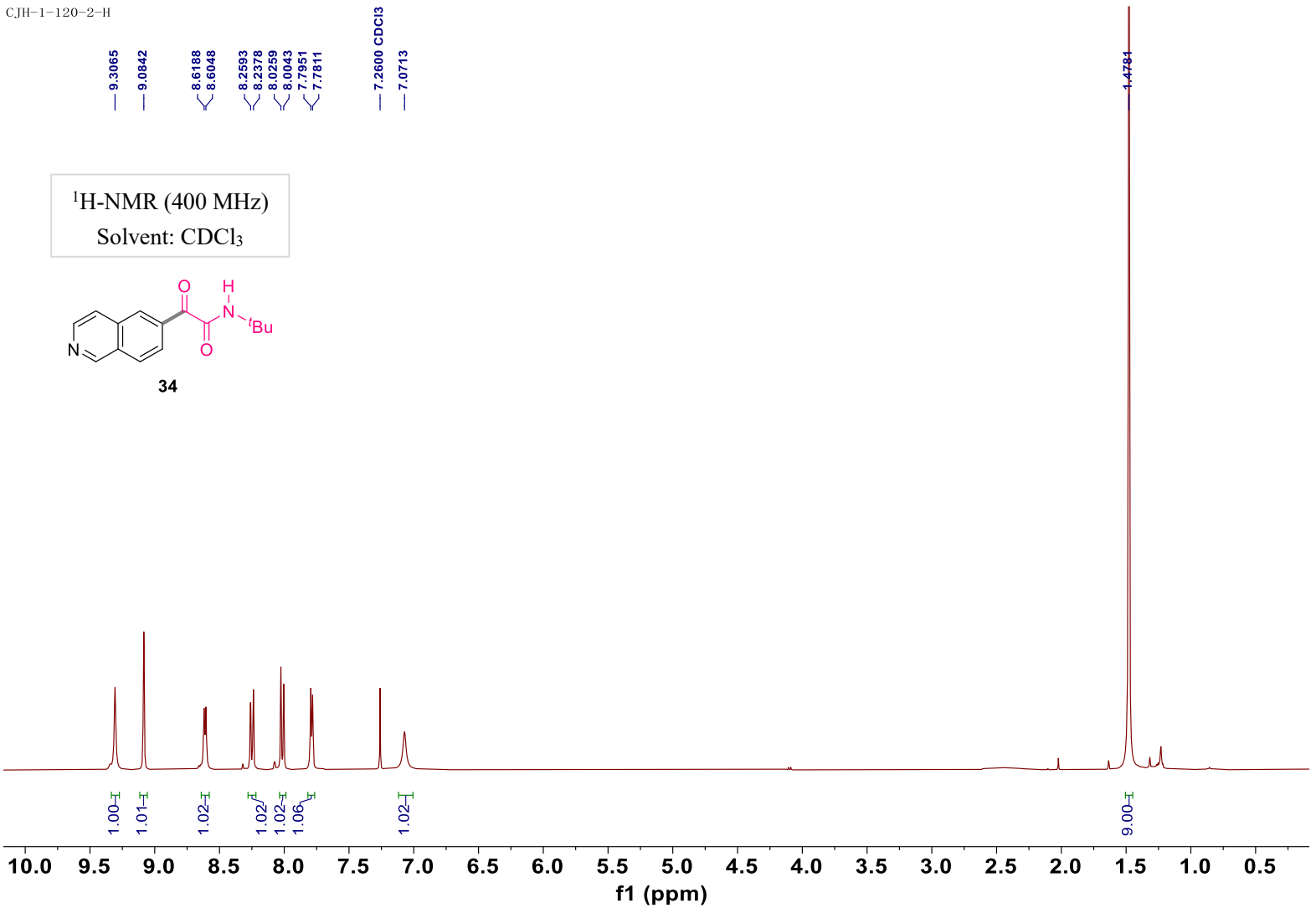
CJH-1-118-1-C

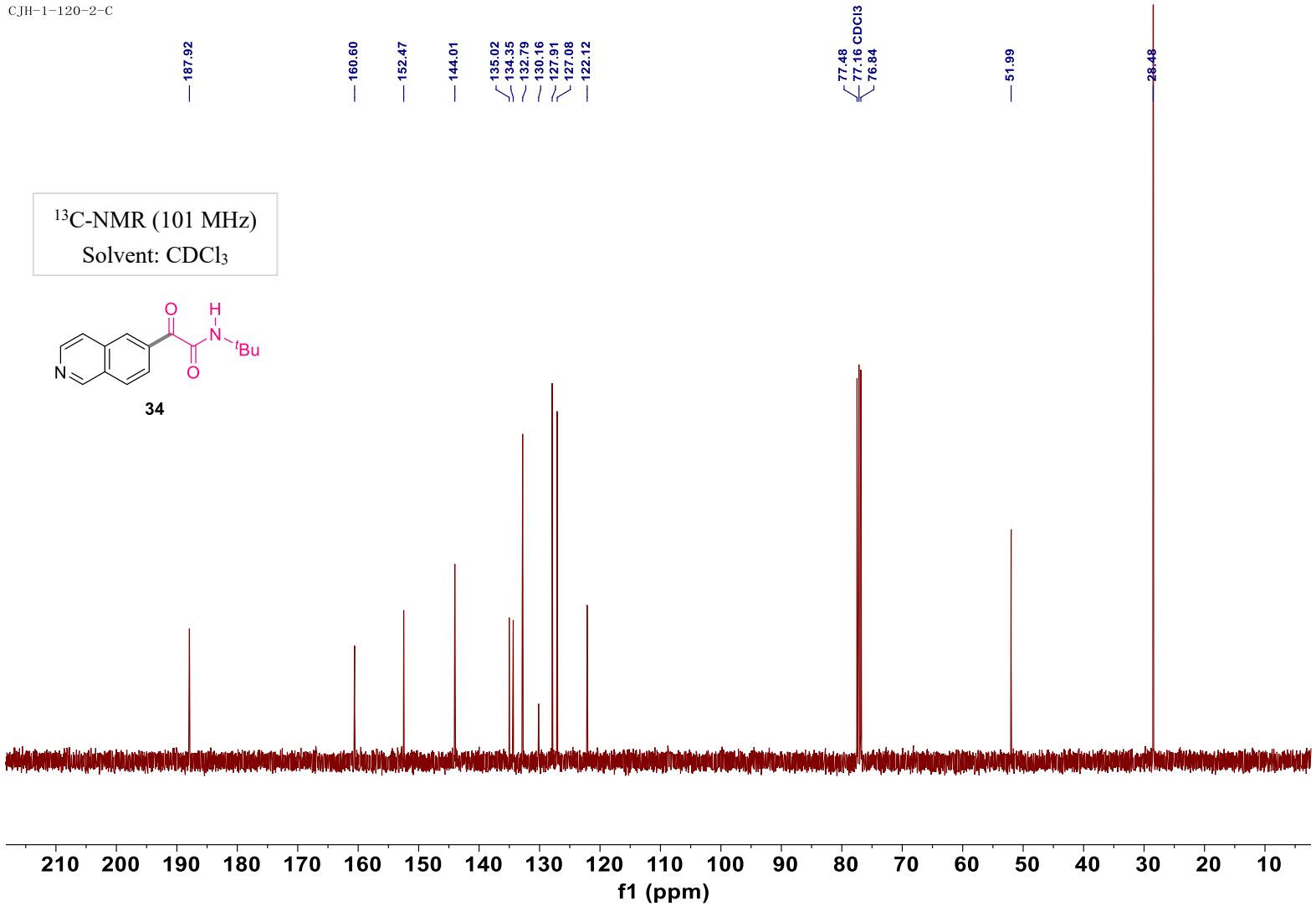
187.35
160.95
153.10
150.34
138.08
134.57
131.00
129.75
129.19
127.21
121.93
77.48
77.16 CDCl3
76.84
51.77
28.38

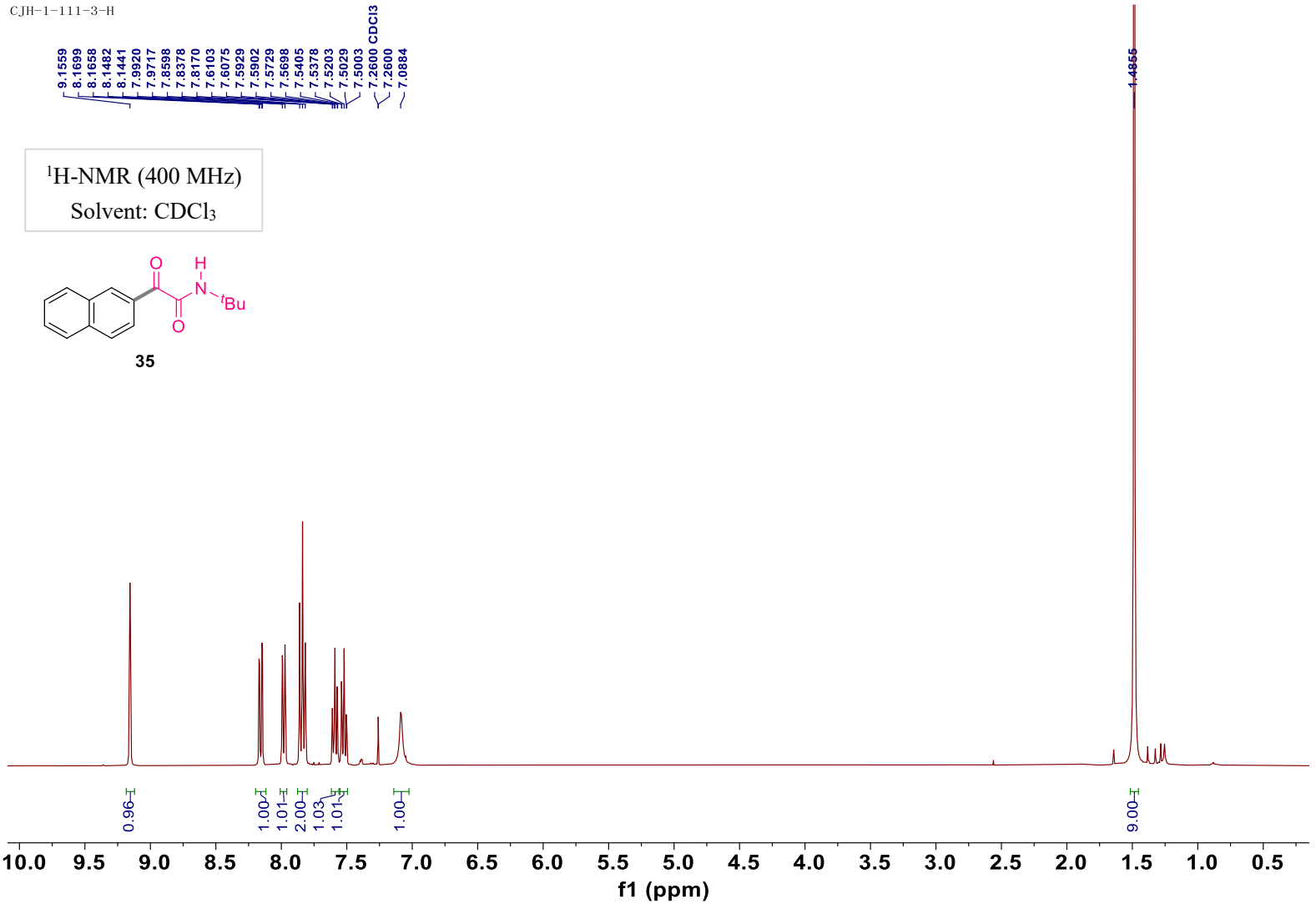
^{13}C-NMR (101 MHz)
Solvent: $CDCl_3$

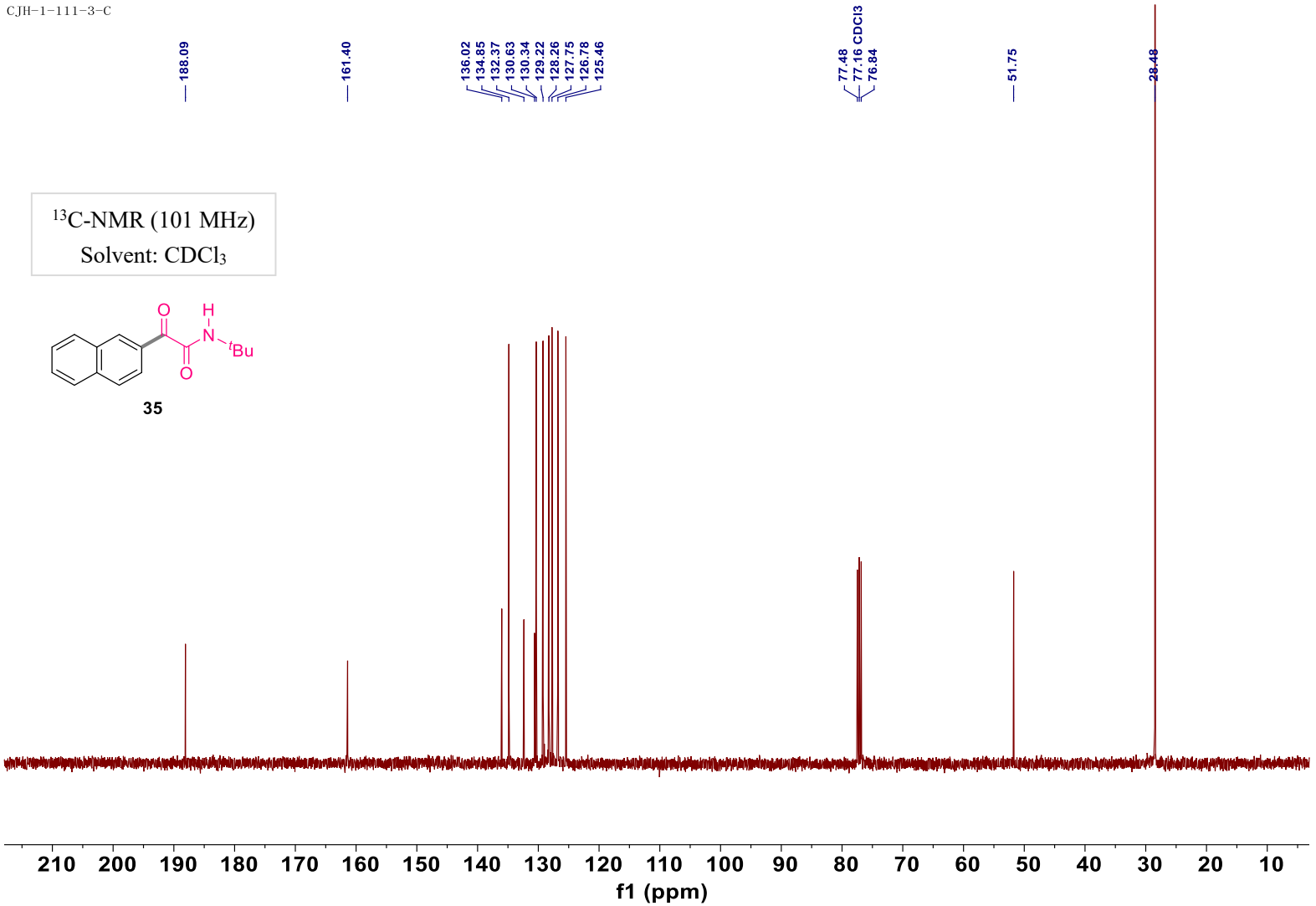


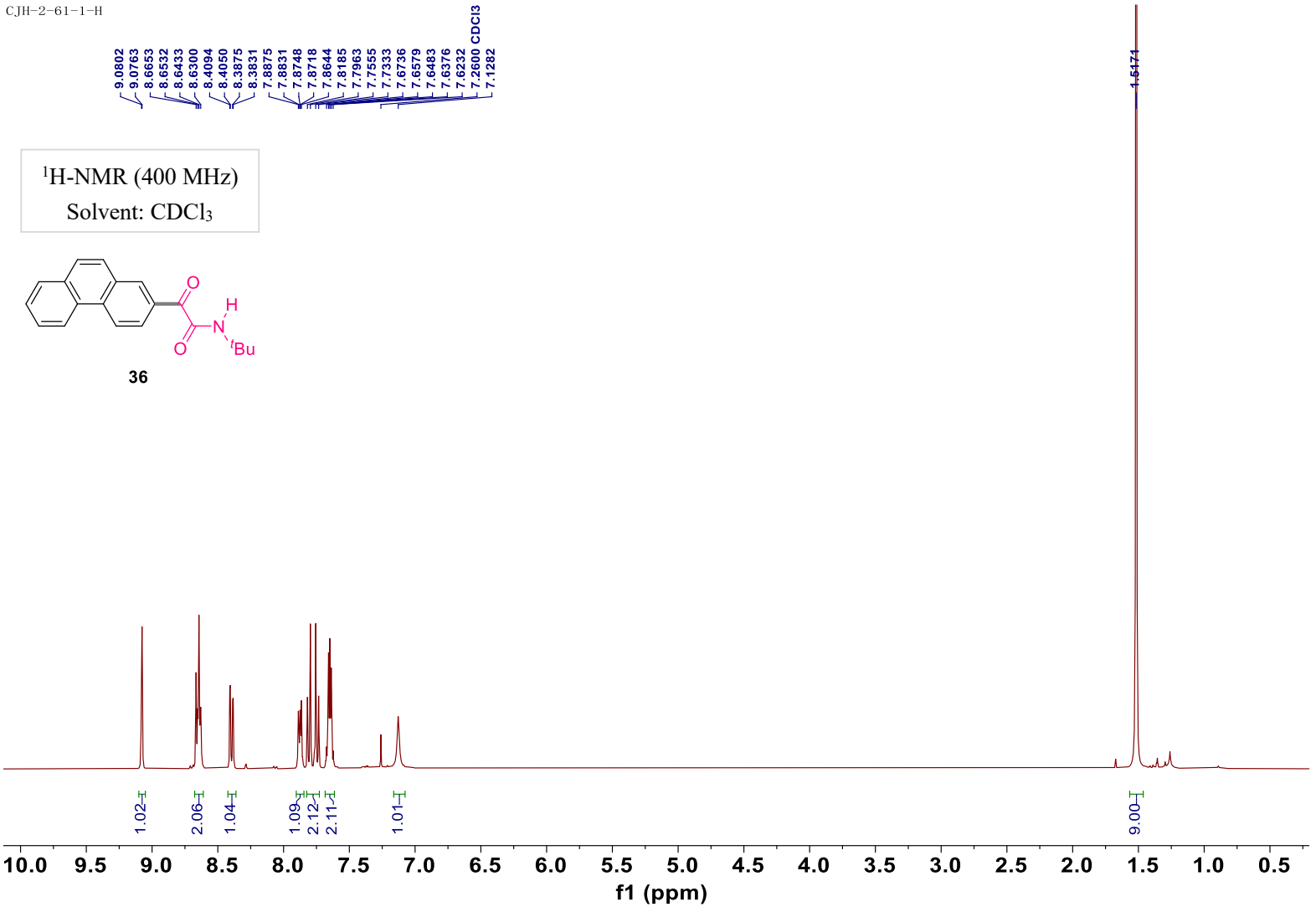
33

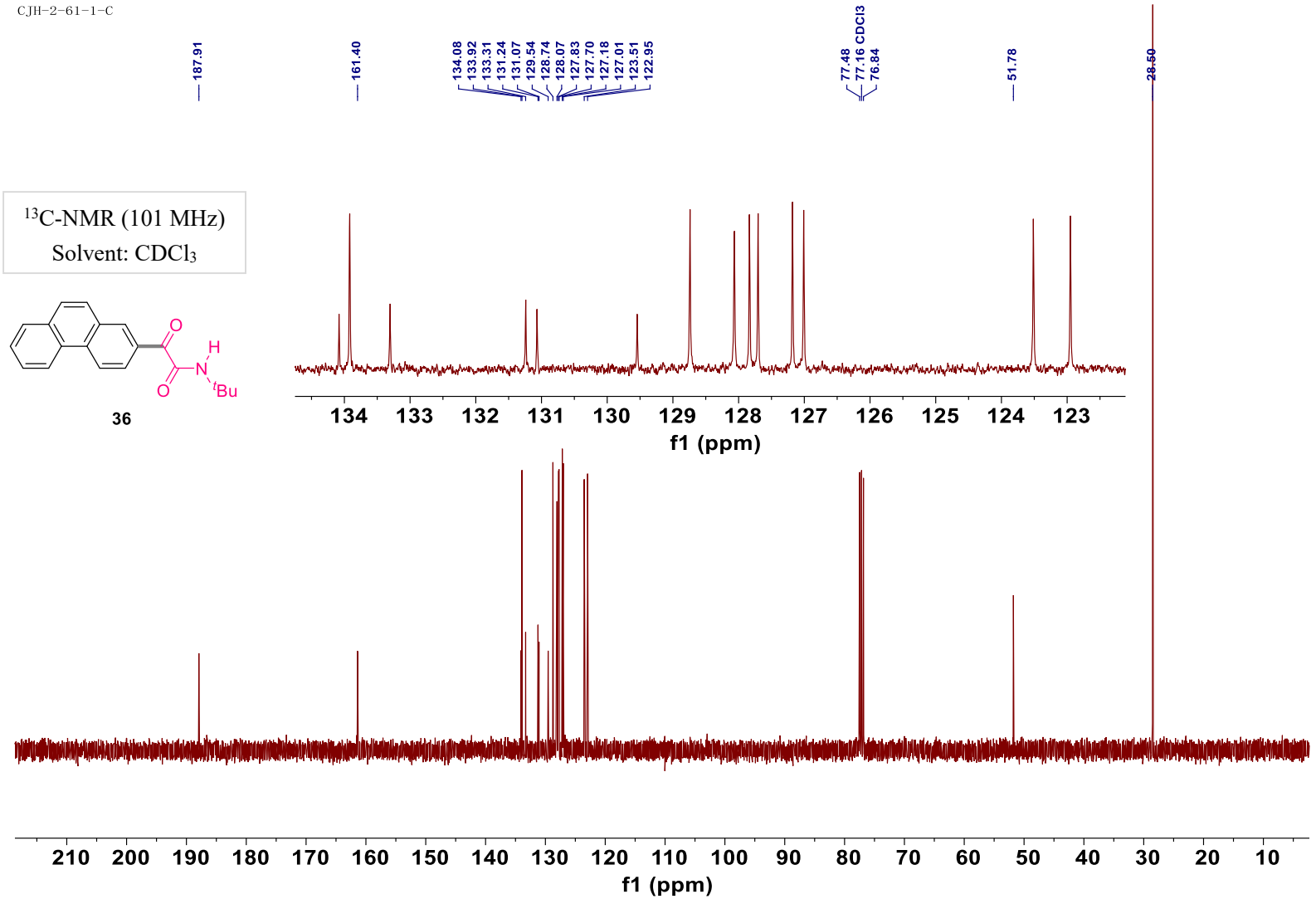

CJH-1-120-2-H
9.3065
9.0842
8.6188
8.6048
8.2593
8.2378
8.0259
8.0043
7.7951
7.7811
7.2600 CDCl3
7.0713
1.4781
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
34
1.00
1.01
1.02
1.02
1.02
1.06
1.02
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

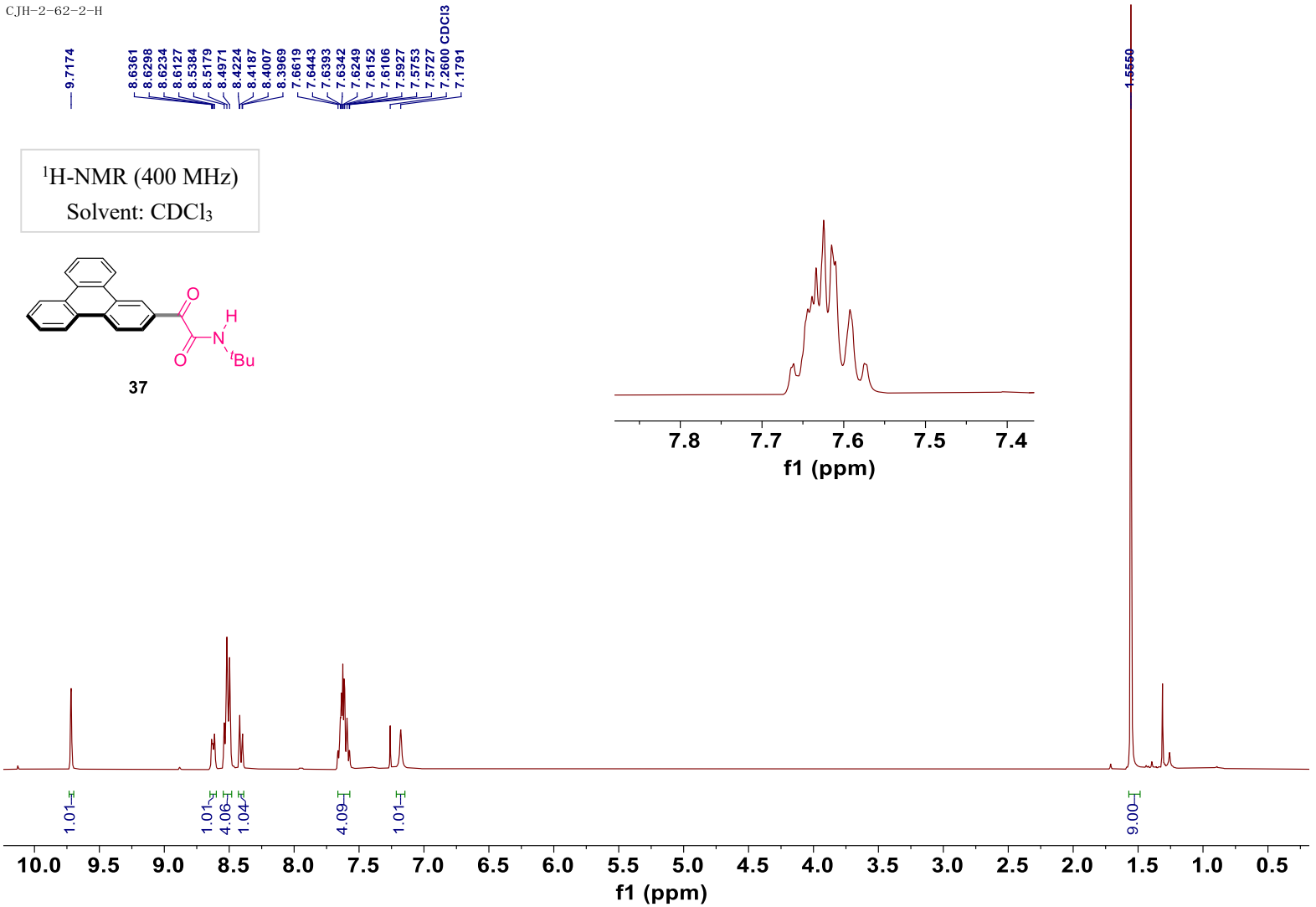

CJH-1-120-2-C
187.92
160.60
152.47
144.01
135.02
134.35
132.79
130.16
127.91
127.08
122.12
77.48
77.16 CDCl3
76.84
51.99
28.48
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
34
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

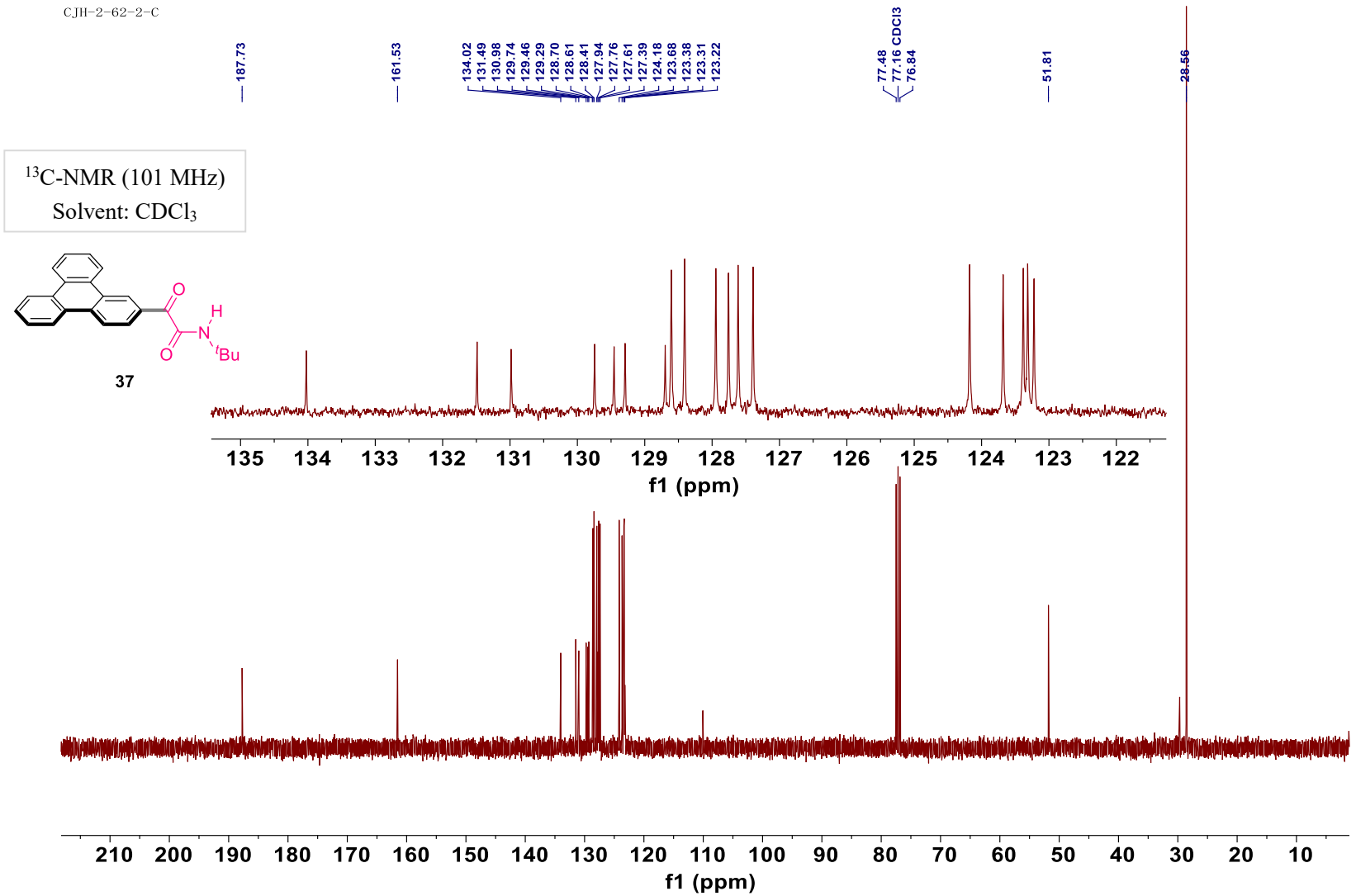

CJH-1-111-3-H
9.1559
8.1699
8.1658
8.1482
8.1441
7.9920
7.9717
7.8598
7.8378
7.8170
7.6103
7.6075
7.5929
7.5902
7.5729
7.5698
7.5405
7.5378
7.5203
7.5029
7.5003
7.2600 CDCl3
7.2600
7.0884
1.4855
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
35
0.96
1.00
1.01
2.00
1.03
1.01
1.00
9.00
10.0 9.5 9.0 8.5 8.0 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
f1 (ppm)

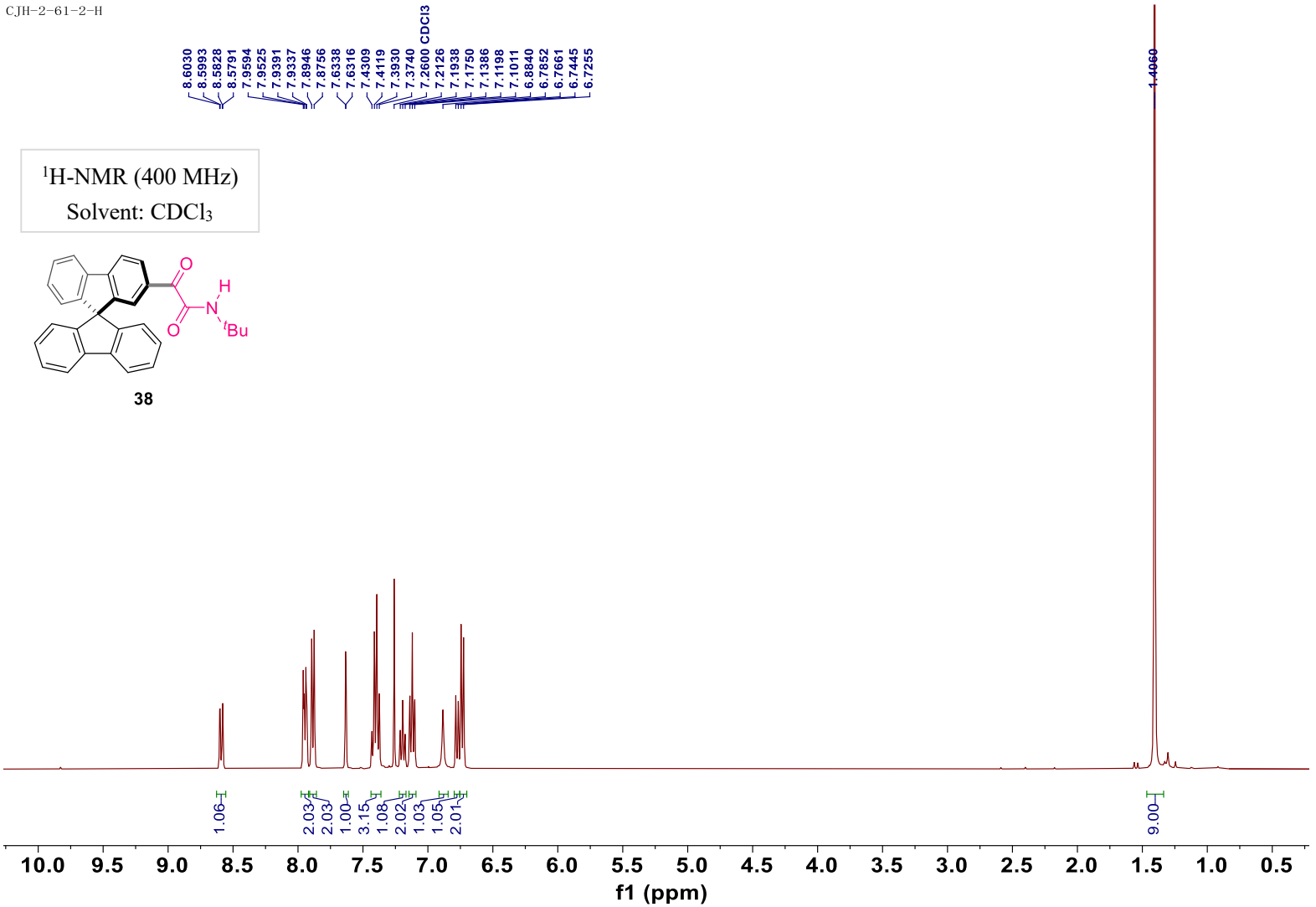

CJH-1-111-3-C
188.09
161.40
136.02
134.85
132.37
130.63
130.34
129.22
128.26
127.75
126.78
125.46
77.48
77.16 CDCl3
76.84
51.75
28.48
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
35
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

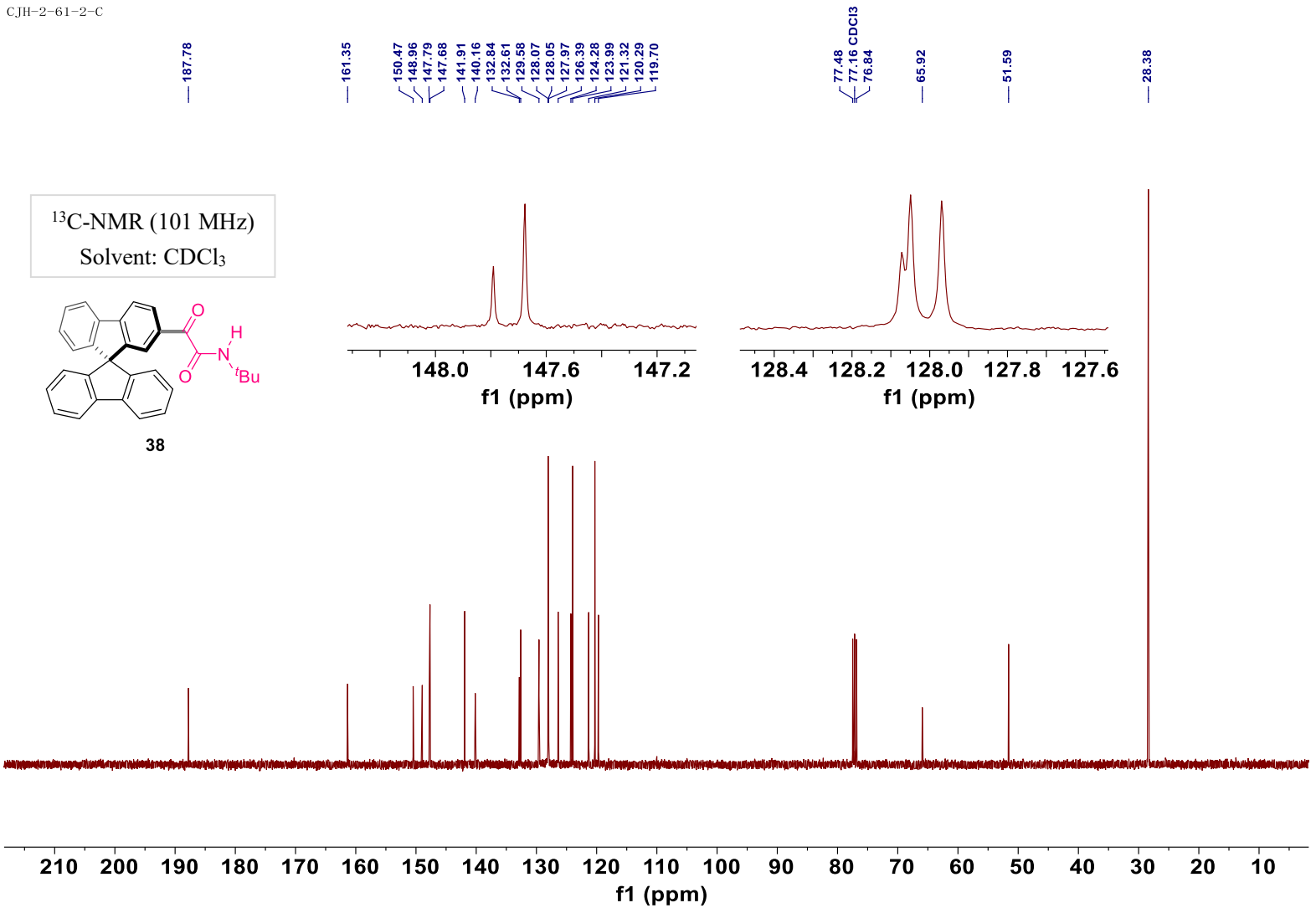

CJH-2-61-1-H
9.0802
9.0763
8.6653
8.6532
8.6433
8.6300
8.4094
8.4050
8.3875
8.3831
7.8875
7.8831
7.8748
7.8718
7.8644
7.8185
7.7963
7.7555
7.7333
7.6736
7.6579
7.6483
7.6376
7.6232
7.2600 CDCl3
7.1282
1.5171
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
O
tBu
36
1.02
2.06
1.04
1.09
2.12
2.11
1.01
9.00
10.0 9.5 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
f1 (ppm)


CJH-2-61-1-C
187.91
161.40
134.08
133.92
133.31
131.24
131.07
129.54
128.74
128.07
127.83
127.70
127.18
127.01
123.51
122.95
77.48
77.16 CDCl3
76.84
51.78
28.50
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
36
134 133 132 131 130 129 128 127 126 125 124 123
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

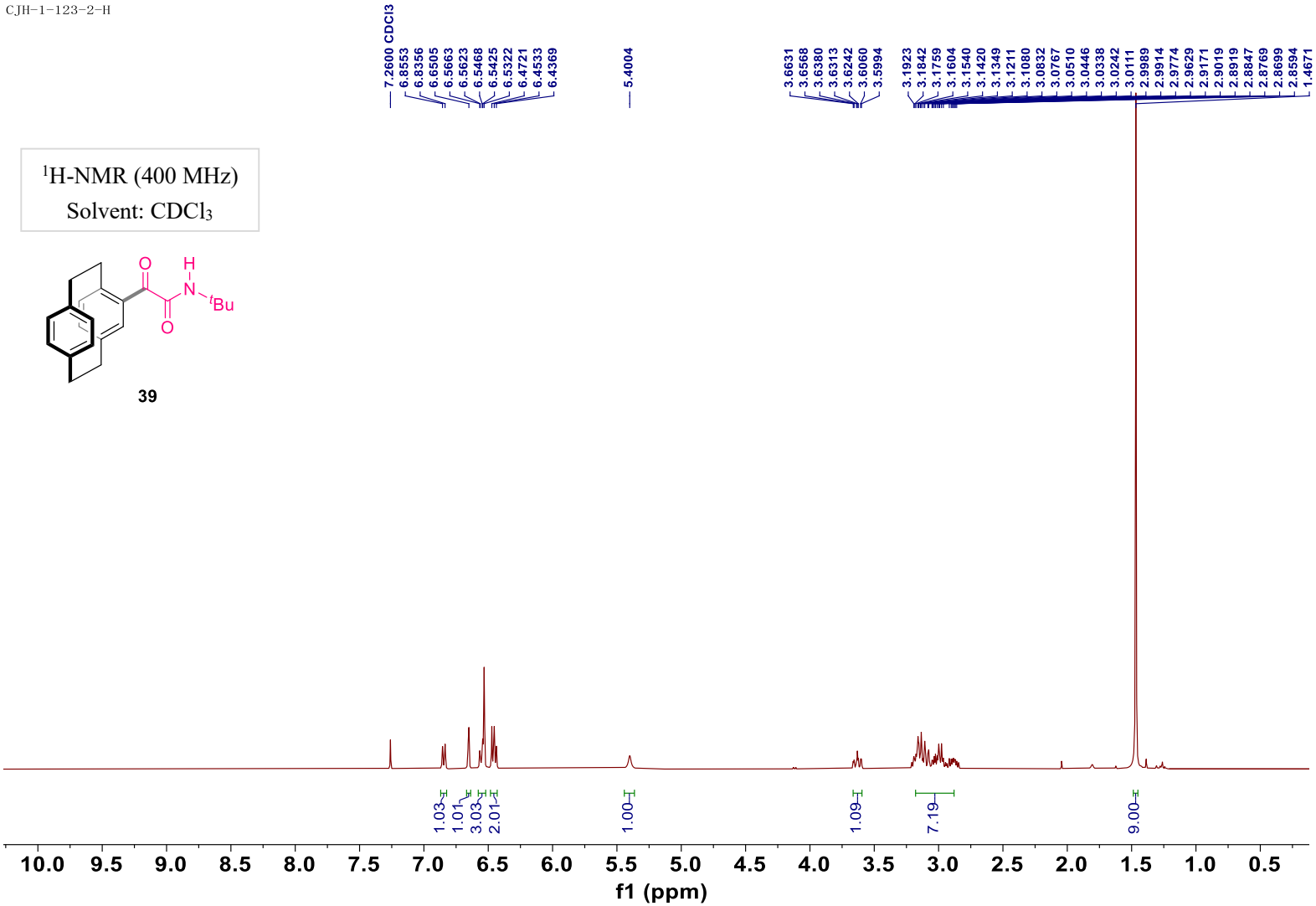

CJH-2-62-2-H
9.7174
8.6361
8.6298
8.6234
8.6127
8.5384
8.5179
8.4971
8.4224
8.4187
8.4007
8.3969
7.6619
7.6443
7.6393
7.6342
7.6249
7.6152
7.6106
7.5927
7.5753
7.5727
7.2600 CDCl3
7.1791
1.5550
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
O
tBu
37
7.8
7.7
7.6
7.5
7.4
f1 (ppm)
1.01
1.01
4.06
1.04
4.09
1.01
9.00
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
f1 (ppm)


CJH-2-62-2-C
187.73
161.53
134.02
131.49
130.98
129.74
129.46
129.29
128.70
128.61
128.41
127.94
127.76
127.61
127.39
124.18
123.68
123.38
123.31
123.22
77.48
77.16 CDCl3
76.84
51.81
28.56
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
O
tBu
37
135 134 133 132 131 130 129 128 127 126 125 124 123 122
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-2-61-2-H
8.6030
8.5993
8.5828
8.5791
7.9594
7.9525
7.9391
7.9337
7.8946
7.8756
7.6338
7.6316
7.4309
7.4119
7.3930
7.3740
7.2600 CDCl3
7.2126
7.1938
7.1750
7.1386
7.1198
7.1011
6.8840
6.7852
6.7661
6.7445
6.7255
1.4060
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
O
tBu
38
1.06
2.03
2.03
1.00
3.15
1.08
2.02
1.03
1.05
2.01
9.00
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
f1 (ppm)

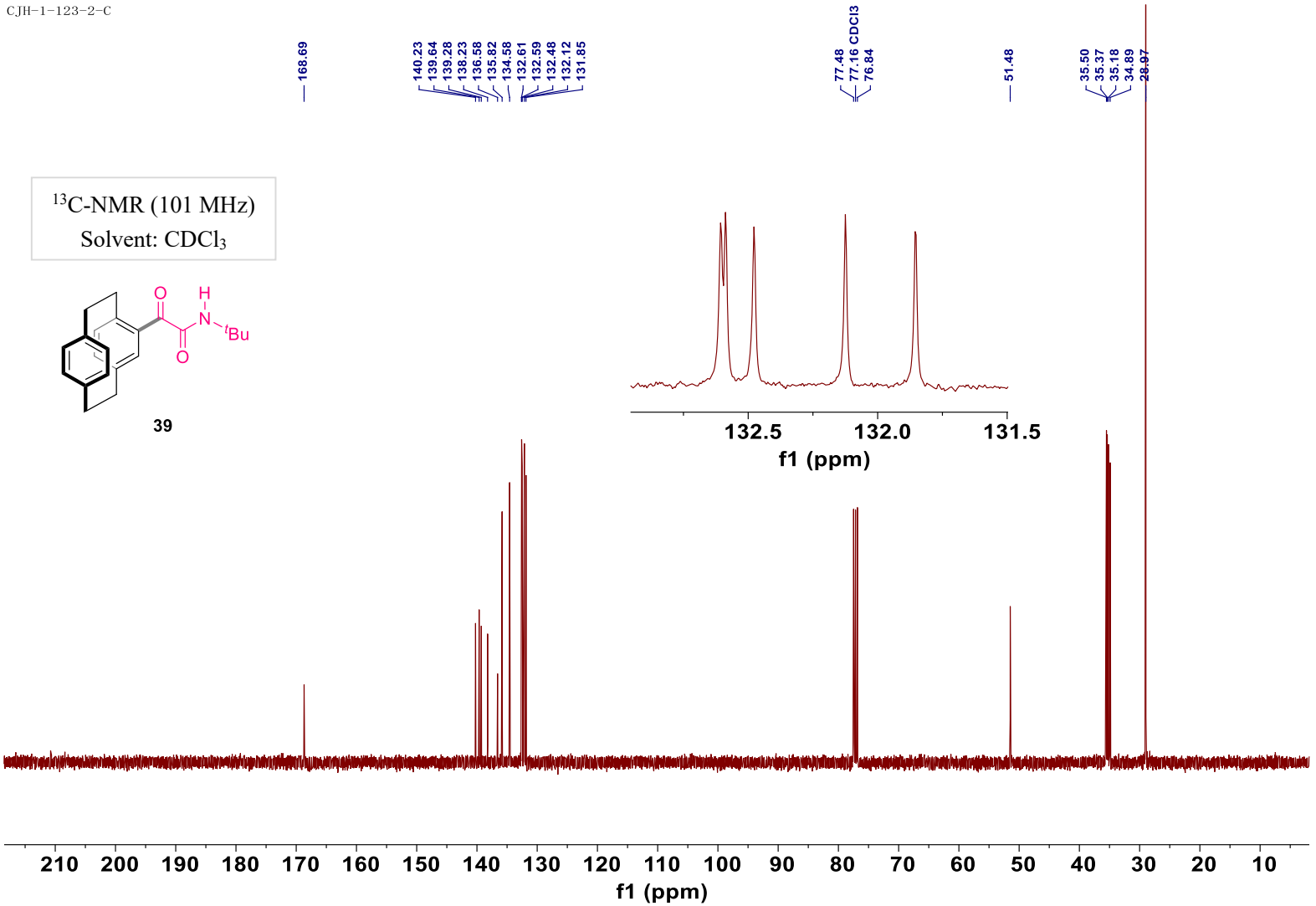

CJH-2-61-2-C
187.78
161.35
150.47
148.96
147.79
147.68
141.91
140.16
132.84
132.61
129.58
128.07
128.05
127.97
126.39
124.28
123.99
121.32
120.29
119.70
77.48
77.16 CDCl3
76.84
65.92
51.59
28.38
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
38
148.0
147.6
147.2
f1 (ppm)
128.4
128.2
128.0
127.8
127.6
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

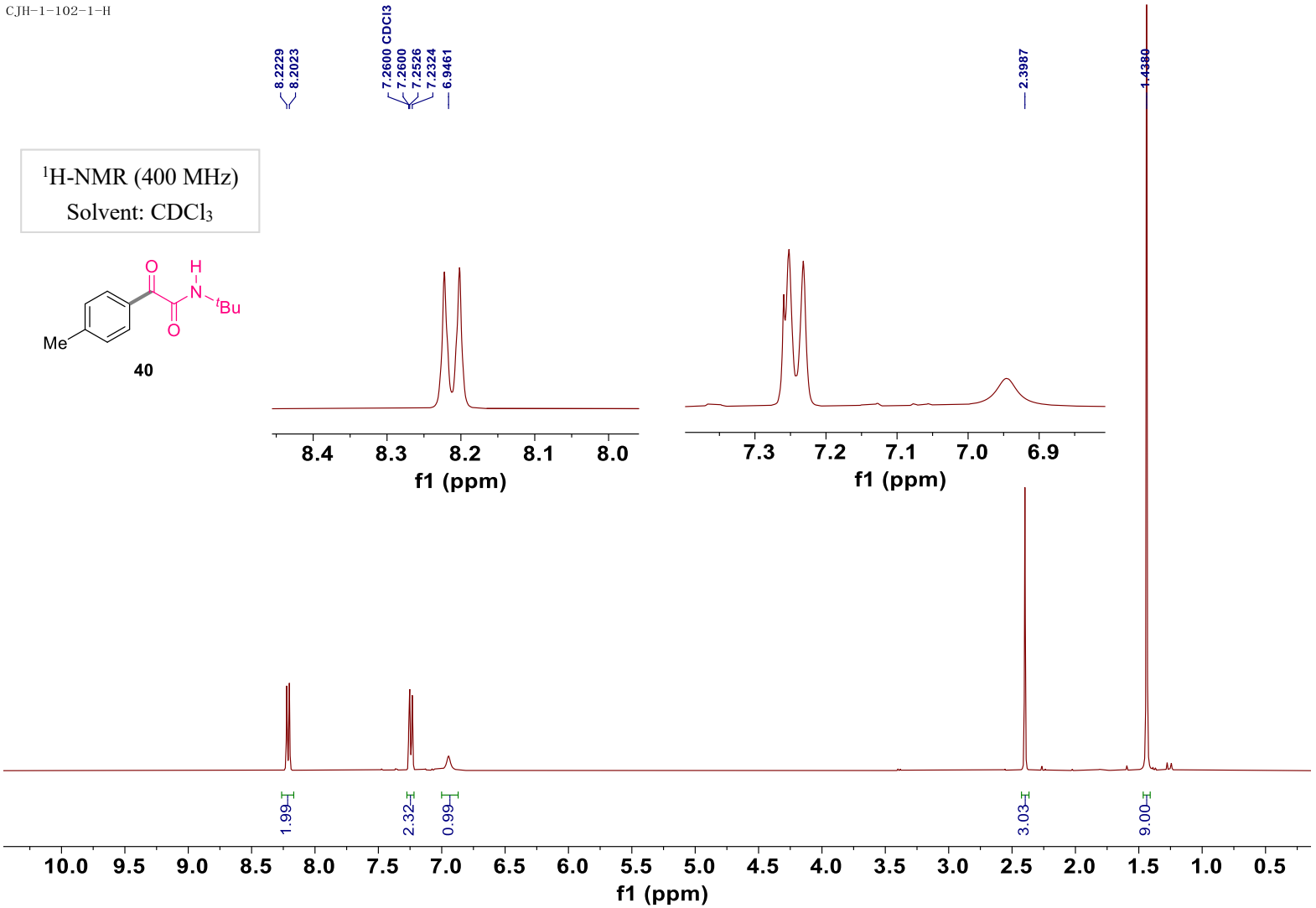
CJH-1-123-2-H

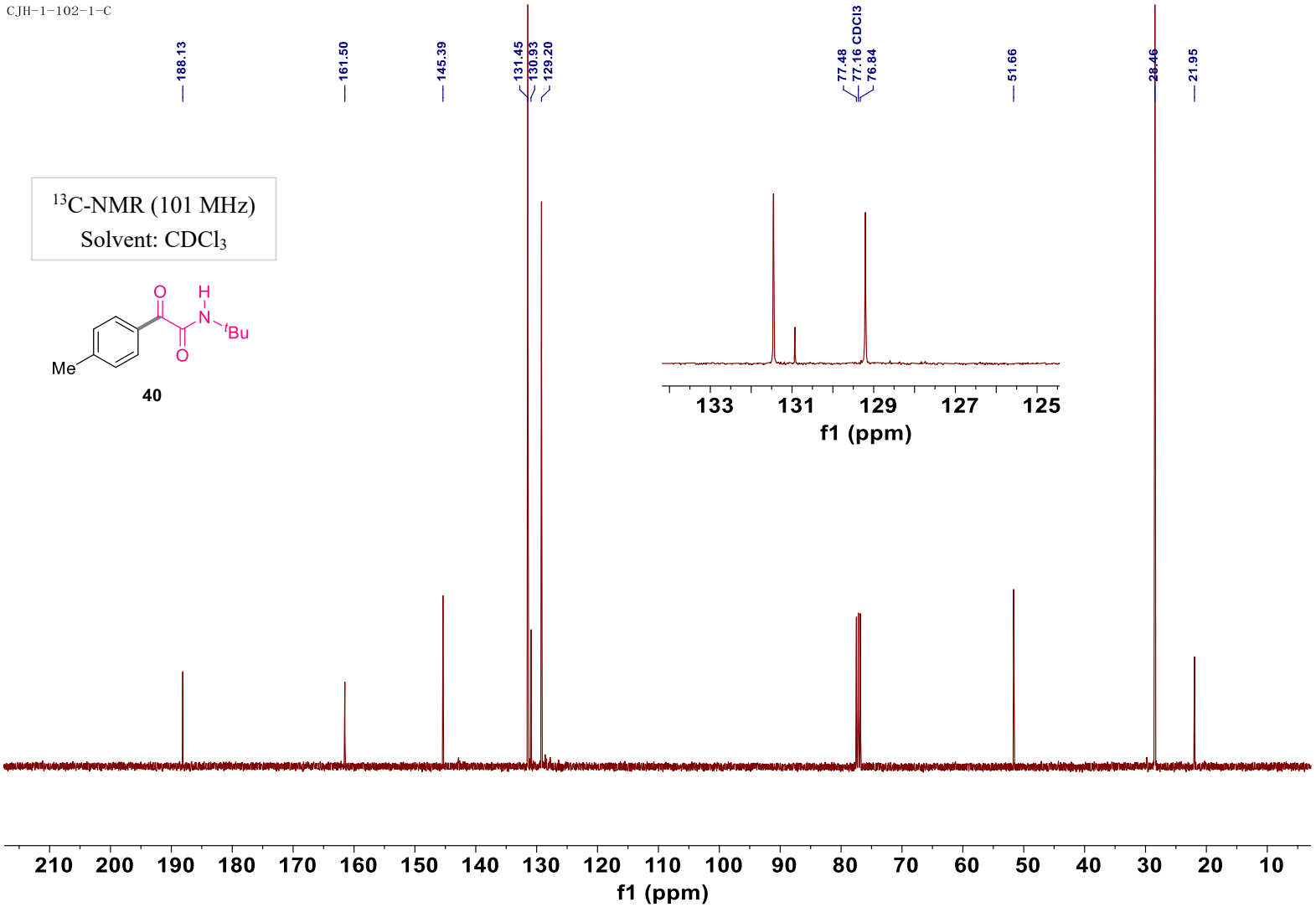


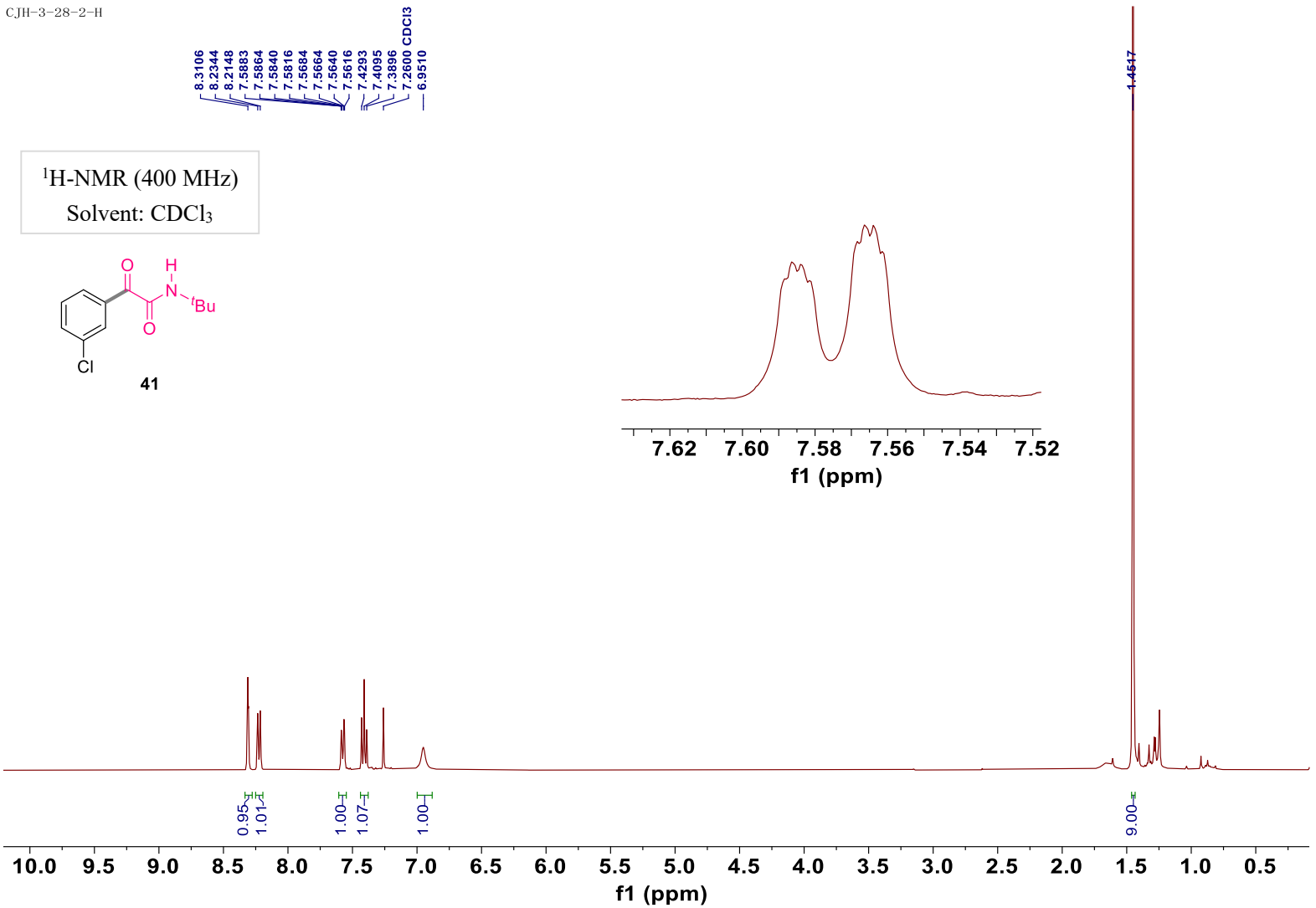
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$

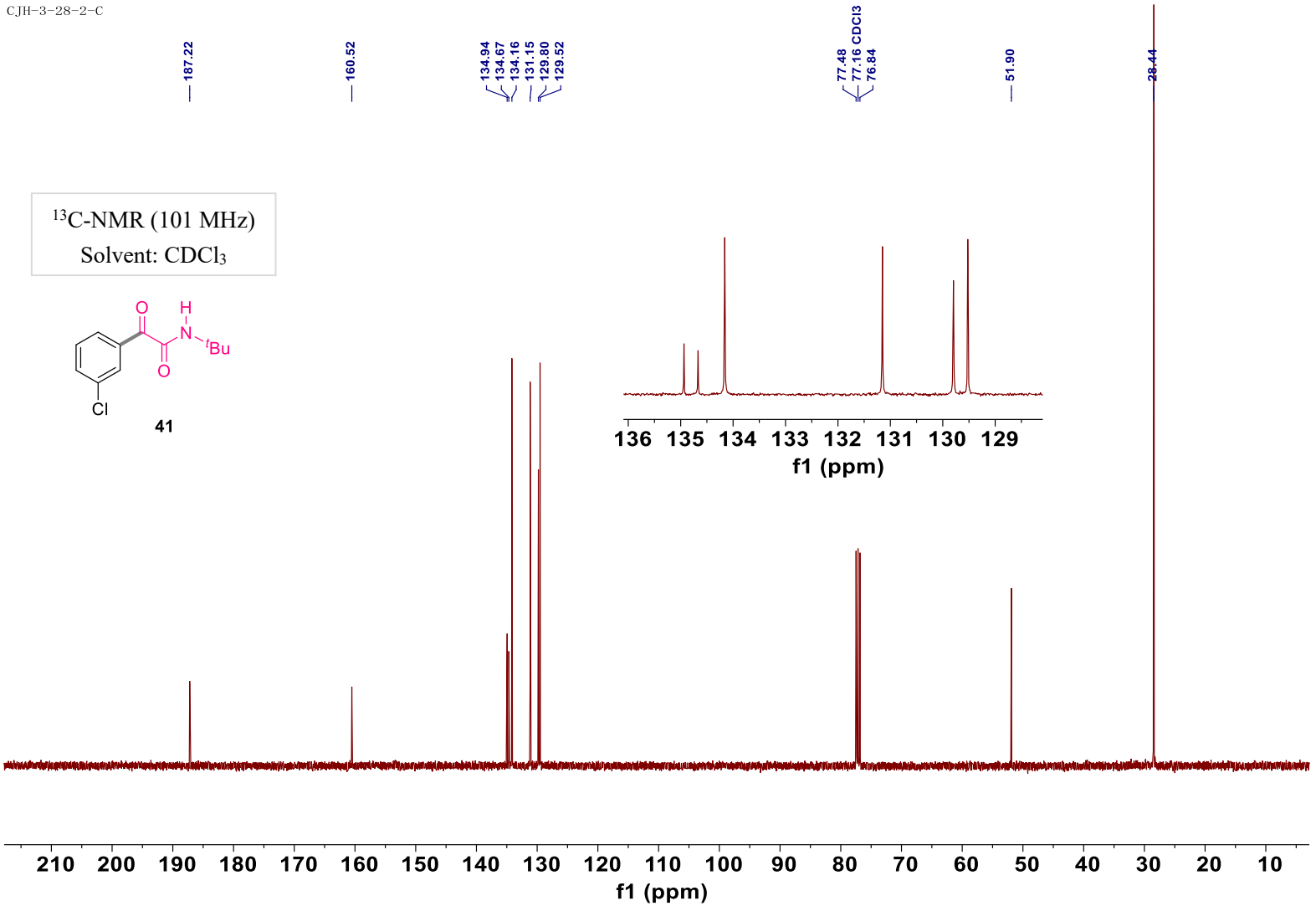
39

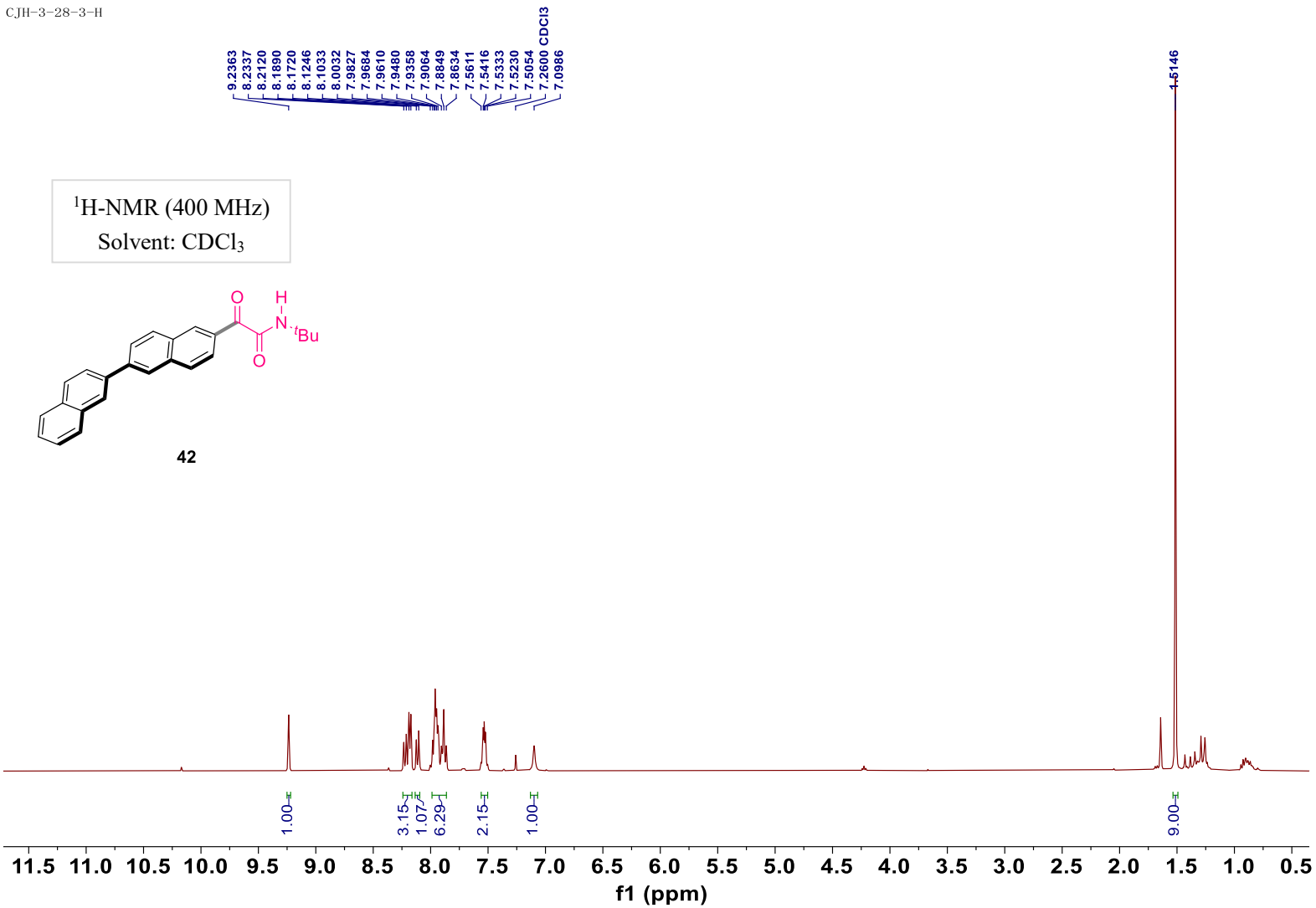

CJH-1-123-2-C
168.69
140.23
139.64
139.28
138.23
136.58
135.82
134.58
132.61
132.59
132.48
132.12
131.85
77.48
77.16 CDCl3
76.84
51.48
35.50
35.37
35.18
34.89
28.97
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
39
132.5
132.0
131.5
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

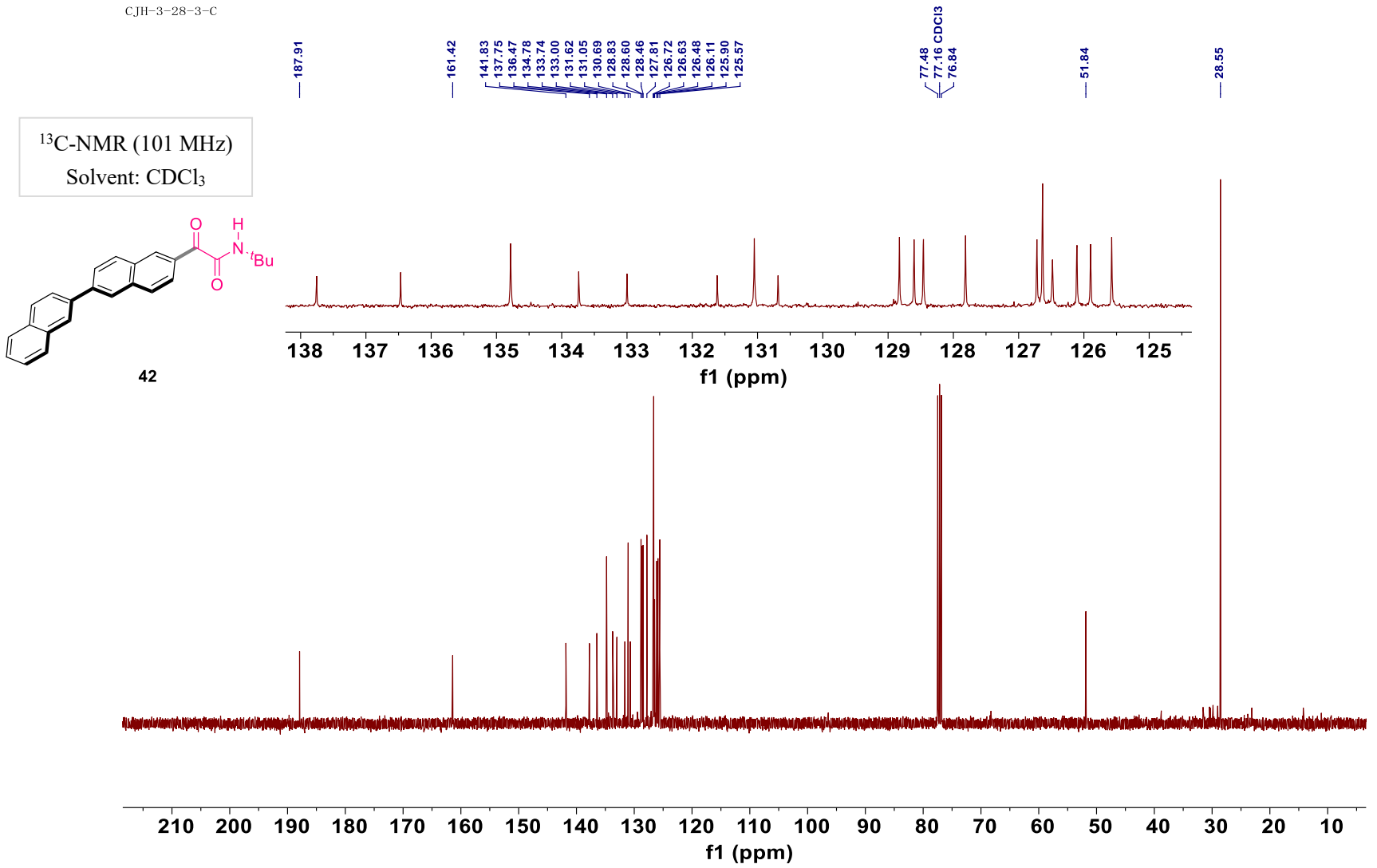

CJH-1-102-1-H
8.2229
8.2023
7.2600 CDCl3
7.2600
7.2526
7.2324
6.9461
2.3987
1.4380
^{1}H-NMR (400 MHz)
Solvent: CDCl$_3$
O
H
N
^{t}Bu
O
Me
40
8.4
8.3
8.2
8.1
8.0
f1 (ppm)
7.3
7.2
7.1
7.0
6.9
f1 (ppm)
1.99
2.32
0.99
3.03
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

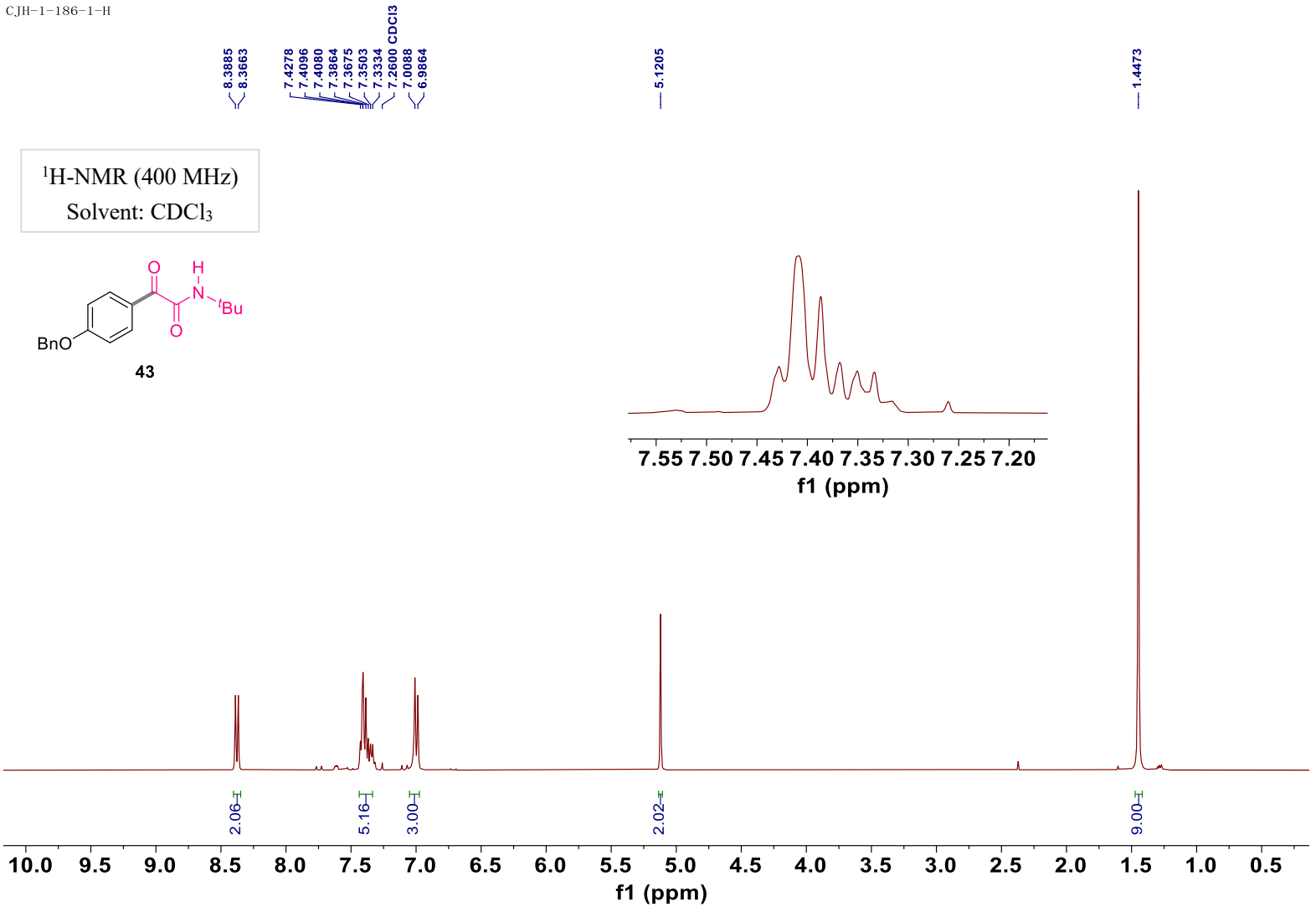

CJH-1-102-1-C
188.13
161.50
145.39
131.45
130.93
129.20
77.48
77.16 CDCl3
76.84
51.66
28.46
21.95
^{13}C-NMR (101 MHz)
Solvent: $CDCl_3$
Me
O
H
N
tBu
O
40
133
131
129
127
125
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

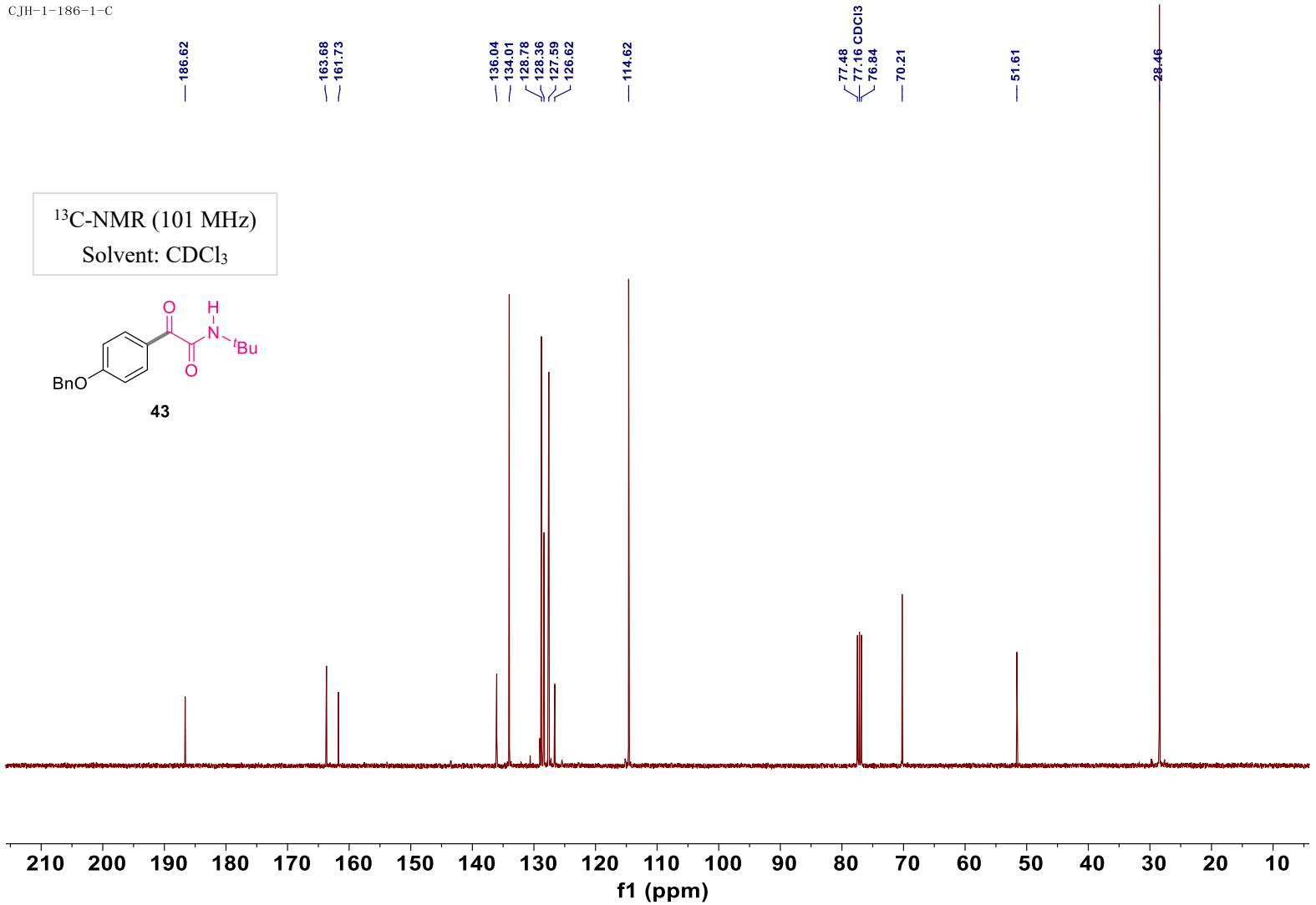

CJH-3-28-2-H
8.3106
8.2344
8.2148
7.5883
7.5864
7.5840
7.5816
7.5684
7.5664
7.5640
7.5616
7.4293
7.4095
7.3896
7.2600 CDCl3
6.9510
1.4617
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
O
H
N
^{t}Bu
O
Cl
41
7.62
7.60
7.58
7.56
7.54
7.52
f1 (ppm)
0.95
1.01
1.00
1.07
1.00
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

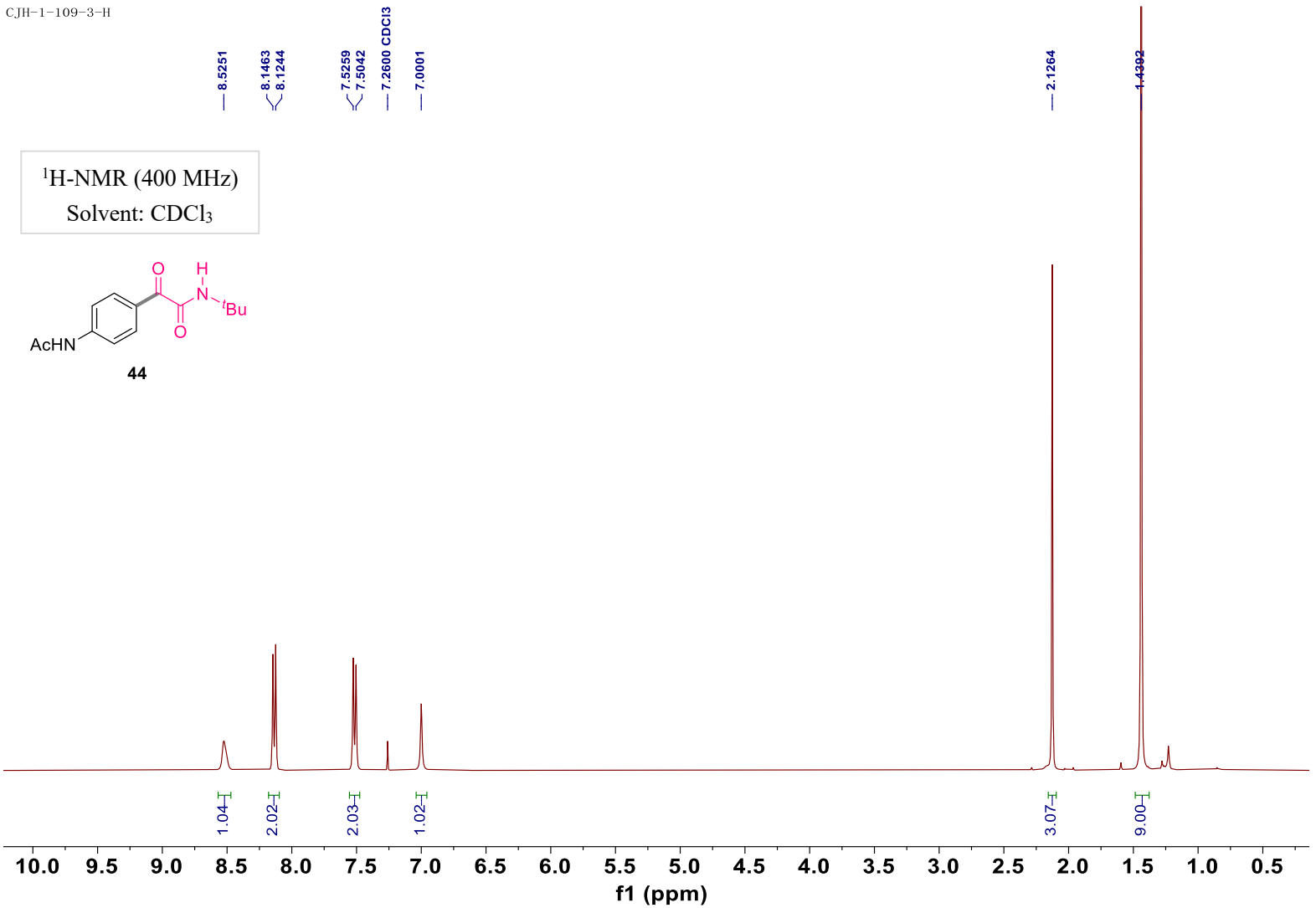

CJH-3-28-2-C
187.22
160.52
134.94
134.67
134.16
131.15
129.80
129.52
77.48
77.16 CDCl3
76.84
51.90
28.44
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Cl
41
136 135 134 133 132 131 130 129
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

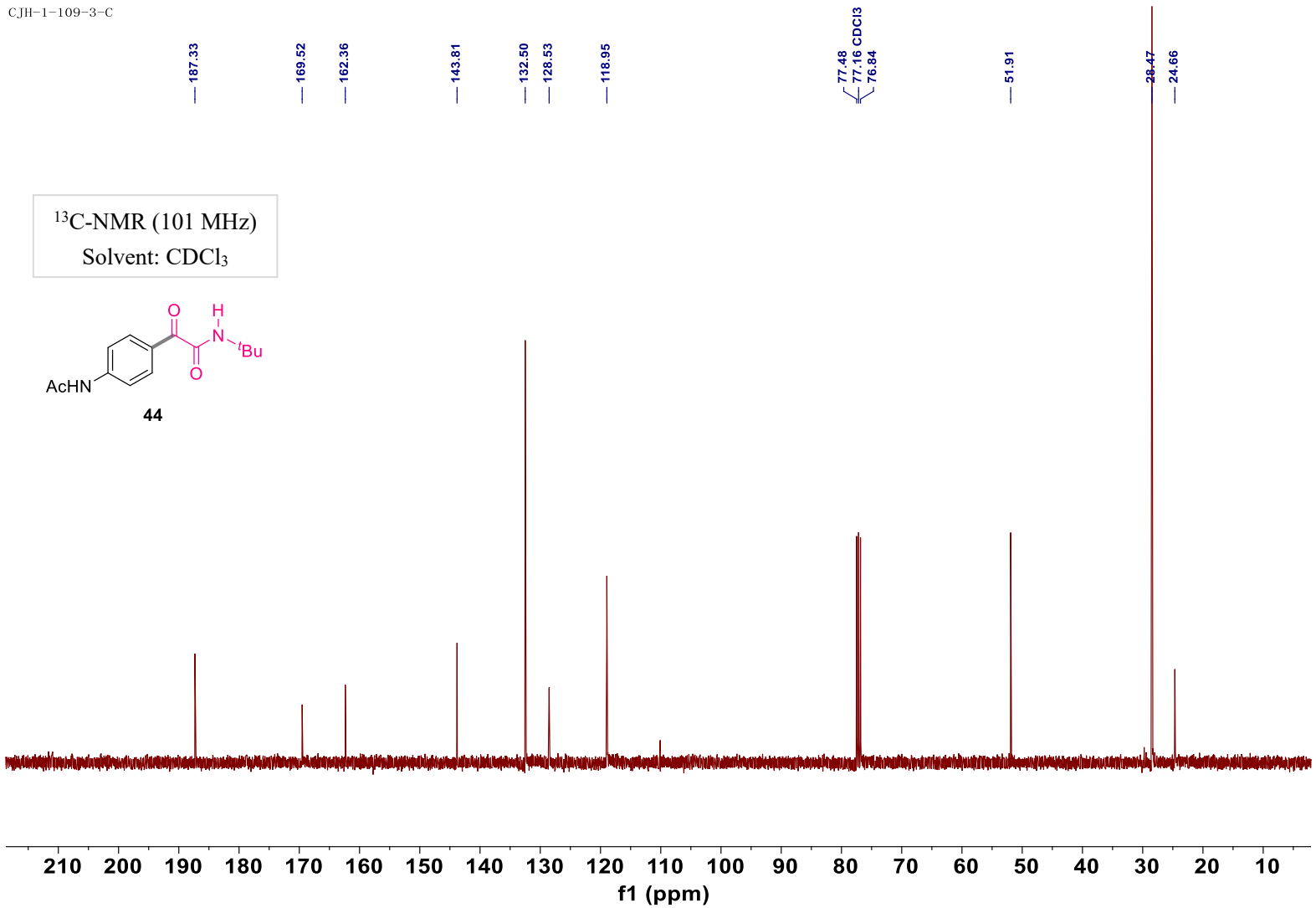

CJH-3-28-3-H
9.2363
8.2337
8.2120
8.1890
8.1720
8.1246
8.1033
8.0032
7.9827
7.9684
7.9610
7.9480
7.9358
7.9064
7.8849
7.8634
7.5611
7.5416
7.5333
7.5230
7.5054
7.2600 CDCl3
7.0986
1.5146
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
42
1.00
3.15
1.07
6.29
2.15
1.00
9.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 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
f1 (ppm)

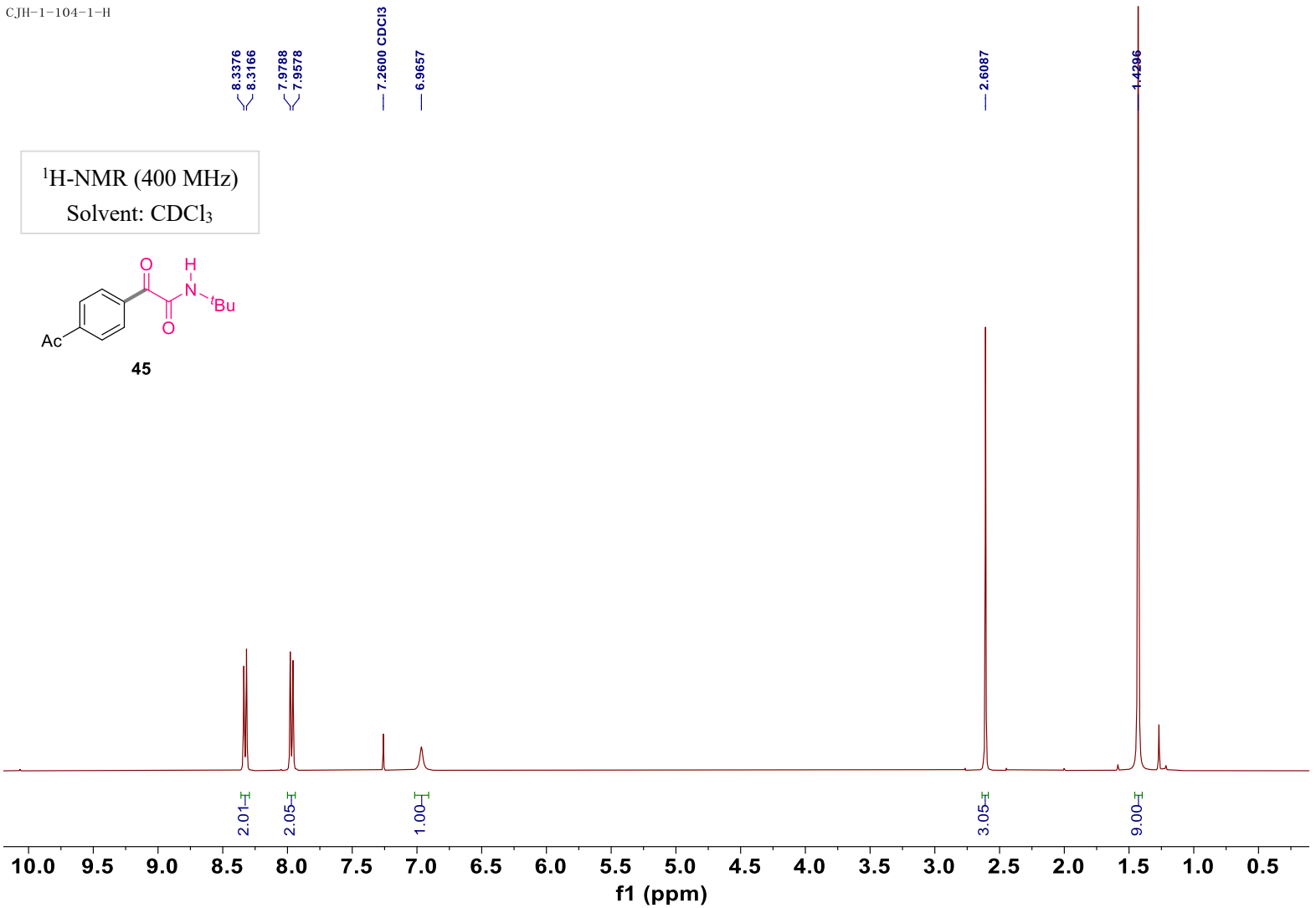

CJH-3-28-3-C
187.91
161.42
141.83
137.75
136.47
134.78
133.74
133.00
131.62
131.05
130.69
128.83
128.60
128.46
127.81
126.72
126.63
126.48
126.11
125.90
125.57
77.48
77.16 CDCl3
76.84
51.84
28.55
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
42
138 137 136 135 134 133 132 131 130 129 128 127 126 125
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

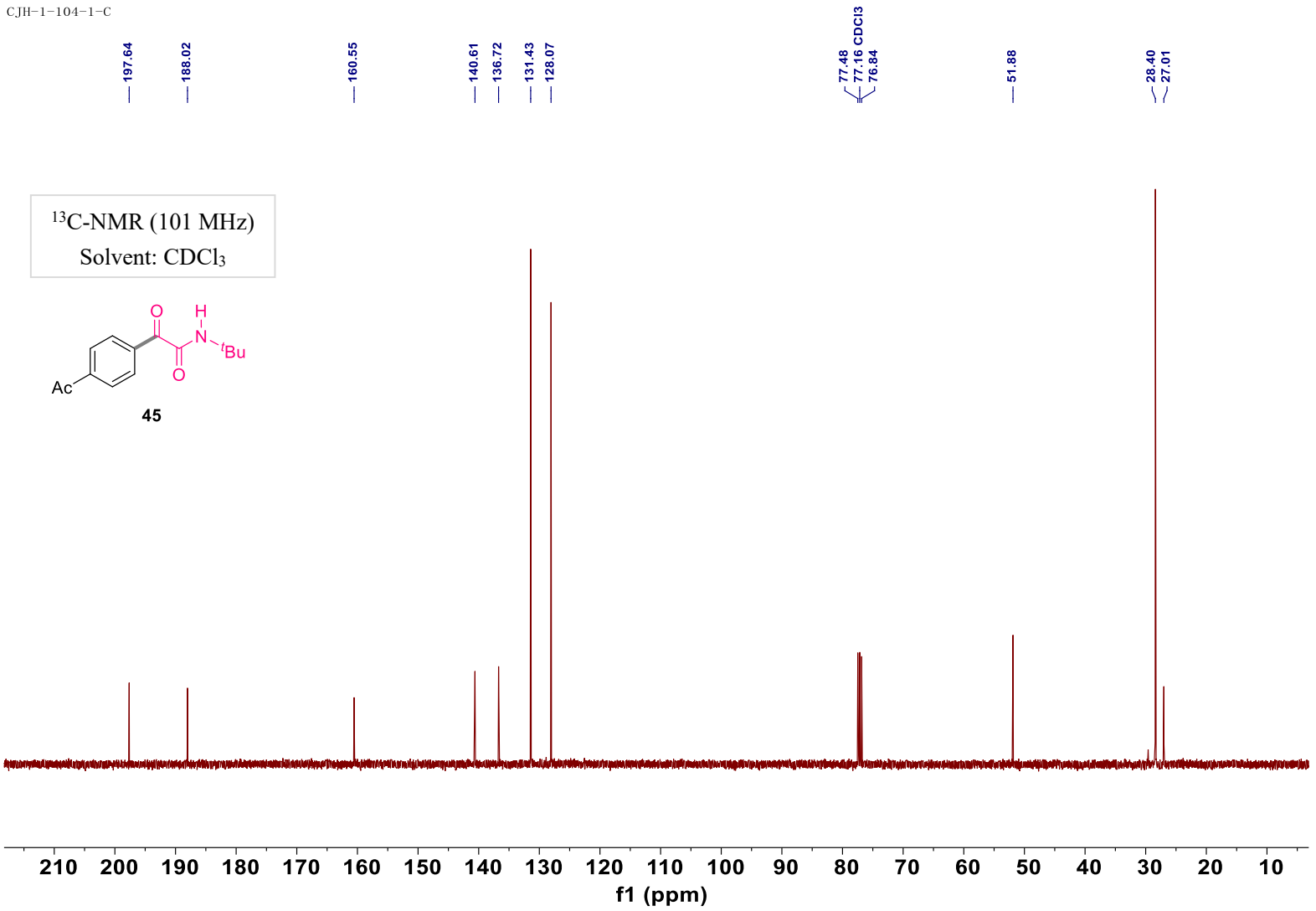

CJH-1-186-1-H
8.3885
8.3663
7.4278
7.4096
7.4080
7.3864
7.3675
7.3503
7.3334
7.2600 CDCl3
7.0088
6.9864
5.1205
1.4473
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
BnO
43
7.55 7.50 7.45 7.40 7.35 7.30 7.25 7.20
f1 (ppm)
2.06
5.16
3.00
2.02
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

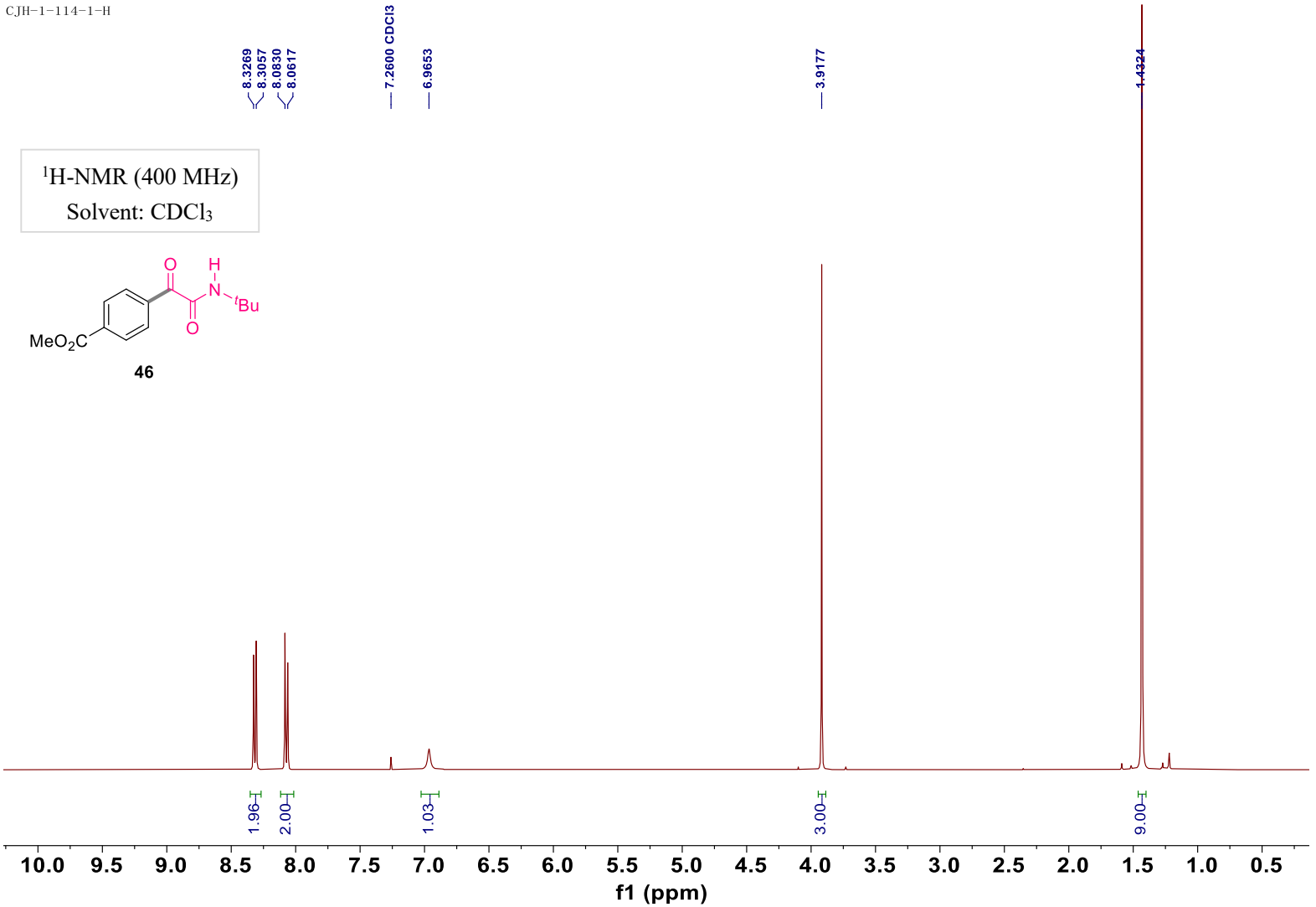

CJH-1-186-1-C
186.62
163.68
161.73
136.04
134.01
128.78
128.36
127.59
126.62
114.62
77.48
77.16 CDCl3
76.84
70.21
51.61
28.46
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
BnO
43
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

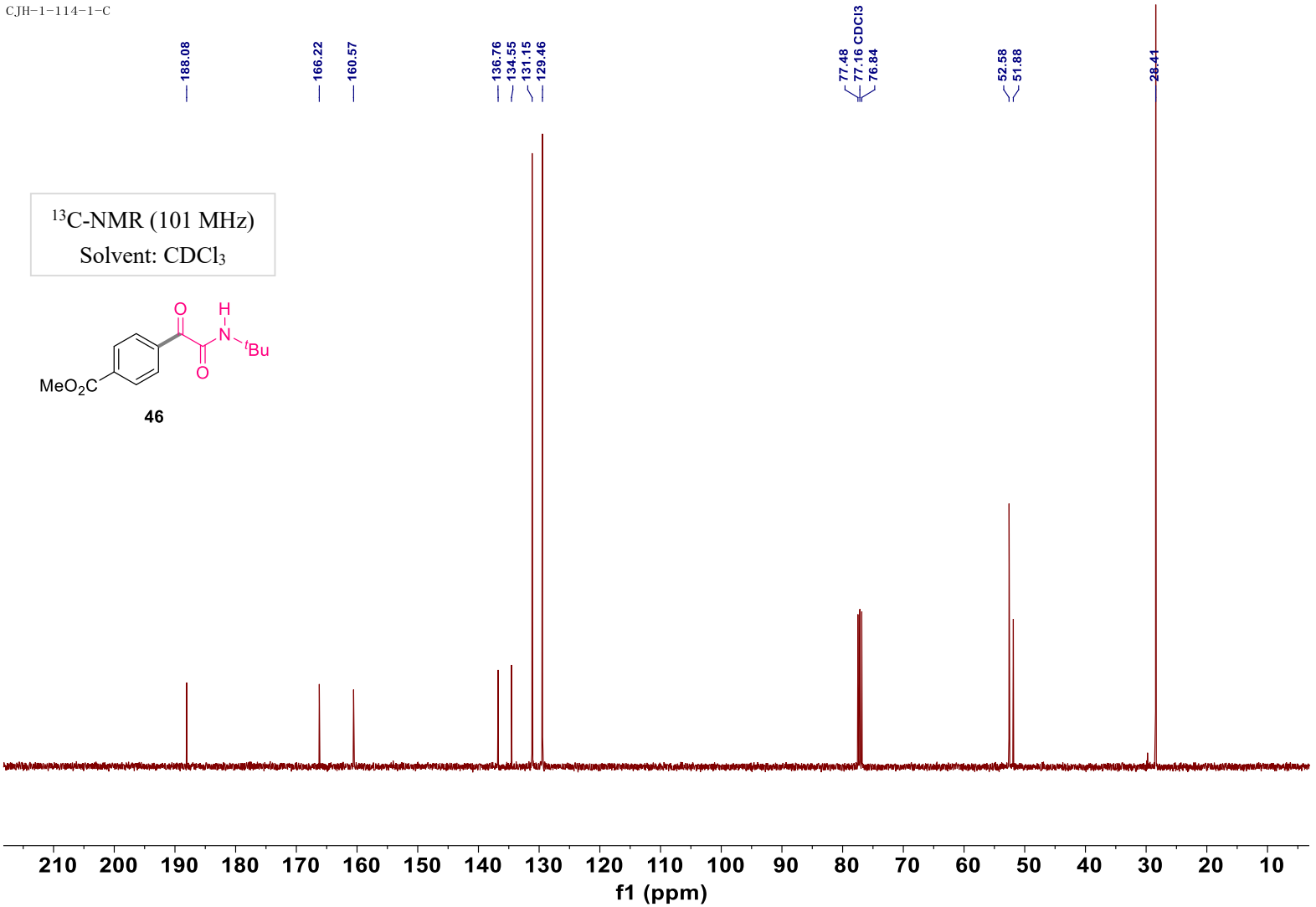

CJH-1-109-3-H
8.5251
8.1463
8.1244
7.5259
7.5042
7.2600 CDCl3
7.0001
2.1264
1.4392
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
AcHN
44
1.04
2.02
2.03
1.02
3.07
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

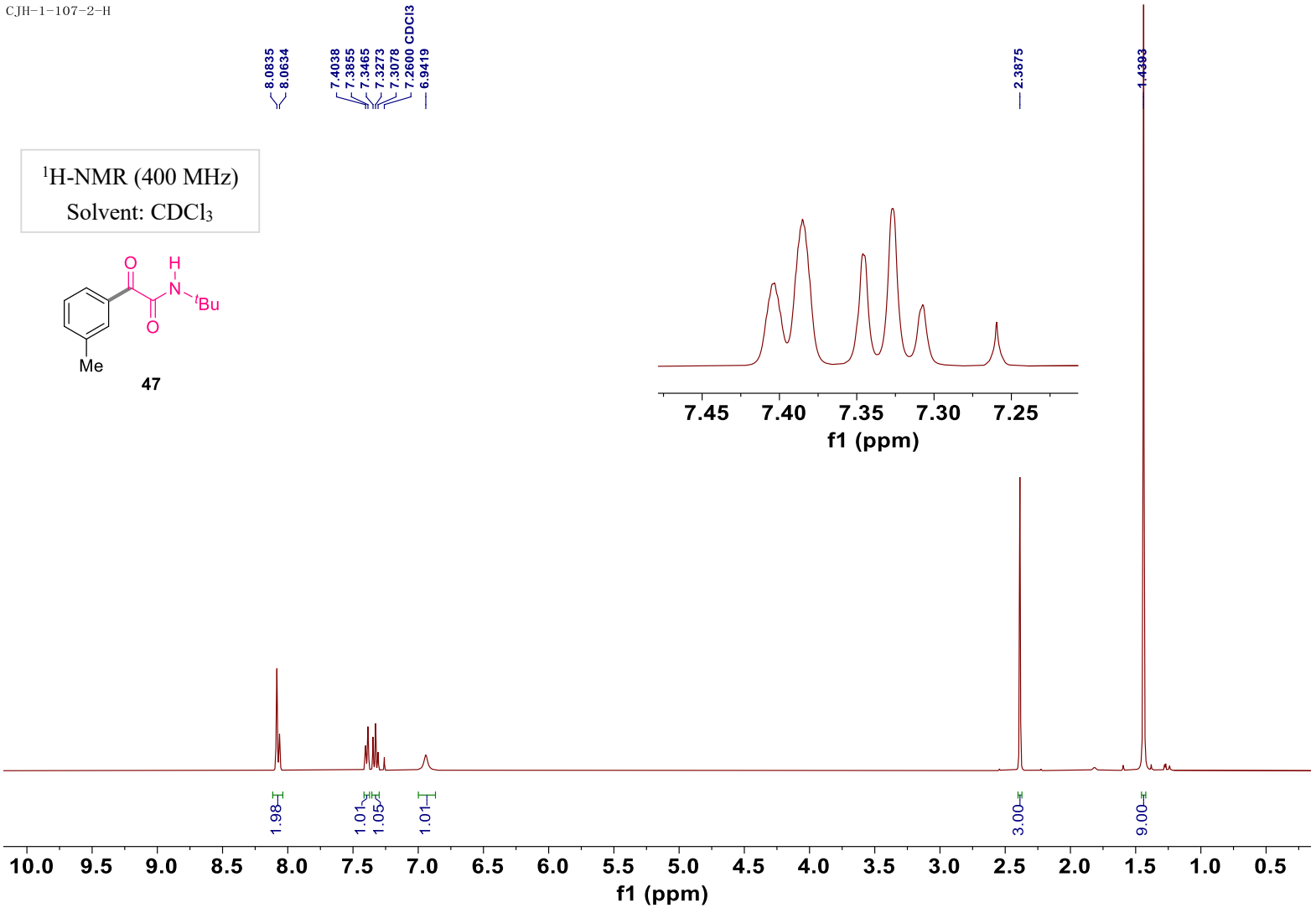

CJH-1-109-3-C
187.33
169.52
162.36
143.81
132.50
128.53
118.95
77.48
77.16 CDCl3
76.84
51.91
28.47
24.66
13C-NMR (101 MHz)
Solvent: CDCl3
AcHN
tBu
44
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

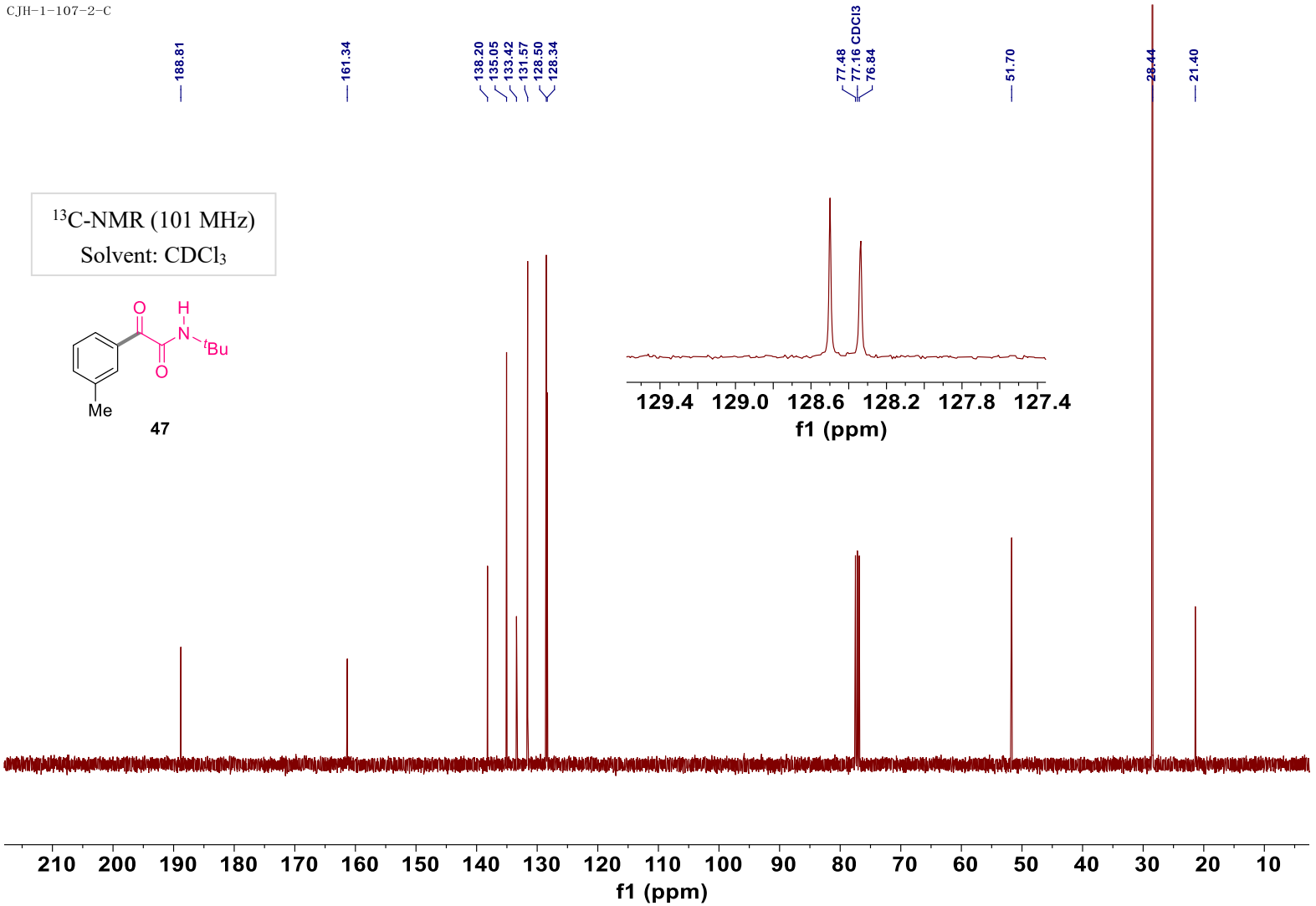

CJH-1-104-1-H
8.3376
8.3166
7.9788
7.9578
7.2600 CDCl3
6.9657
2.6087
1.4296
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Ac
45
2.01
2.05
1.00
3.05
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

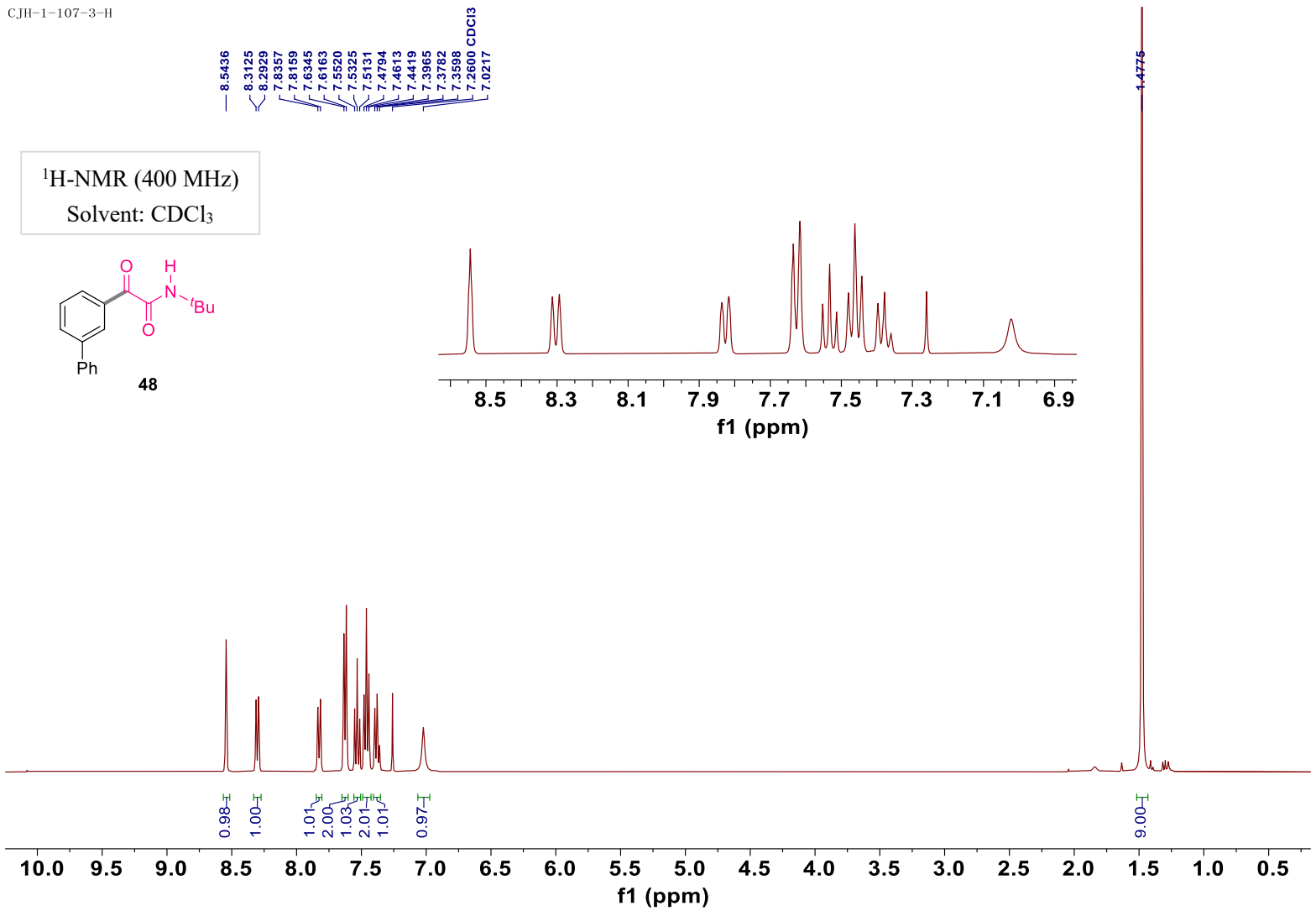

CJH-1-104-1-C
197.64
188.02
160.55
140.61
136.72
131.43
128.07
77.48
77.16 CDCl3
76.84
51.88
28.40
27.01
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Ac
45
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

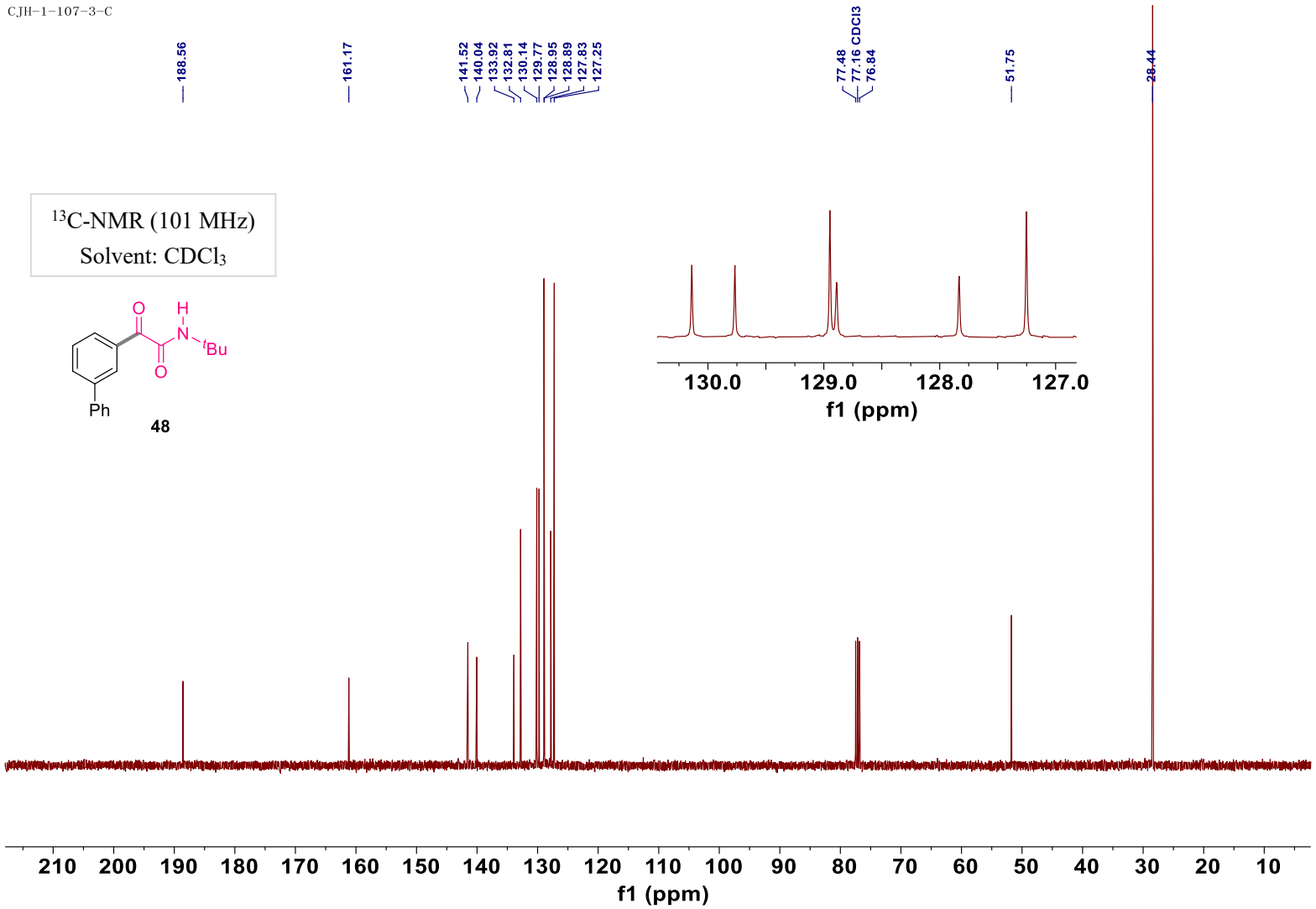

CJH-1-114-1-H
8.3269
8.3057
8.0830
8.0617
7.2600 CDCl3
6.9653
3.9177
1.4324
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
O
H
N
^{t}Bu
O
MeO_2C
46
1.96
2.00
1.03
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

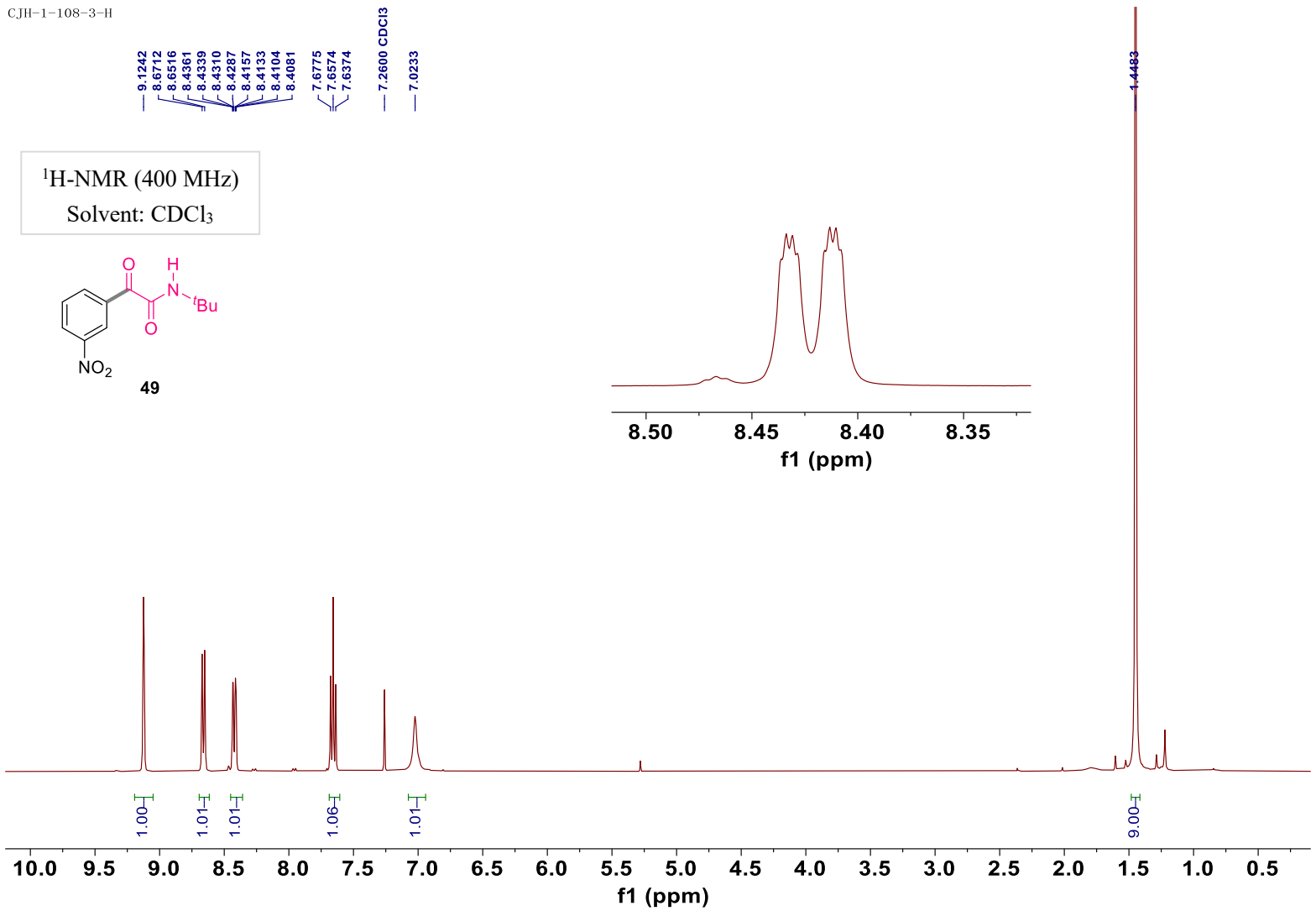

CJH-1-114-1-C
188.08
166.22
160.57
136.76
134.55
131.15
129.46
77.48
77.16 CDCl3
76.84
52.58
51.88
28.41
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
MeO2C
46
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

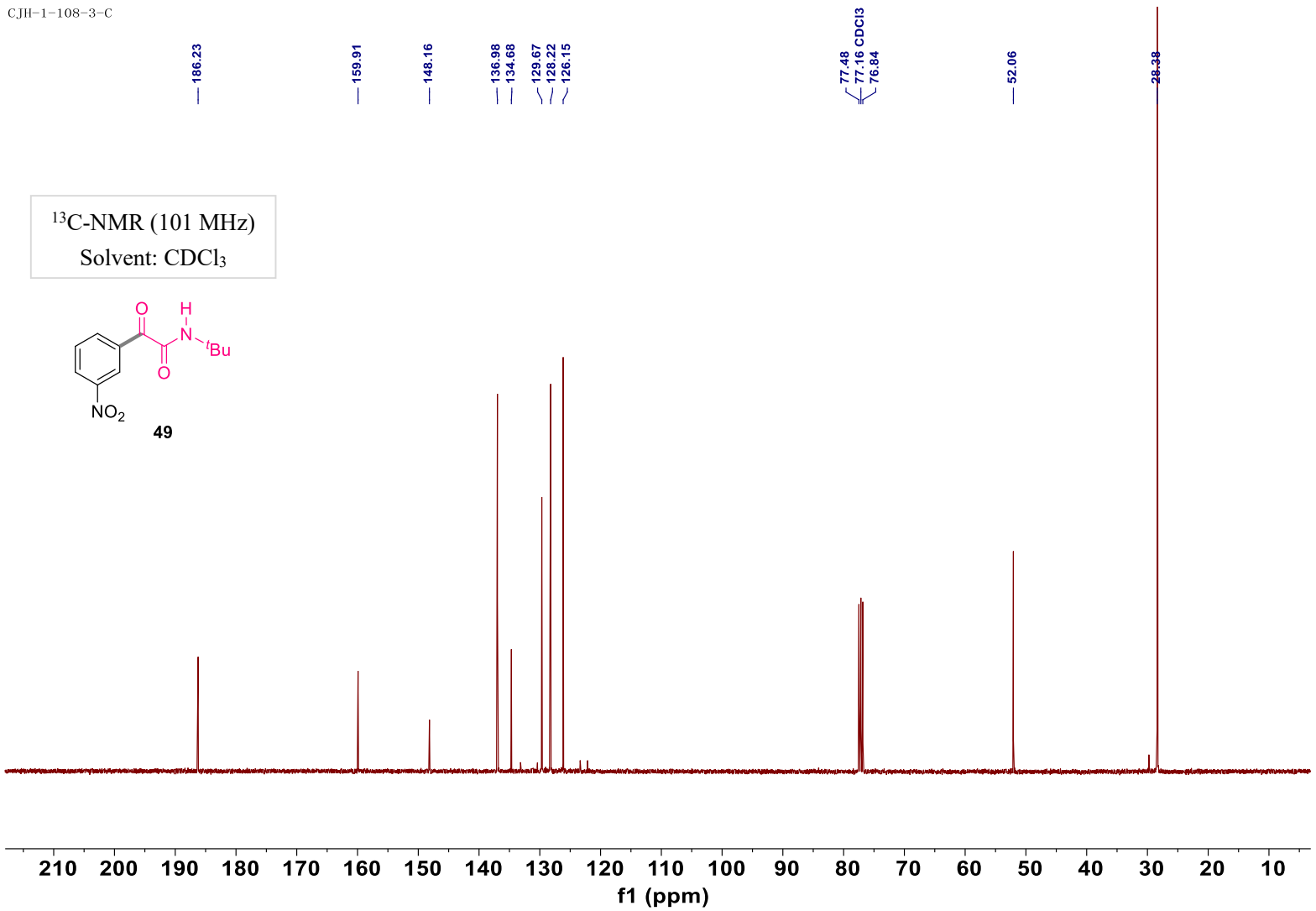

CJH-1-107-2-H
8.0835
8.0634
7.4038
7.3855
7.3465
7.3273
7.3078
7.2600 CDCl3
6.9419
2.3875
1.4393
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Me
47
7.45
7.40
7.35
7.30
7.25
f1 (ppm)
1.98
1.01
1.05
1.01
3.00
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

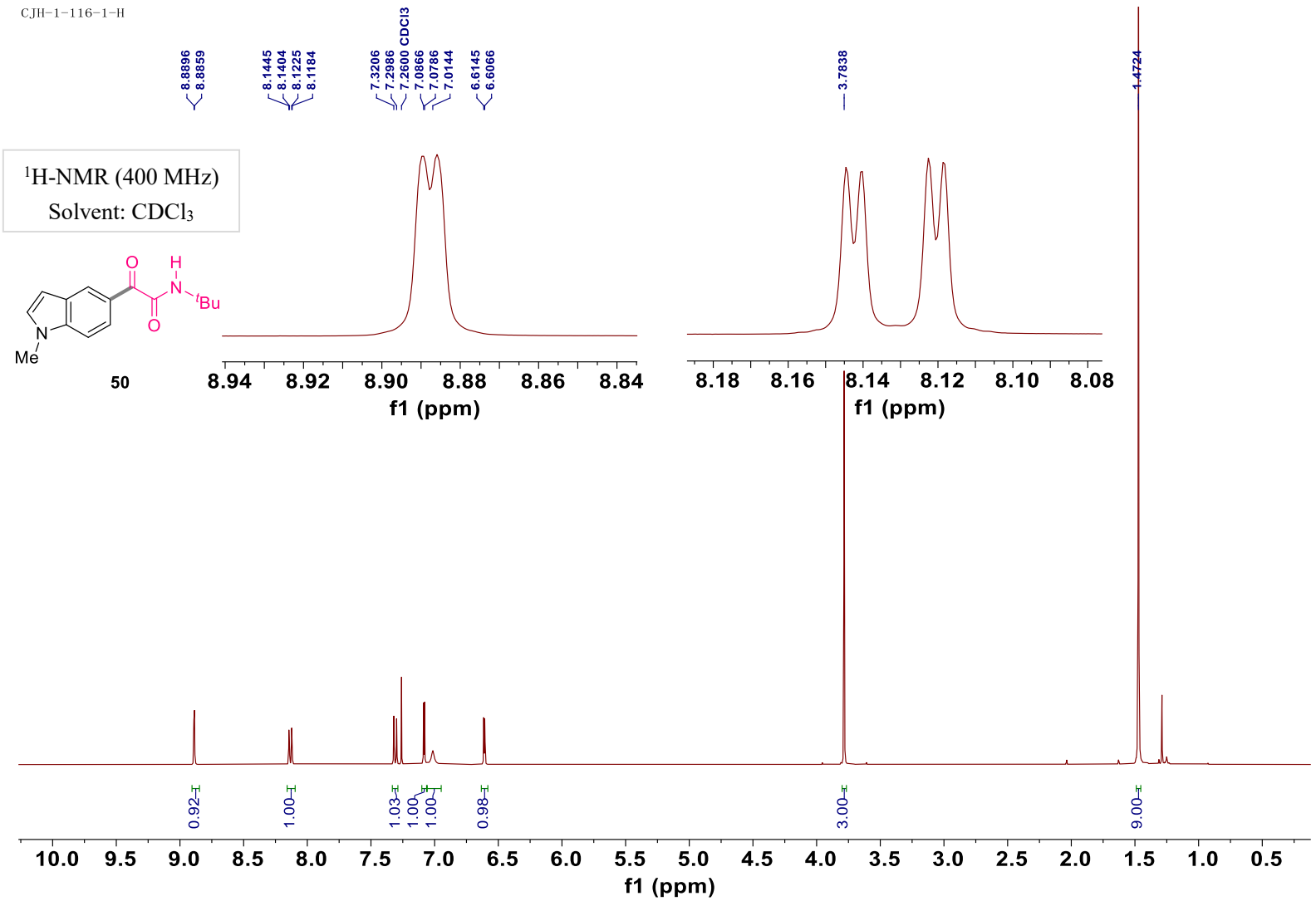

CJH-1-107-2-C
188.81
161.34
138.20
135.05
133.42
131.57
128.50
128.34
77.48
77.16 CDCl3
76.84
51.70
28.44
21.40
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Me
47
129.4 129.0 128.6 128.2 127.8 127.4
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

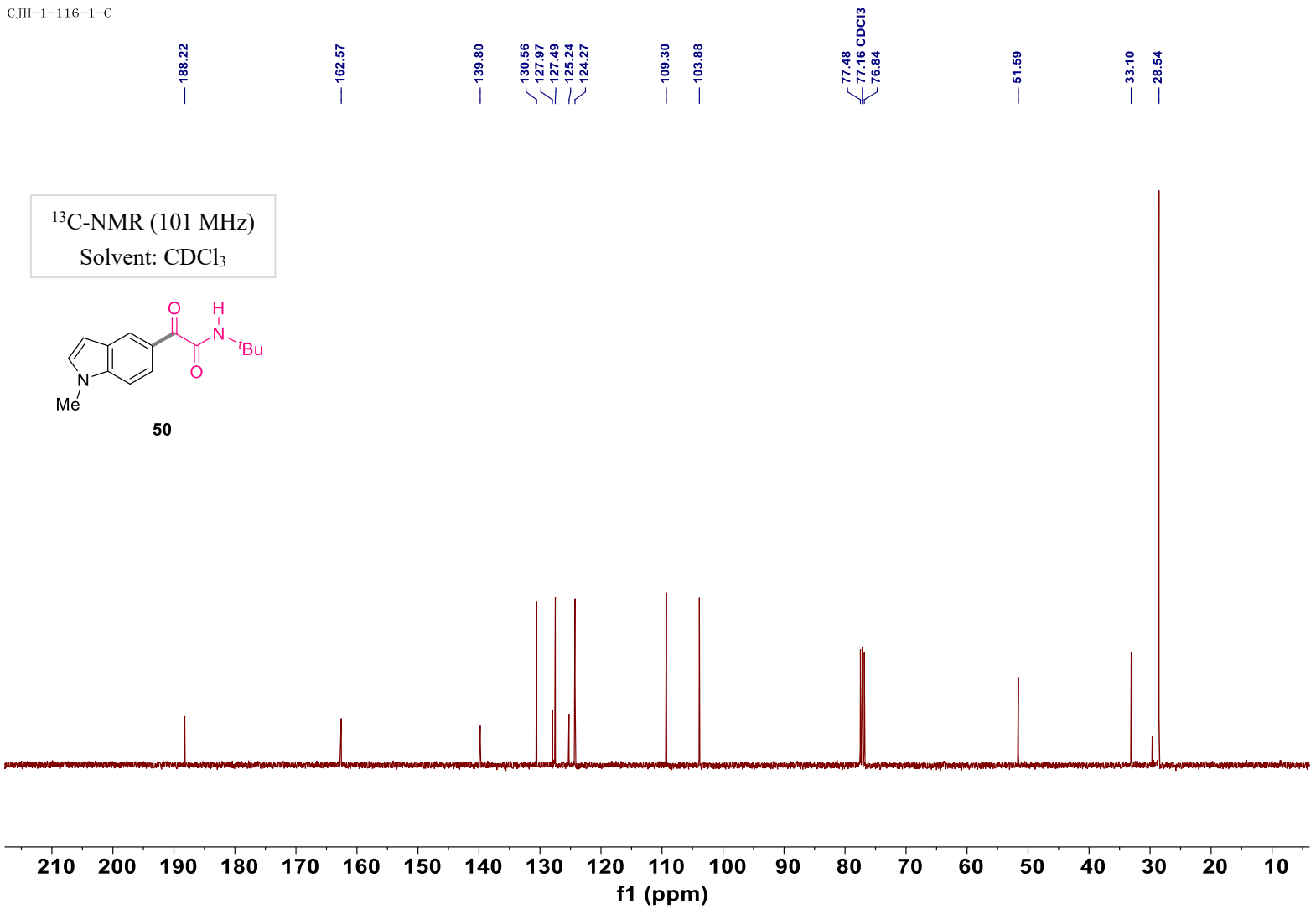

CJH-1-107-3-H
8.5436
8.3125
8.2929
7.8357
7.8159
7.6345
7.6163
7.5520
7.5325
7.5131
7.4794
7.4613
7.4419
7.3965
7.3782
7.3598
7.2600 CDCl3
7.0217
1.4775
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Ph
48
8.5
8.3
8.1
7.9
7.7
7.5
7.3
7.1
6.9
f1 (ppm)
0.98
1.00
1.01
2.00
1.03
2.01
1.01
0.97
9.00
10.0
9.5
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
f1 (ppm)

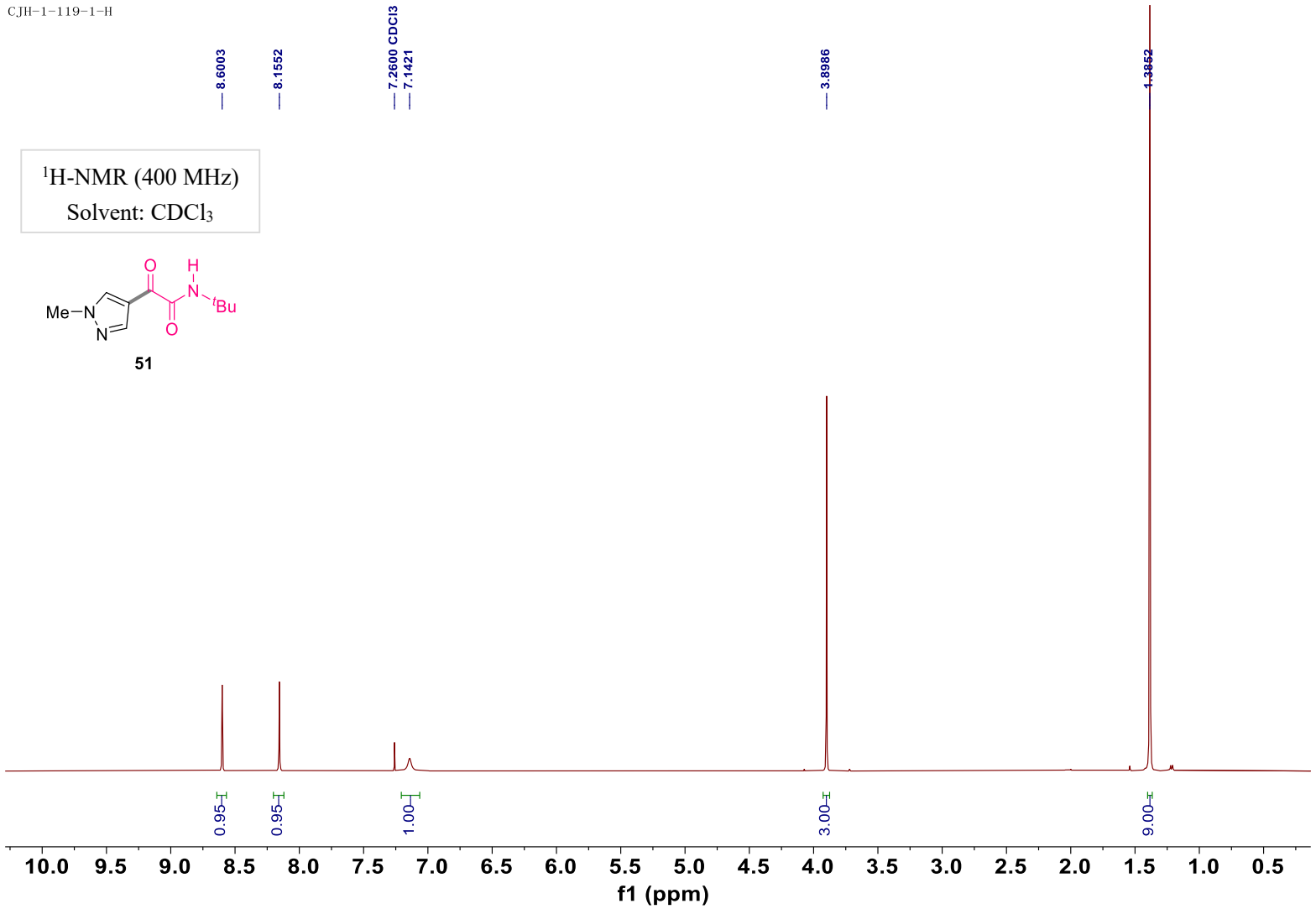

CJH-1-107-3-C
188.56
161.17
141.52
140.04
133.92
132.81
130.14
129.77
128.95
128.89
127.83
127.25
77.48
77.16 CDCl3
76.84
51.75
28.44
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
Ph
48
130.0
129.0
128.0
127.0
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

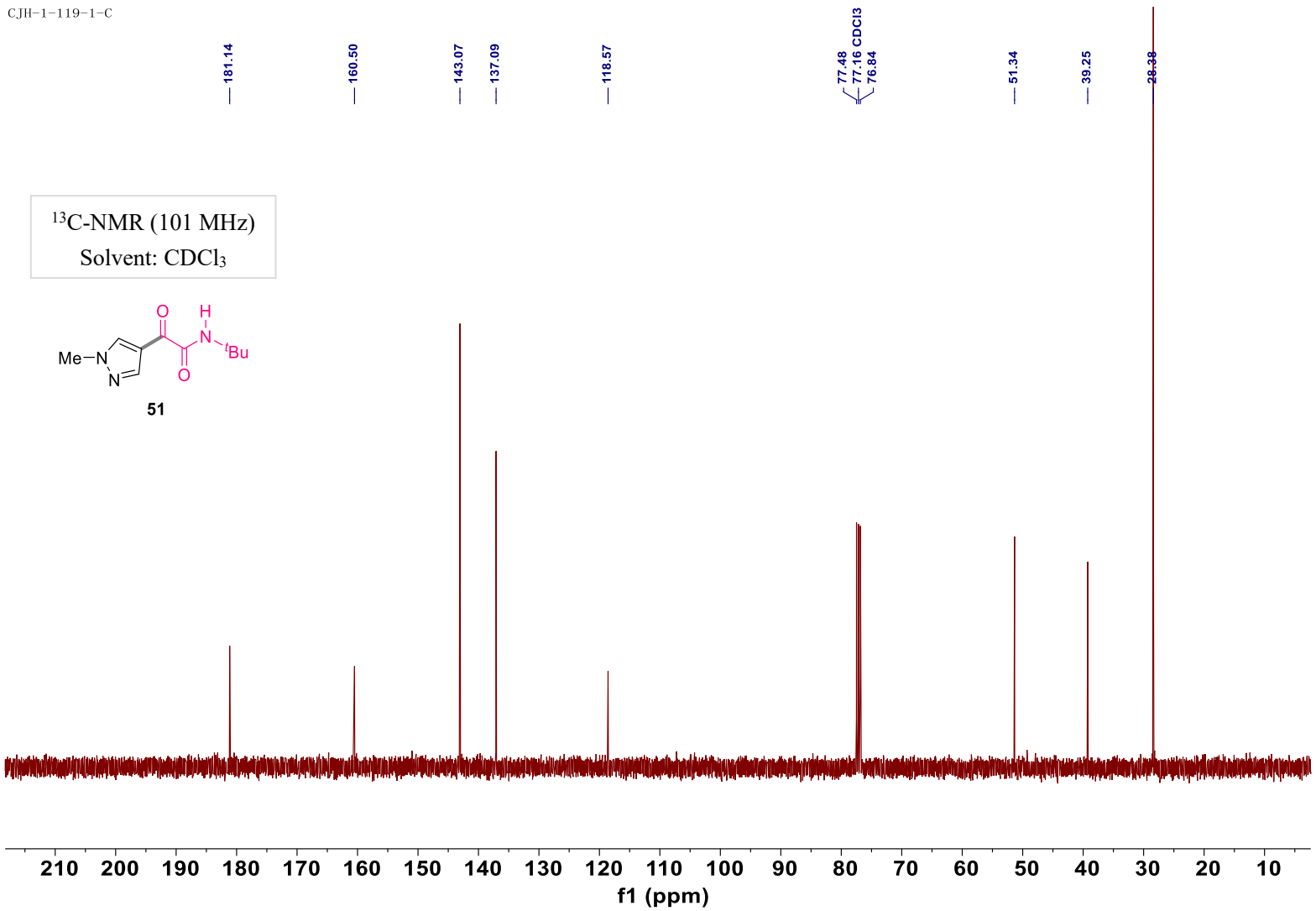

CJH-1-108-3-H
9.1242
8.6712
8.6516
8.4361
8.4339
8.4310
8.4287
8.4157
8.4133
8.4104
8.4081
7.6775
7.6574
7.6374
7.2600 CDCl3
7.0233
1.4483
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
NO2
49
8.50
8.45
8.40
8.35
f1 (ppm)
1.00
1.01
1.01
1.06
1.01
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

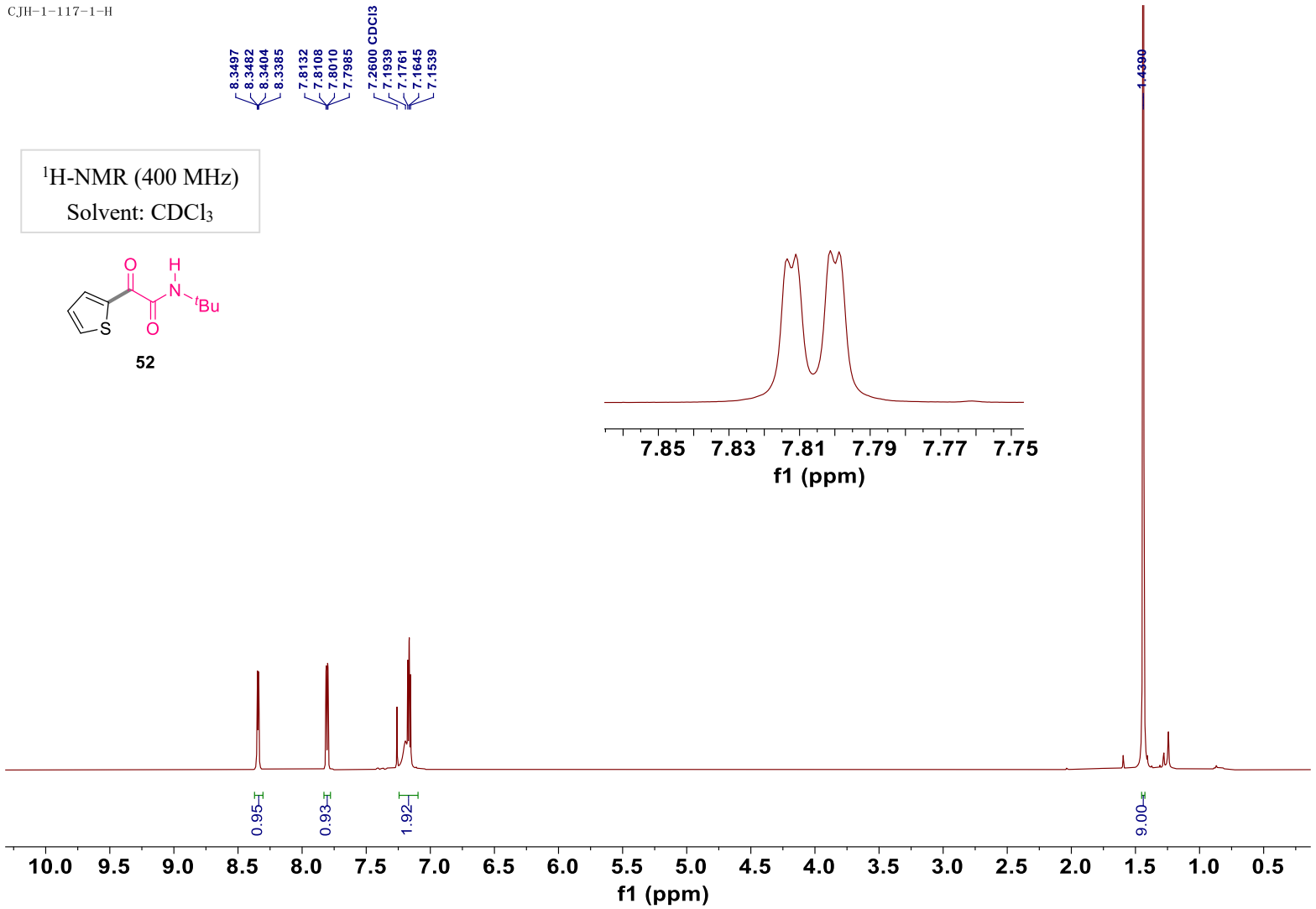

CJH-1-108-3-C
186.23
159.91
148.16
136.98
134.68
129.67
128.22
126.15
77.48
77.16 CDCl3
76.84
52.06
28.38
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
NO2
49
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

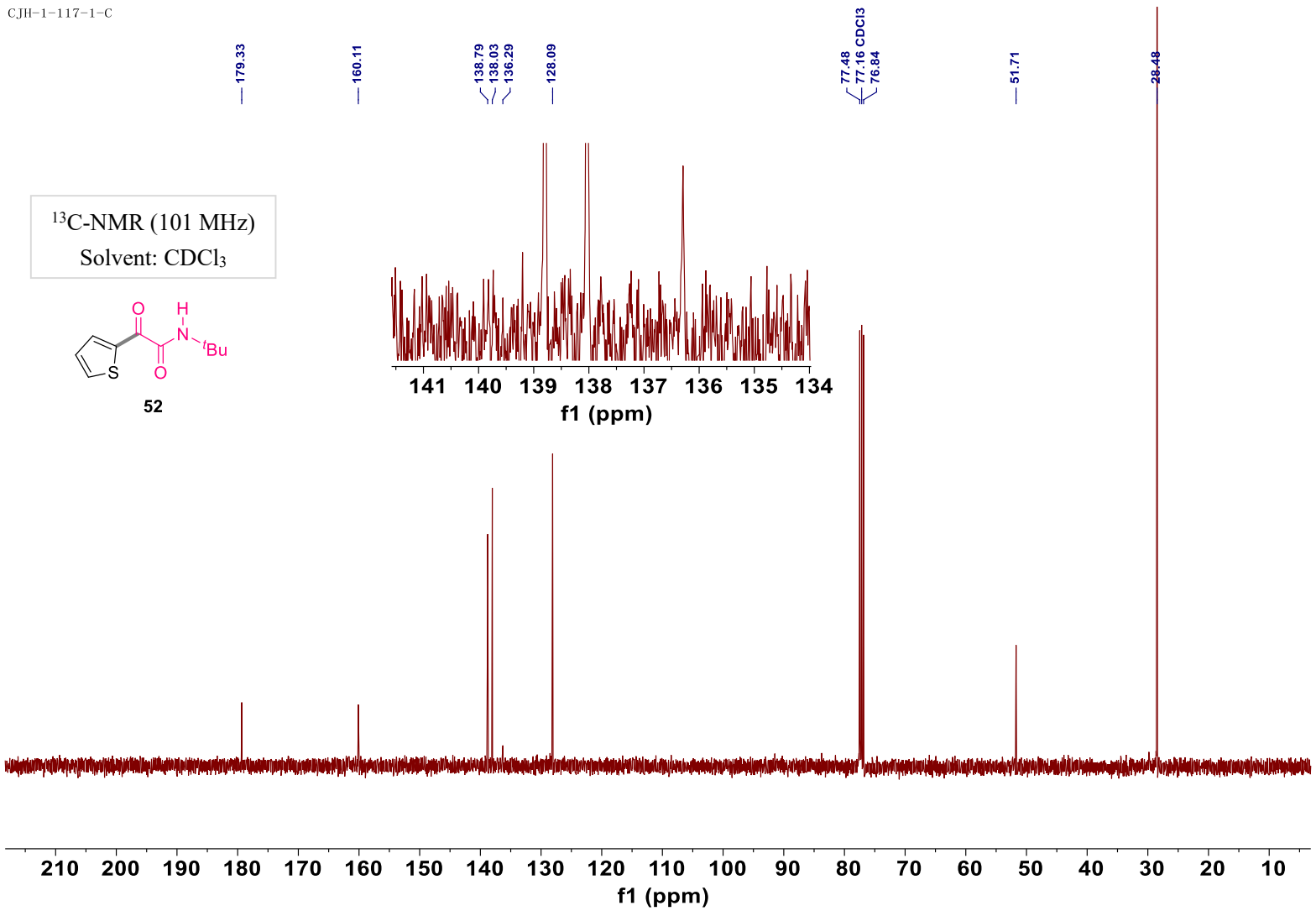

CJH-1-116-1-H
8.8896
8.8859
8.1445
8.1404
8.1225
8.1184
7.3206
7.2986
7.2600 CDCl3
7.0866
7.0786
7.0144
6.6145
6.6066
3.7838
1.4724
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
Me
50
8.94
8.92
8.90
8.88
8.86
8.84
f1 (ppm)
8.18
8.16
8.14
8.12
8.10
8.08
f1 (ppm)
0.92
1.00
1.03
1.00
1.00
0.98
3.00
9.00
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
f1 (ppm)

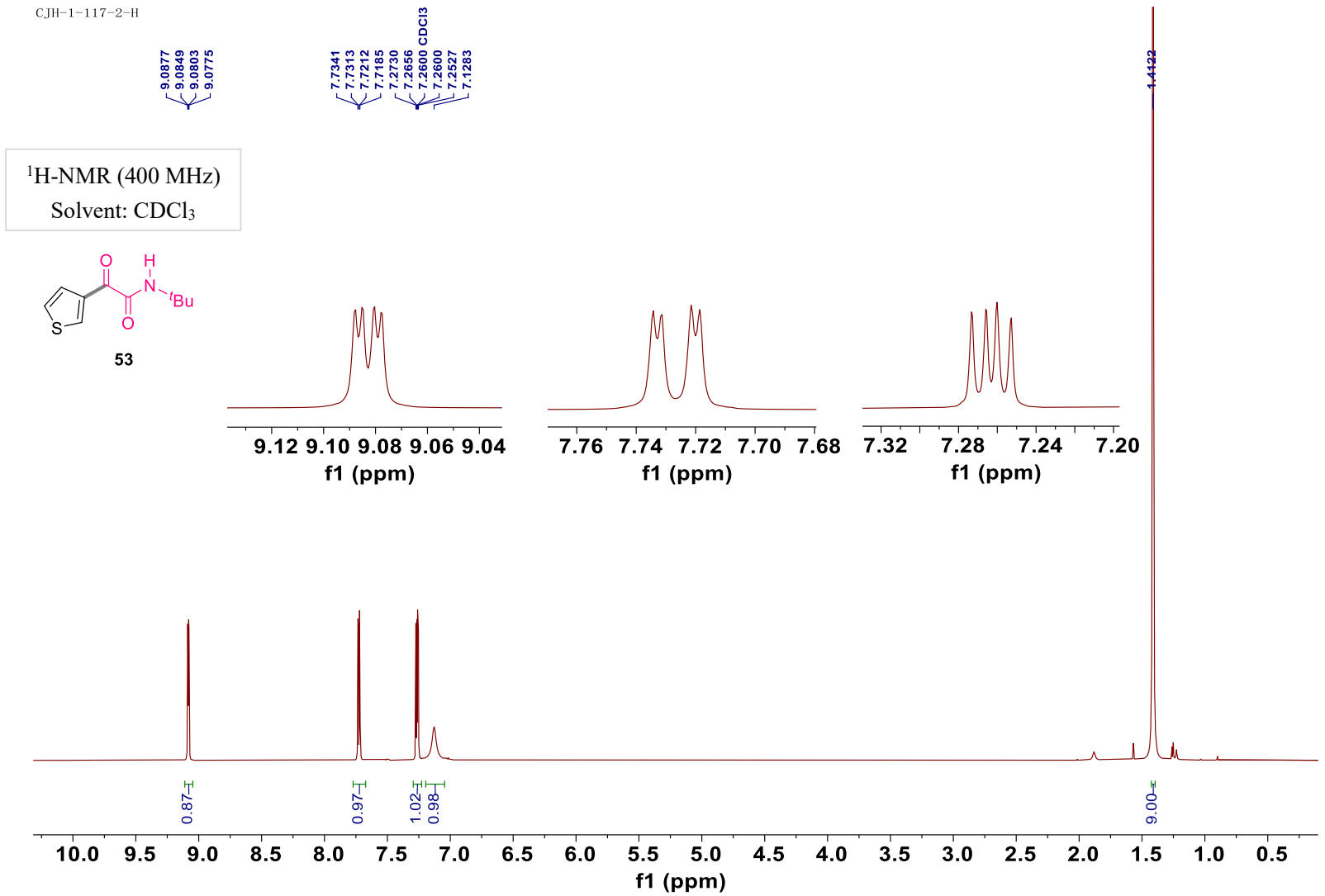

CJH-1-116-1-C
188.22
162.57
139.80
130.56
127.97
127.49
125.24
124.27
109.30
103.88
77.48
77.16 CDCl3
76.84
51.59
33.10
28.54
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
Me
50
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

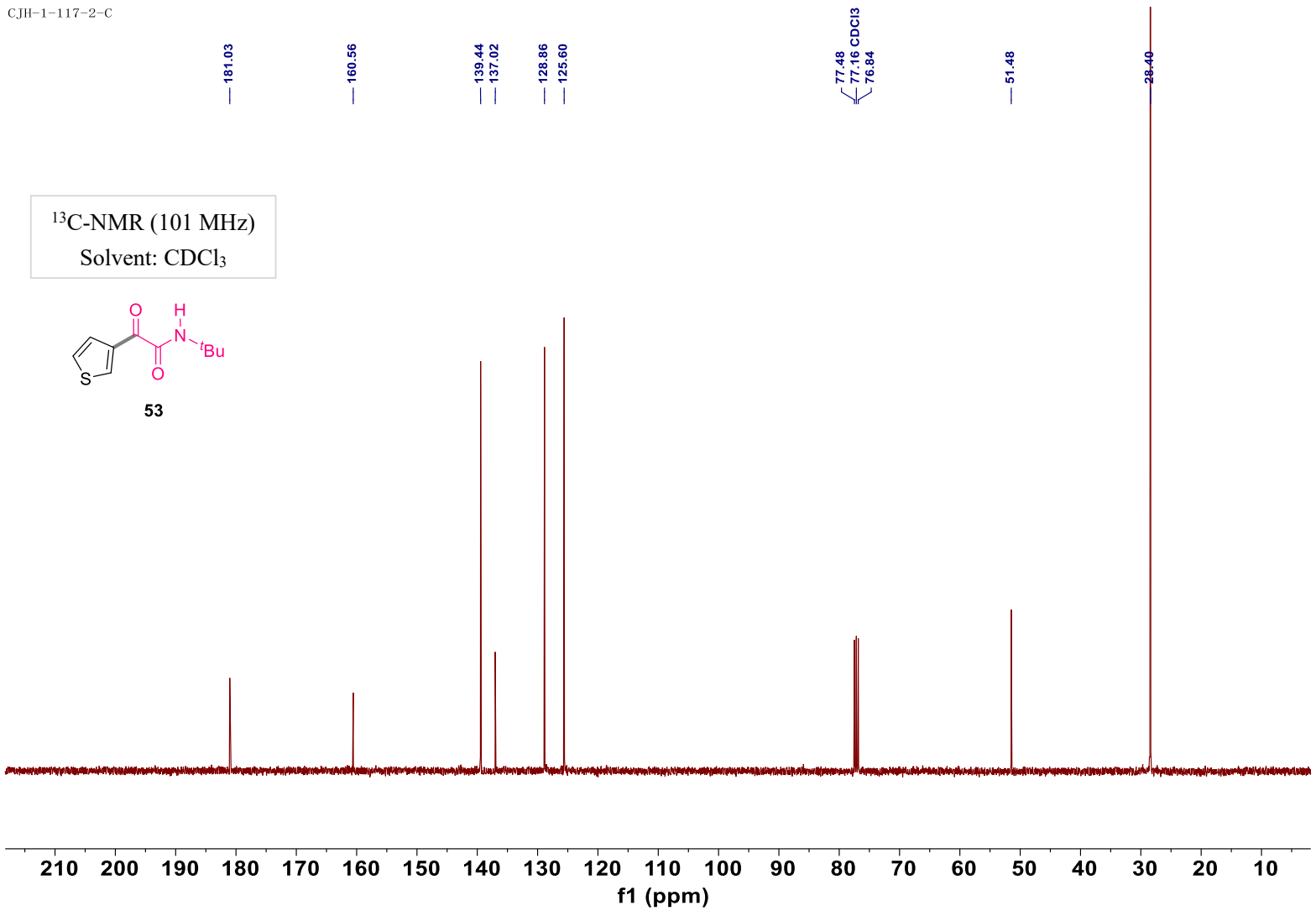

CJH-1-119-1-H
8.6003
8.1552
7.2600 CDCl3
7.1421
3.8986
1.3852
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$
Me
N
N
O
H
N
^{t}Bu
O
51
0.95
0.95
1.00
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

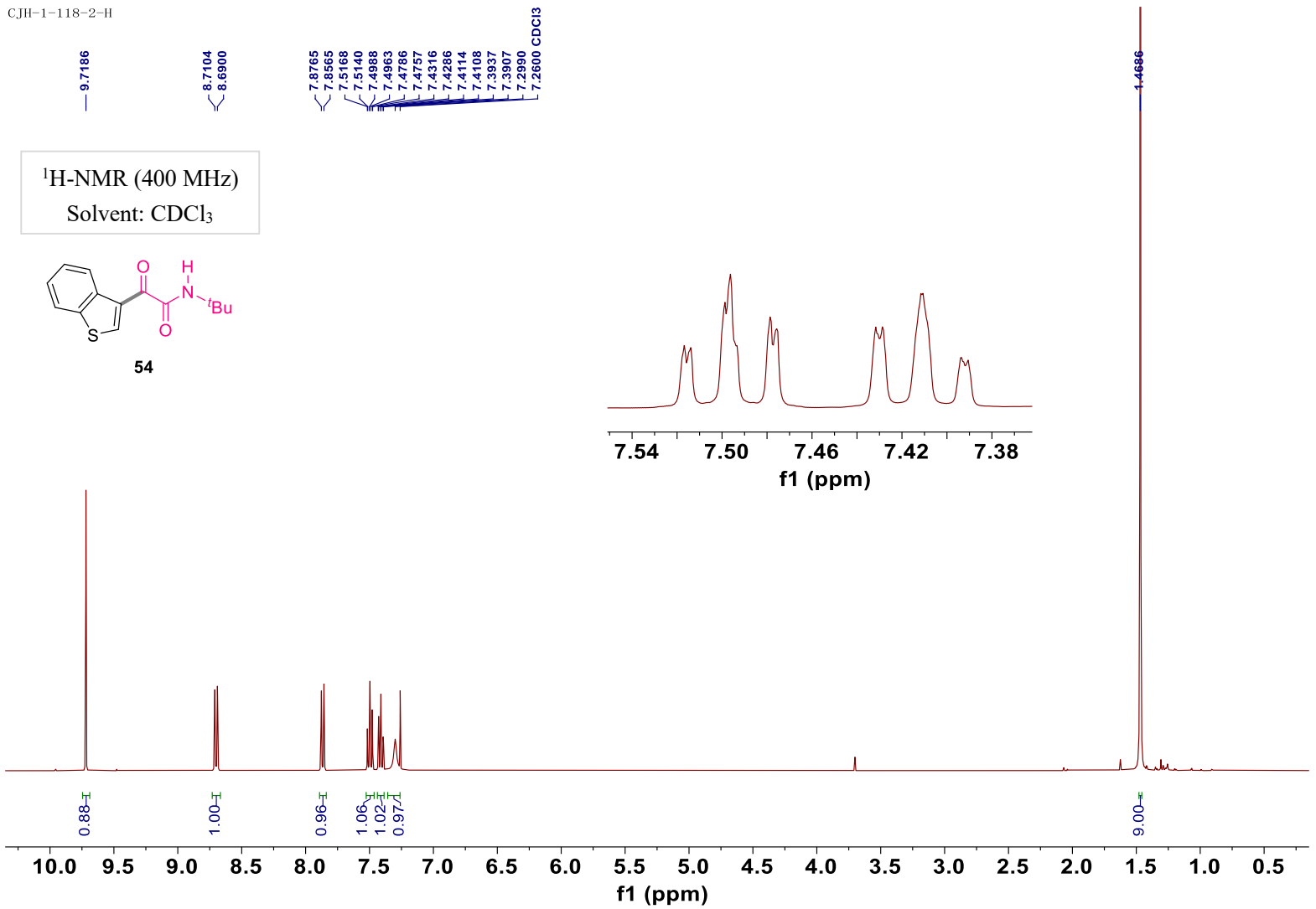

CJH-1-119-1-C
181.14
160.50
143.07
137.09
118.57
77.48
77.16 CDCl3
76.84
51.34
39.25
28.38
13C-NMR (101 MHz)
Solvent: CDCl3
Me
N
N
O
H
N
tBu
O
51
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

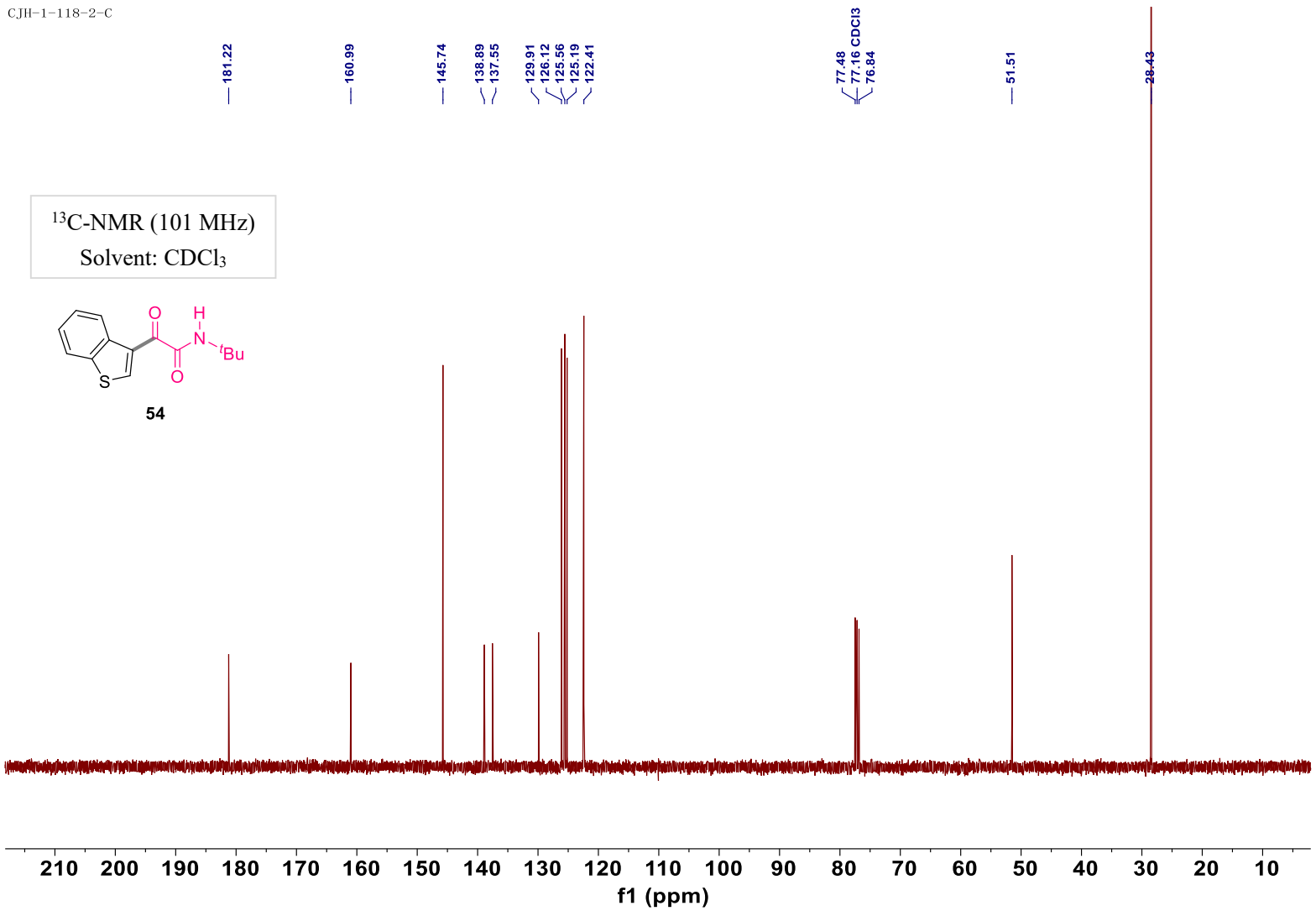

CJH-1-117-1-H
8.3497
8.3482
8.3404
8.3385
7.8132
7.8108
7.8010
7.7985
7.2600 CDCl3
7.1939
7.1761
7.1645
7.1539
1.4390
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
S
O
52
7.85
7.83
7.81
7.79
7.77
7.75
f1 (ppm)
0.95
0.93
1.92
9.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

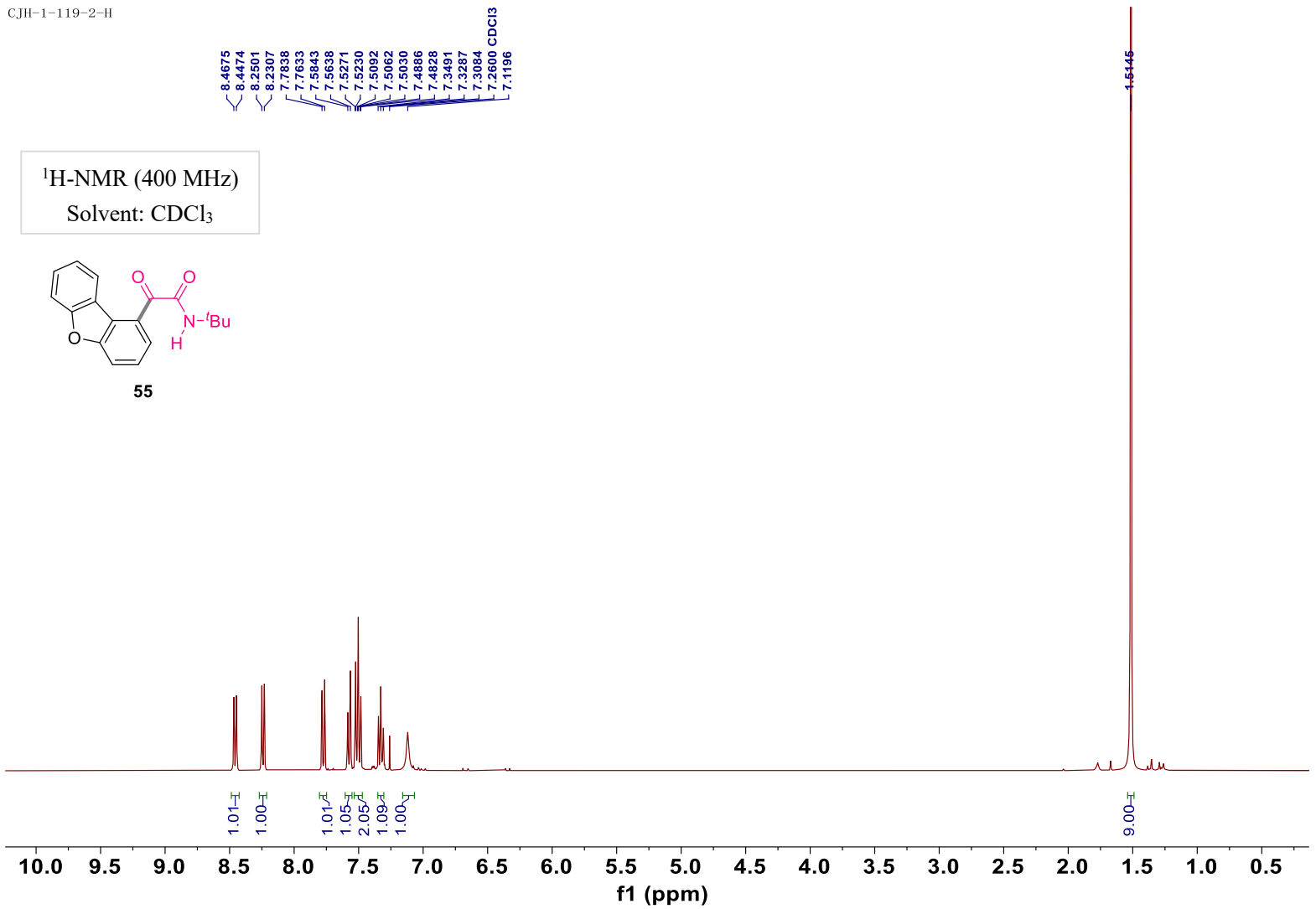

CJH-1-117-1-C
179.33
160.11
138.79
138.03
136.29
128.09
77.48
77.16 CDCl3
76.84
51.71
28.48
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
S
52
141 140 139 138 137 136 135 134
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

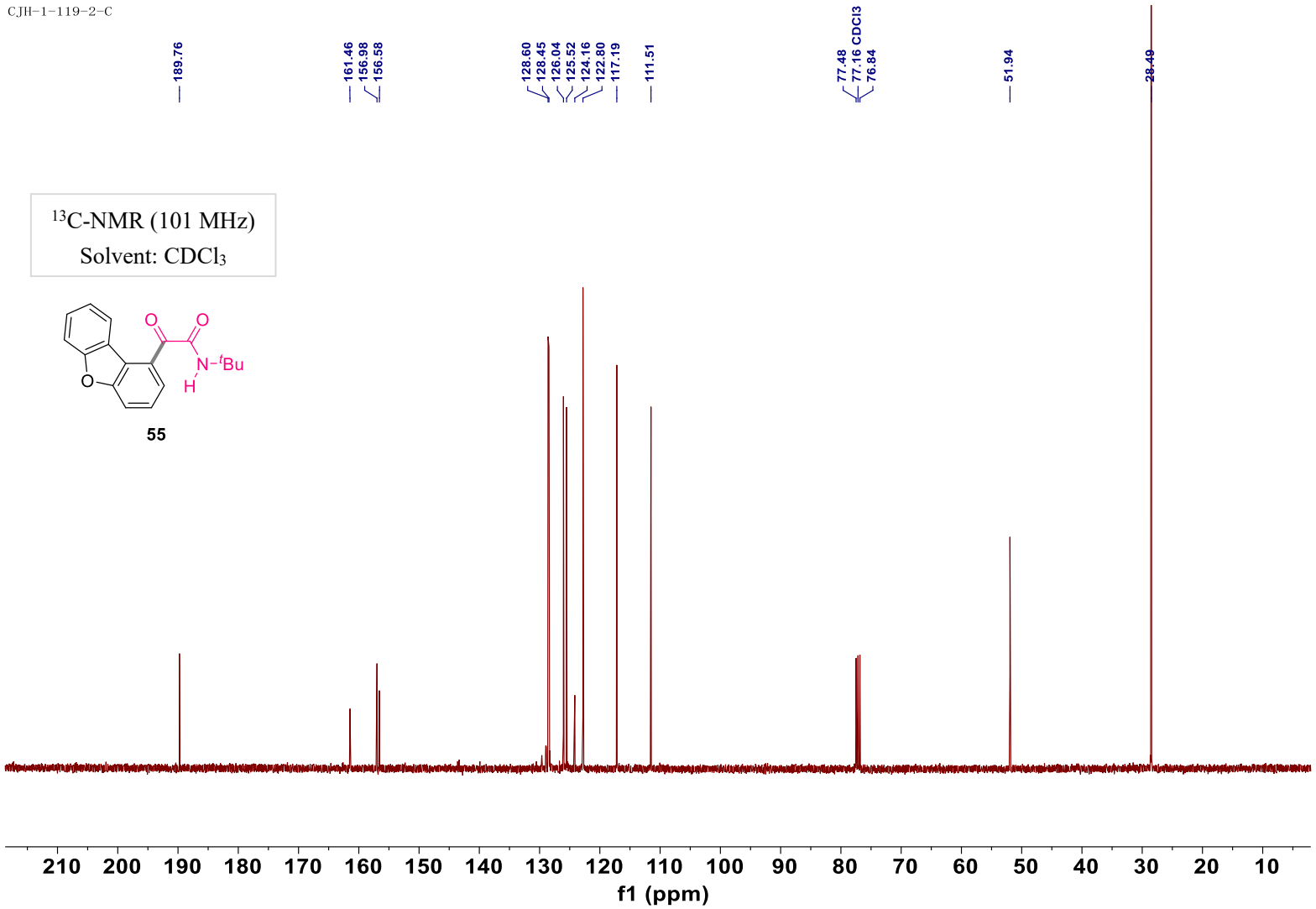

CJH-1-117-2-H
9.0877
9.0849
9.0803
9.0775
7.7341
7.7313
7.7212
7.7185
7.2730
7.2656
7.2600 CDCl3
7.2600
7.2527
7.1283
1.4422
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
S
53
9.12 9.10 9.08 9.06 9.04
f1 (ppm)
7.76 7.74 7.72 7.70 7.68
f1 (ppm)
7.32 7.28 7.24 7.20
f1 (ppm)
0.87
0.97
1.02
0.98
9.00
10.0 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
f1 (ppm)

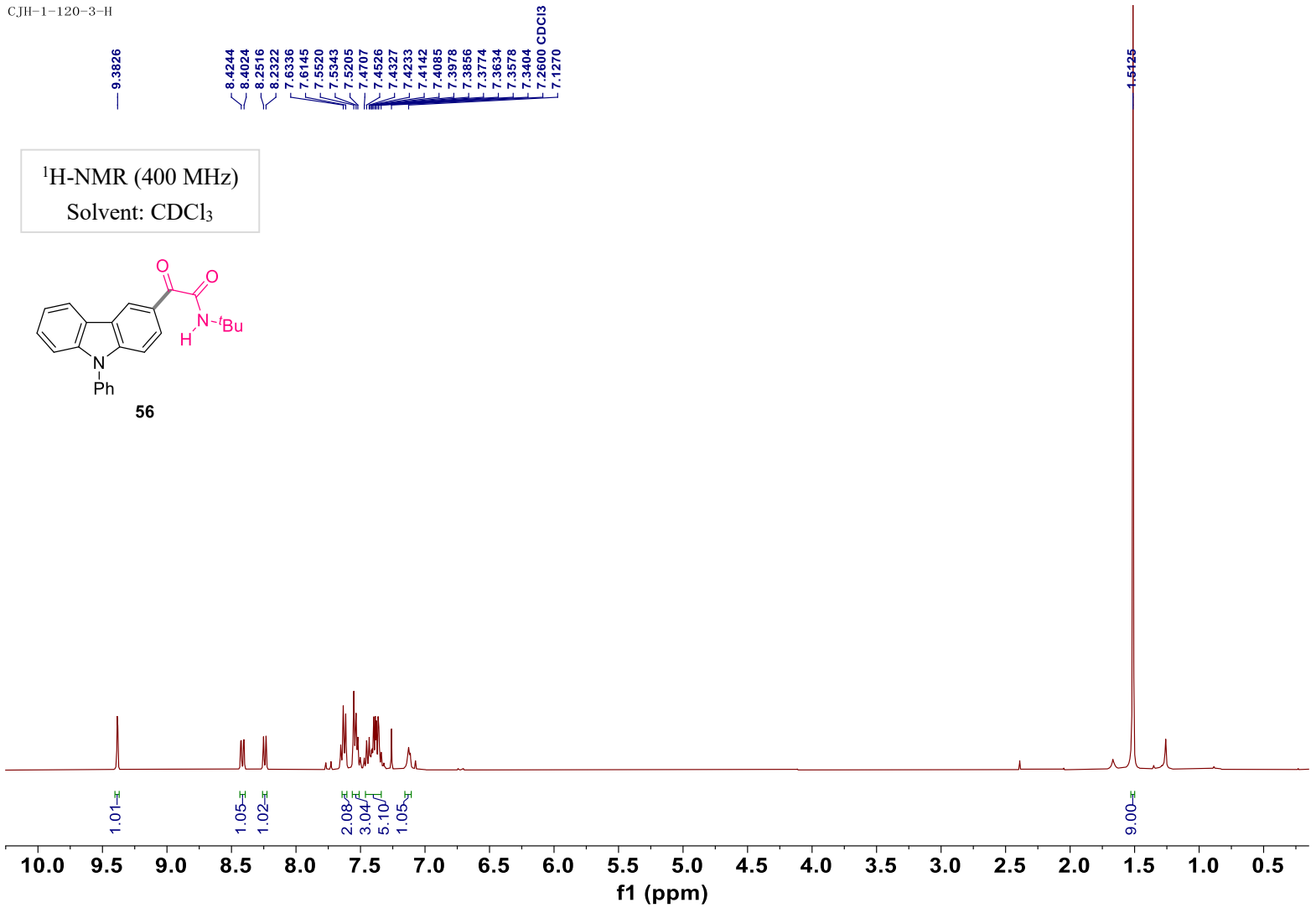

CJH-1-117-2-C
181.03
160.56
139.44
137.02
128.86
125.60
77.48
77.16 CDCl3
76.84
51.48
28.40
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
S
53
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

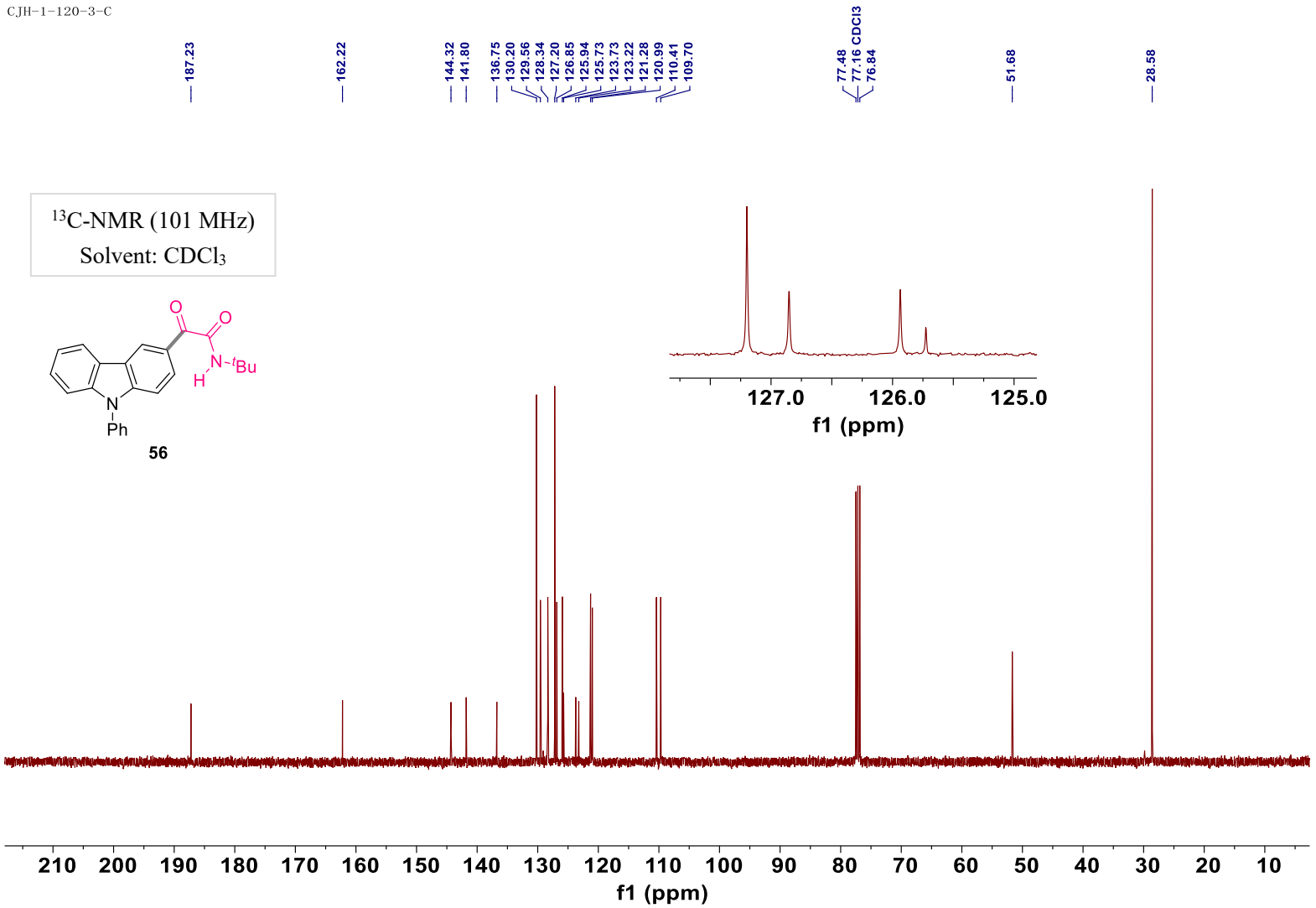

CJH-1-118-2-H
9.7186
8.7104
8.6900
7.8765
7.8565
7.5168
7.5140
7.4988
7.4963
7.4786
7.4757
7.4316
7.4286
7.4114
7.4108
7.3937
7.3907
7.2990
7.2600 CDCl3
1.4686
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
S
54
7.54
7.50
7.46
7.42
7.38
f1 (ppm)
0.88
1.00
0.96
1.06
1.02
0.97
9.00
10.0
9.5
9.0
8.5
8.0
7.5
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
f1 (ppm)


CJH-1-118-2-C
181.22
160.99
145.74
138.89
137.55
129.91
126.12
125.56
125.19
122.41
77.48
77.16 CDCl3
76.84
51.51
28.43
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
tBu
O
S
54
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

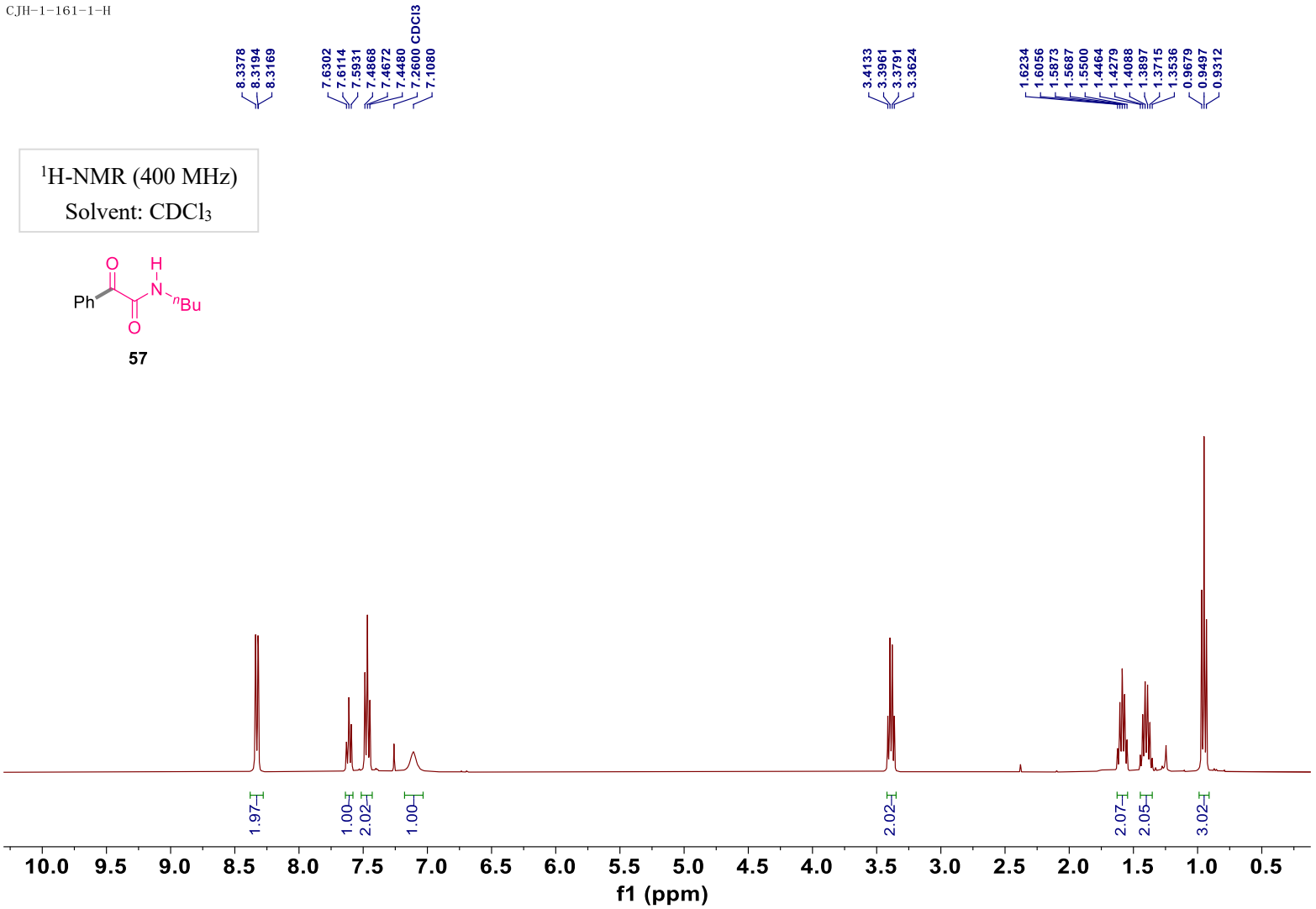

CJH-1-119-2-H
8.4675
8.4474
8.2501
8.2307
7.7838
7.7633
7.5843
7.5638
7.5271
7.5230
7.5092
7.5062
7.5030
7.4886
7.4828
7.3491
7.3287
7.3084
7.2600 CDCl3
7.1196
1.6145
1H-NMR (400 MHz)
Solvent: CDCl3
O
O
N-tBu
H
O
55
1.01
1.00
1.01
1.05
2.05
1.09
1.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

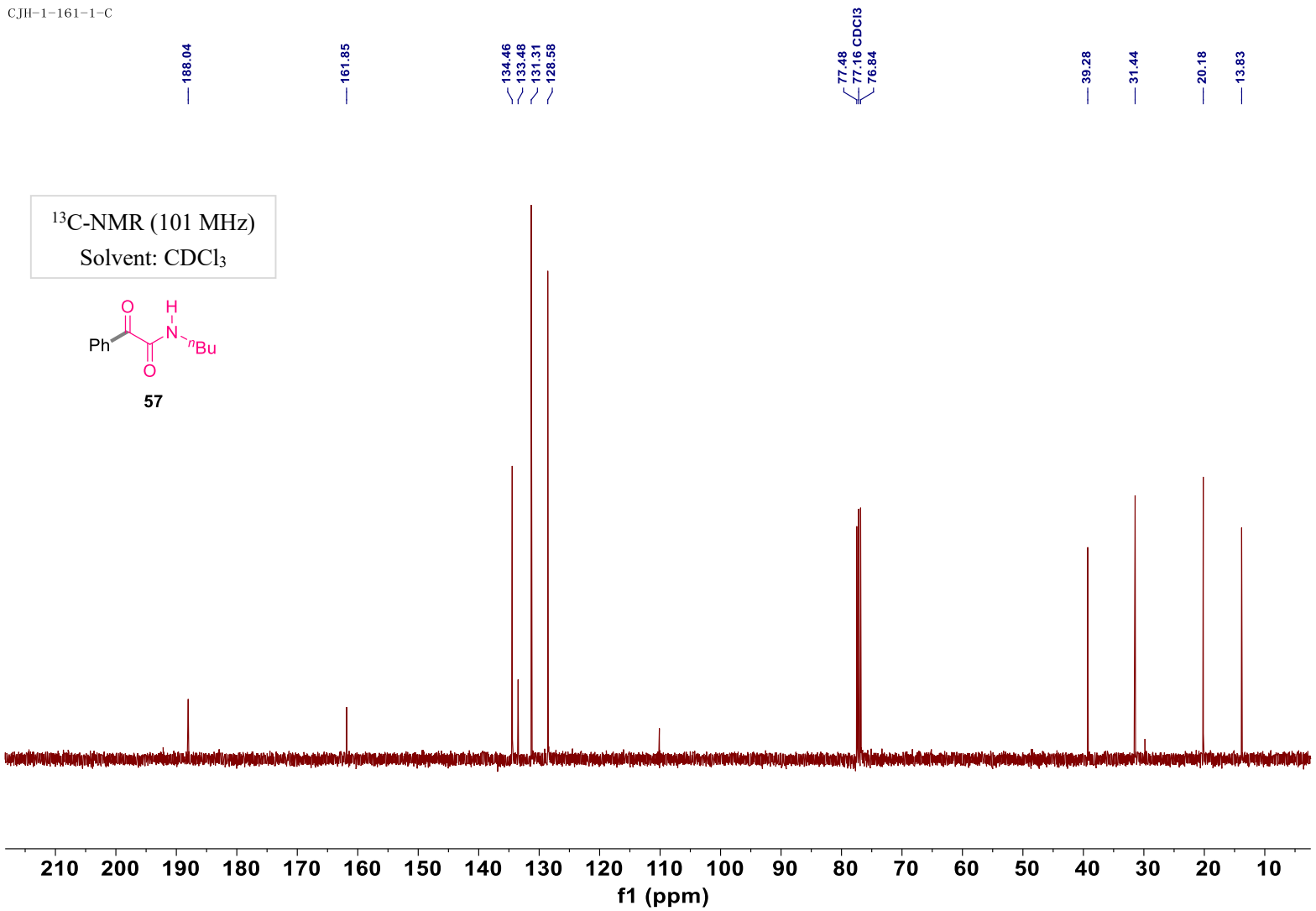

CJH-1-119-2-C
189.76
161.46
156.98
156.58
128.60
128.45
126.04
125.52
124.16
122.80
117.19
111.51
77.48
77.16 CDCl3
76.84
51.94
28.49
13C-NMR (101 MHz)
Solvent: CDCl3
O
O
N-tBu
H
O
55
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

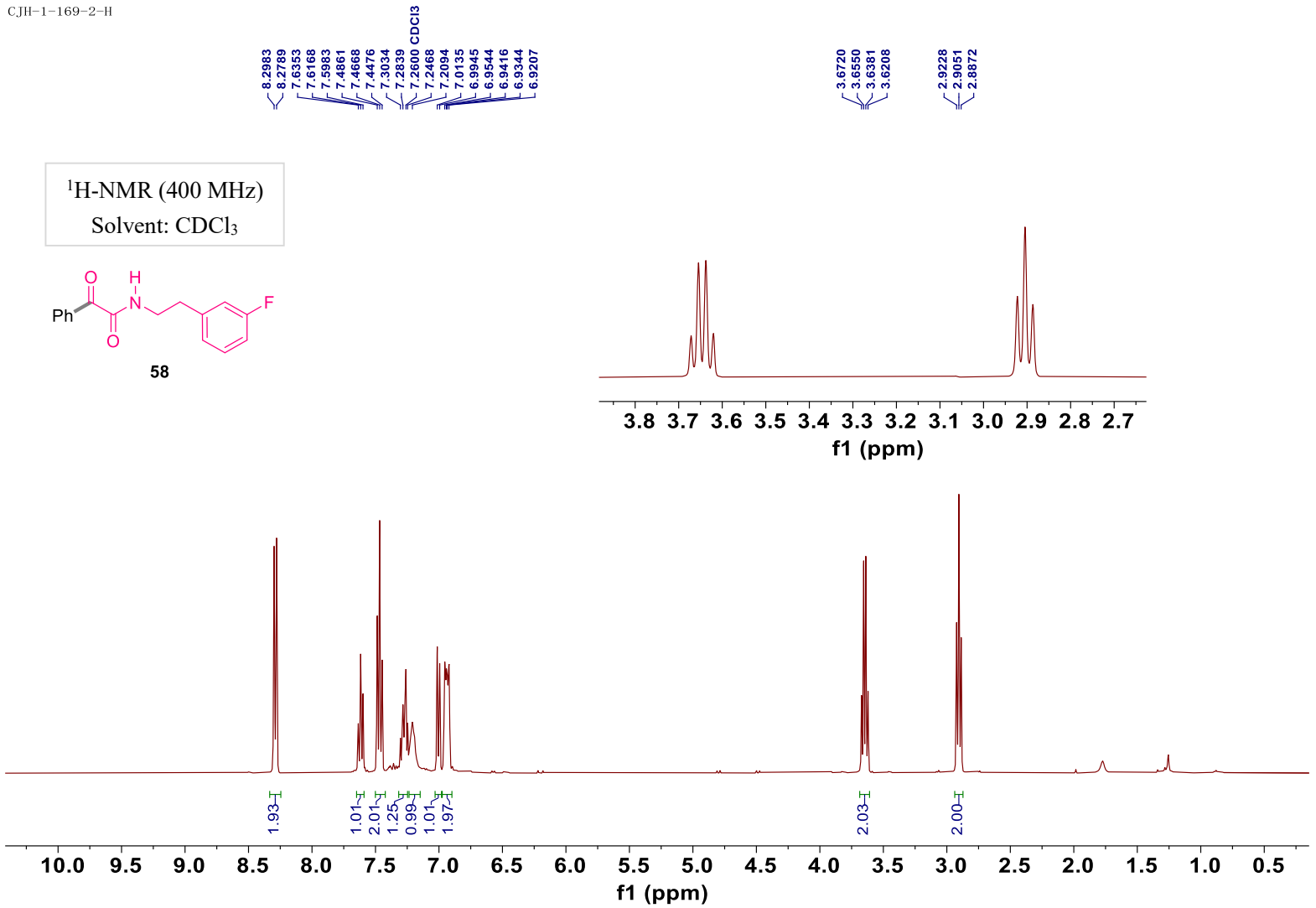

CJH-1-120-3-H
9.3826
8.4244
8.4024
8.2516
8.2322
7.6336
7.6145
7.5520
7.5343
7.5205
7.4707
7.4526
7.4327
7.4233
7.4142
7.4085
7.3978
7.3856
7.3774
7.3634
7.3578
7.3404
7.2600 CDCl3
7.1270
1.5125
1H-NMR (400 MHz)
Solvent: CDCl3
O
O
N
tBu
H
N
Ph
56
1.01
1.05
1.02
2.08
3.04
5.10
1.05
9.00
10.0 9.5 9.0 8.5 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
f1 (ppm)

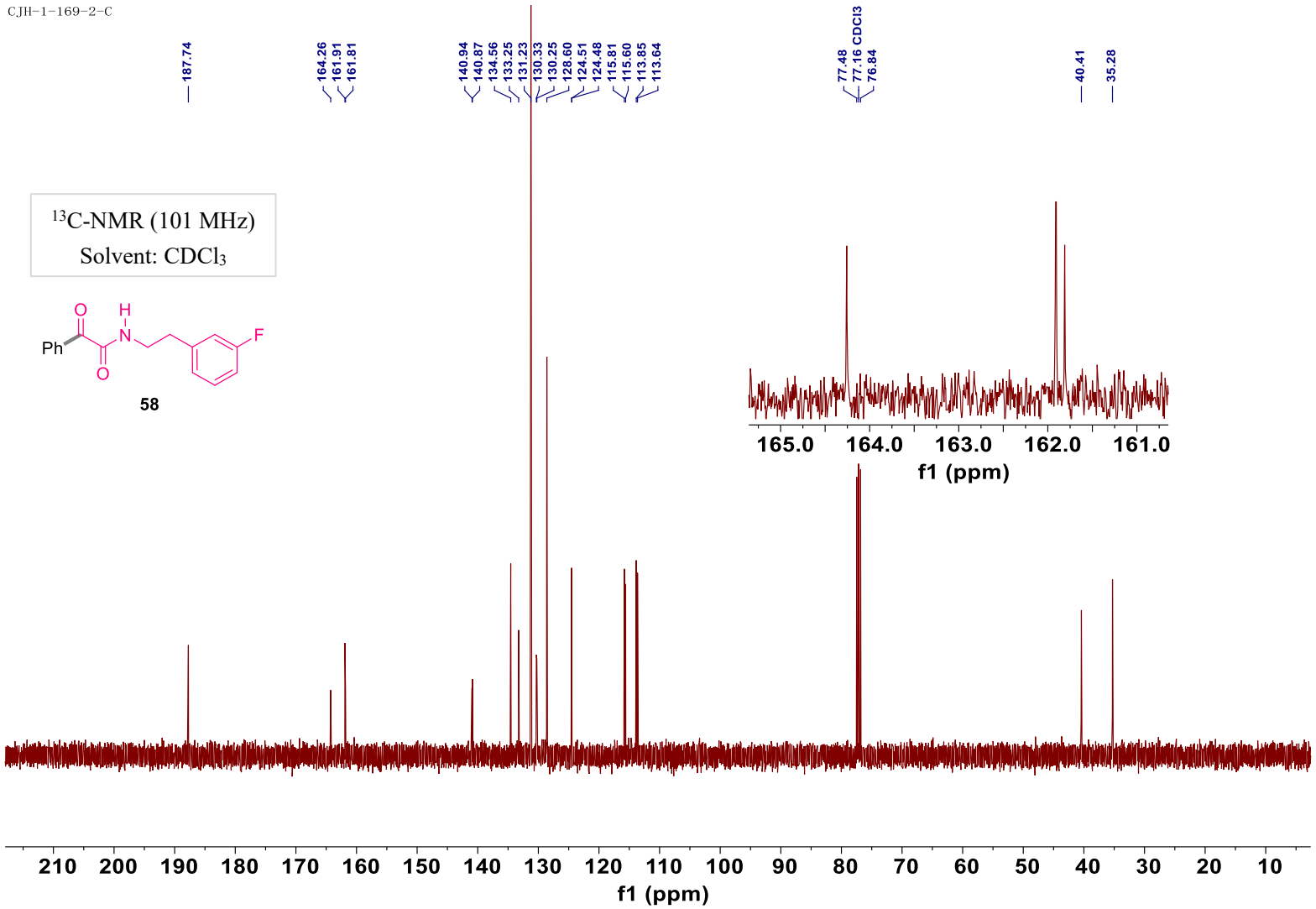

CJH-1-120-3-C
187.23
162.22
144.32
141.80
136.75
130.20
129.56
128.34
127.20
126.85
125.94
125.73
123.73
123.22
121.28
120.99
110.41
109.70
77.48
77.16 CDCl3
76.84
51.68
28.58
13C-NMR (101 MHz)
Solvent: CDCl3
O
O
N-tBu
H
N
Ph
56
127.0
126.0
125.0
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

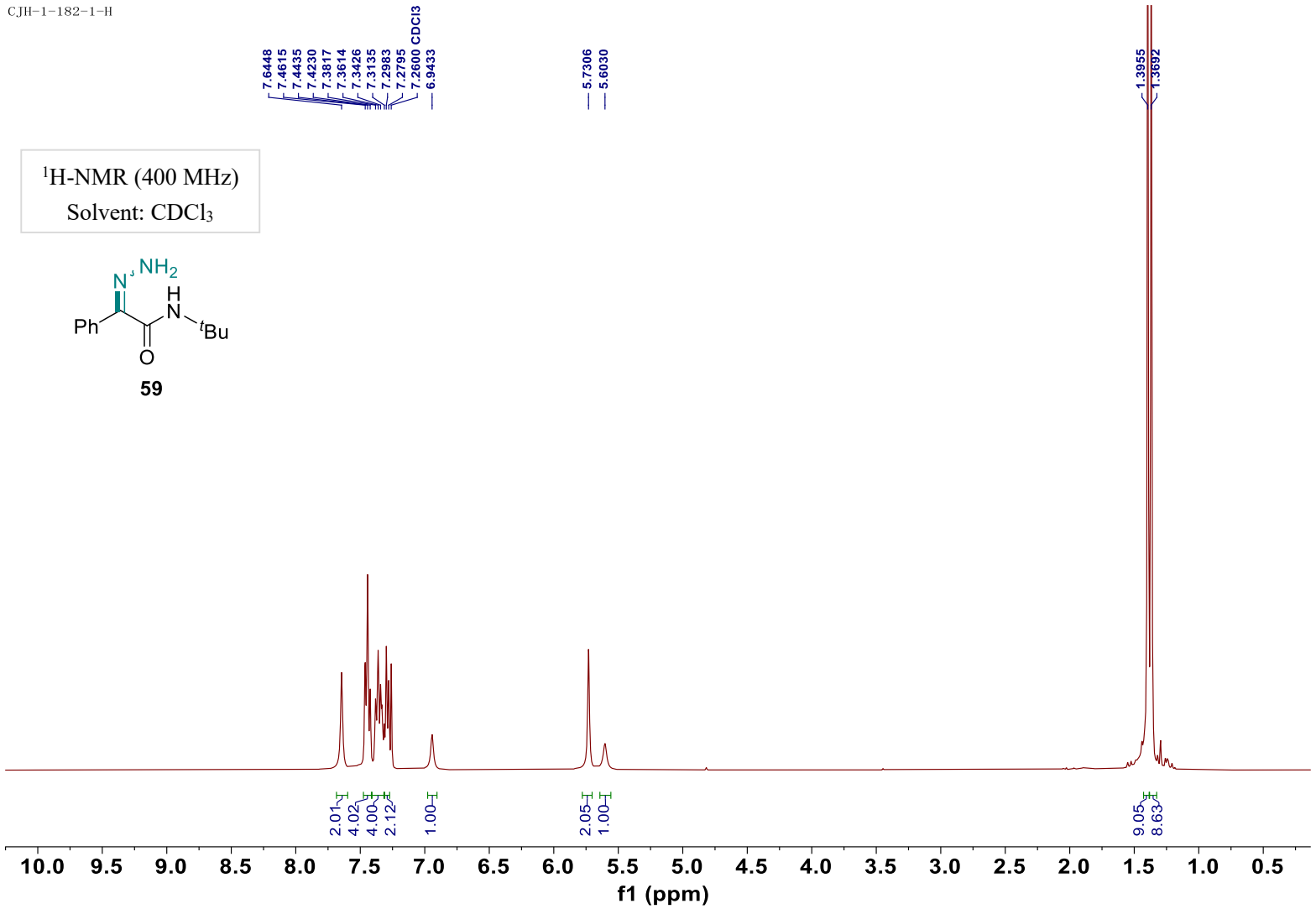
CJH-1-161-1-H

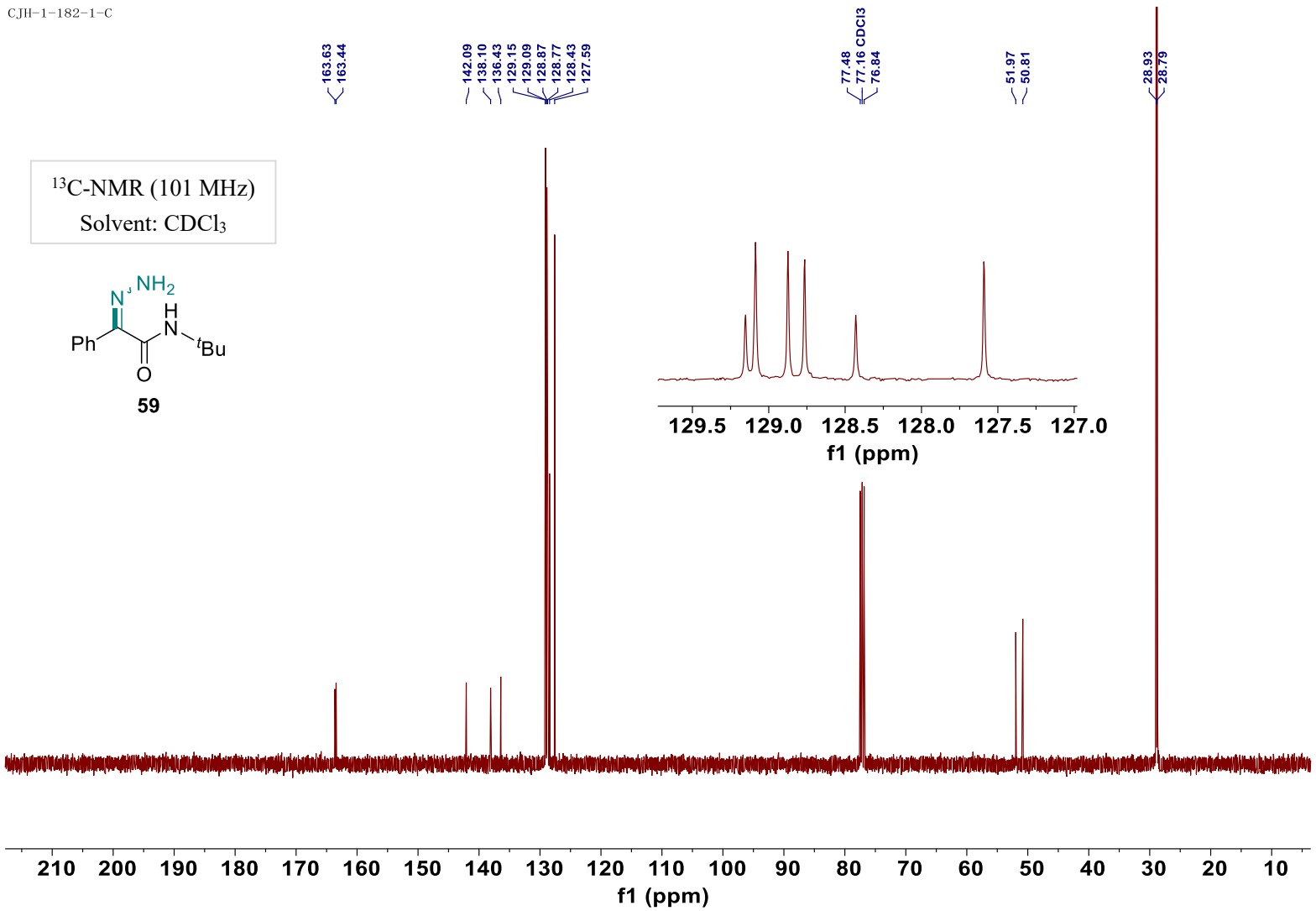

8.3378
8.3194
8.3169
7.6302
7.6114
7.5931
7.4868
7.4672
7.4480
7.2600 CDCl3
7.1080
3.4133
3.3961
3.3791
3.3624
1.6234
1.6056
1.5873
1.5687
1.5500
1.4464
1.4279
1.4088
1.3897
1.3715
1.3536
0.9679
0.9497
0.9312
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
nBu
Ph
O
57
1.97
1.00
2.02
1.00
2.02
2.07
2.05
3.02
10.0 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
f1 (ppm)

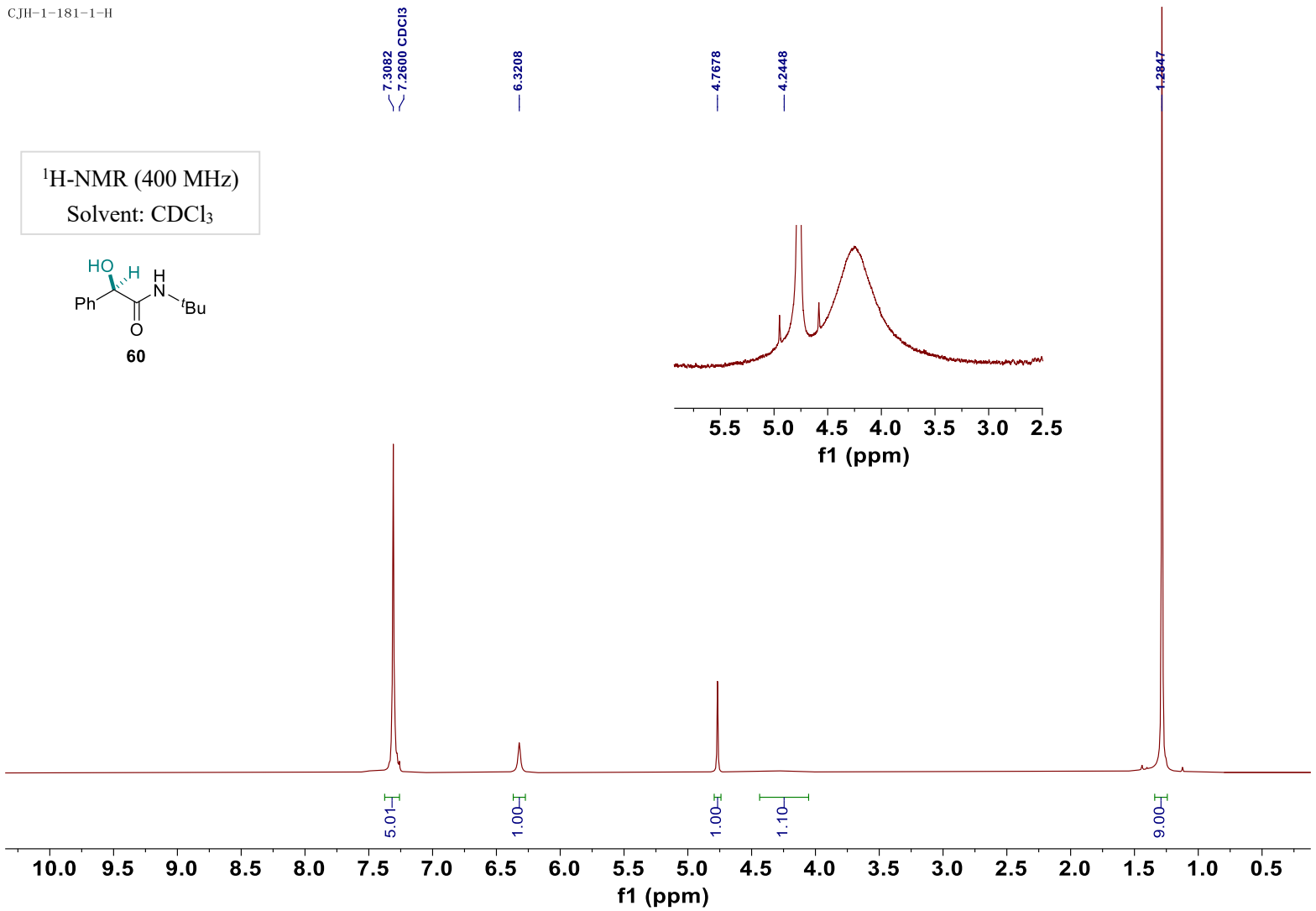

CJH-1-161-1-C
188.04
161.85
134.46
133.48
131.31
128.58
77.48
77.16 CDCl3
76.84
39.28
31.44
20.18
13.83
13C-NMR (101 MHz)
Solvent: CDCl3
Ph
O
H
N
nBu
O
57
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

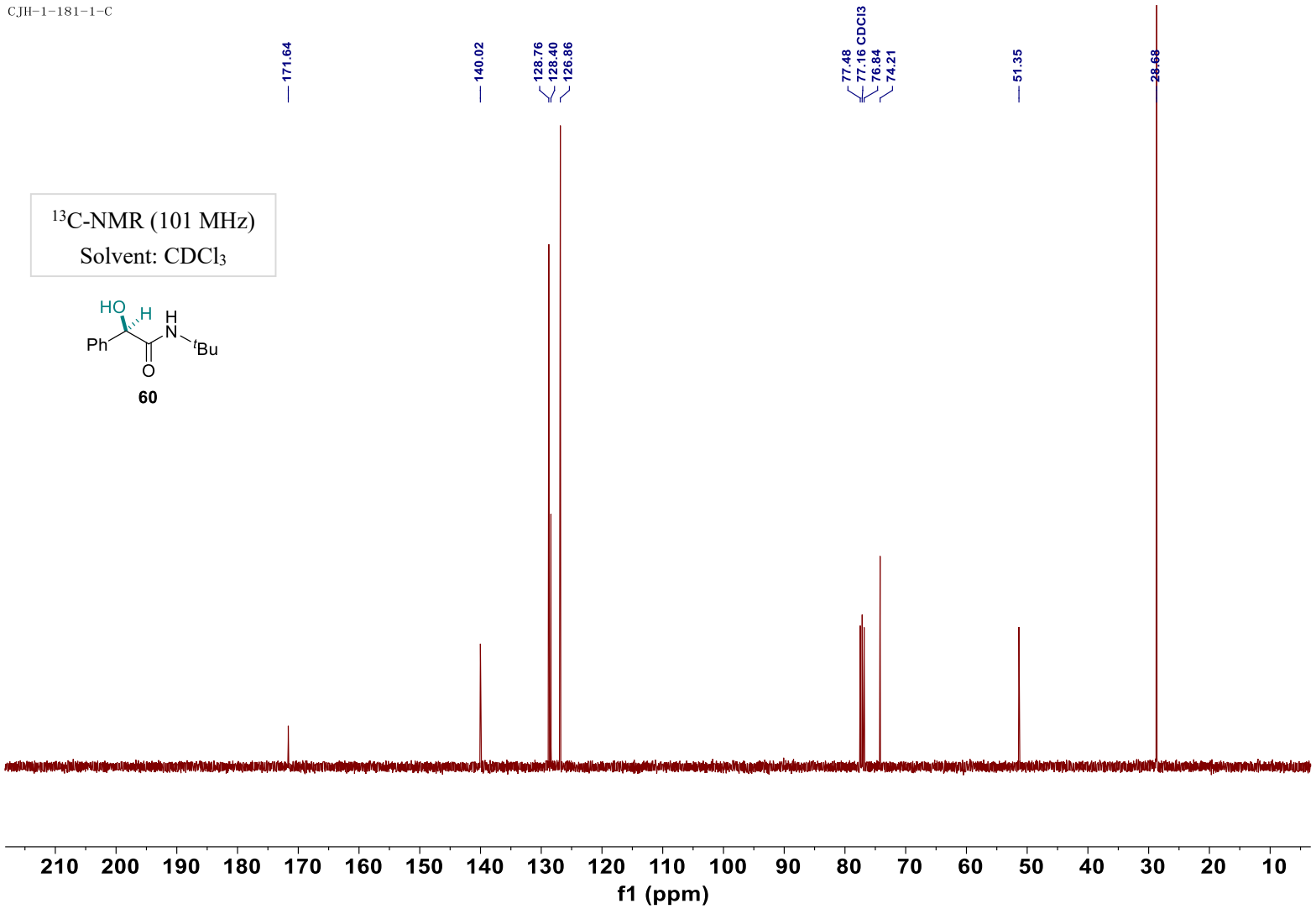

CJH-1-169-2-H
8.2983
8.2789
7.6353
7.6168
7.5983
7.4861
7.4668
7.4476
7.3034
7.2839
7.2600 CDCl3
7.2468
7.2094
7.0135
6.9945
6.9544
6.9416
6.9344
6.9207
3.6720
3.6550
3.6381
3.6208
2.9228
2.9051
2.8872
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
Ph
O
F
58
3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1 3.0 2.9 2.8 2.7
f1 (ppm)
1.93
1.01
2.01
1.25
0.99
1.01
1.97
2.03
2.00
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
f1 (ppm)

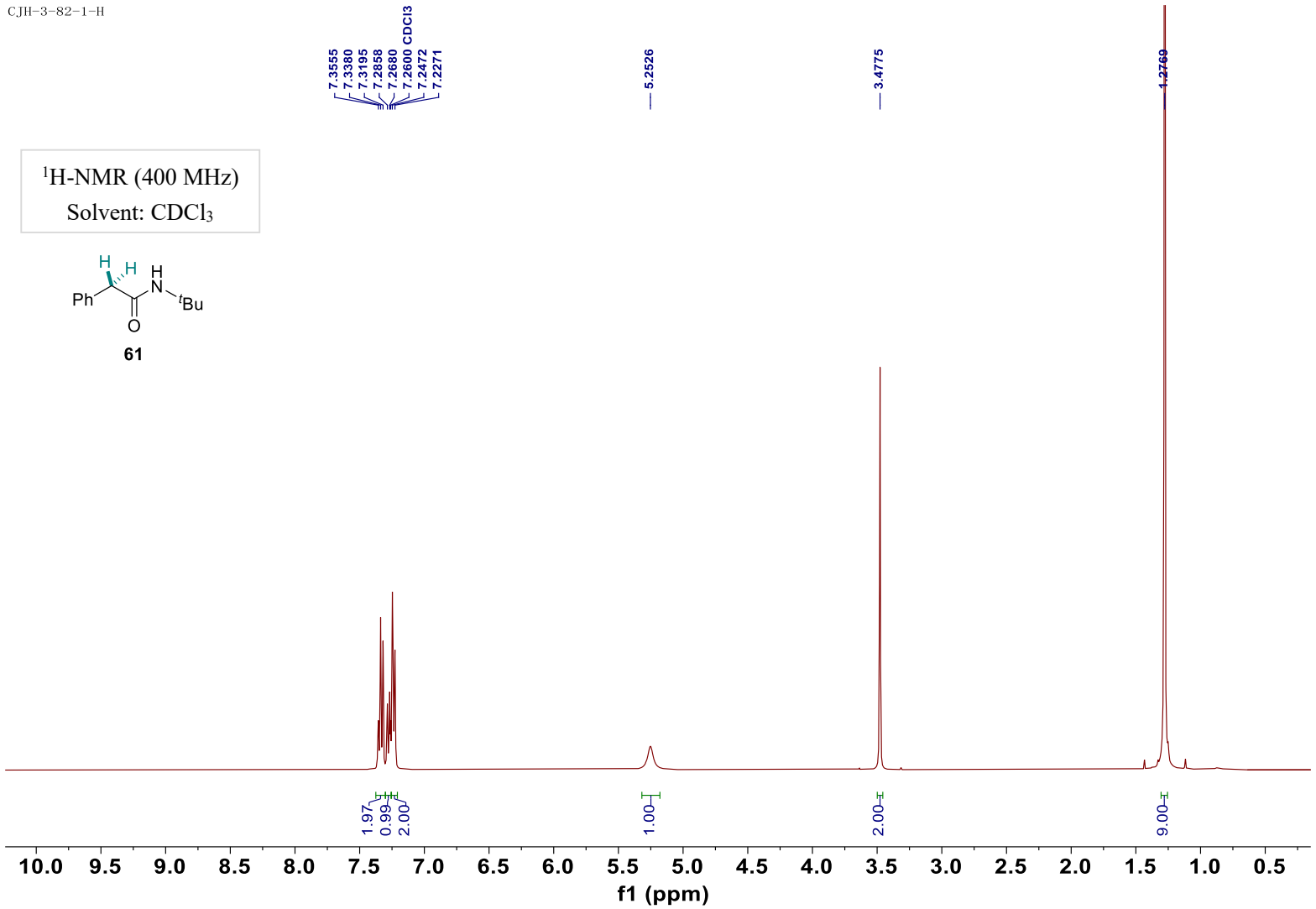

CJH-1-169-2-C
187.74
164.26
161.91
161.81
140.94
140.87
134.56
133.25
131.23
130.33
130.25
128.60
124.51
124.48
115.81
115.60
113.85
113.64
77.48
77.16 CDCl3
76.84
40.41
35.28
13C-NMR (101 MHz)
Solvent: CDCl3
Ph
O
H
N
O
F
58
165.0
164.0
163.0
162.0
161.0
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

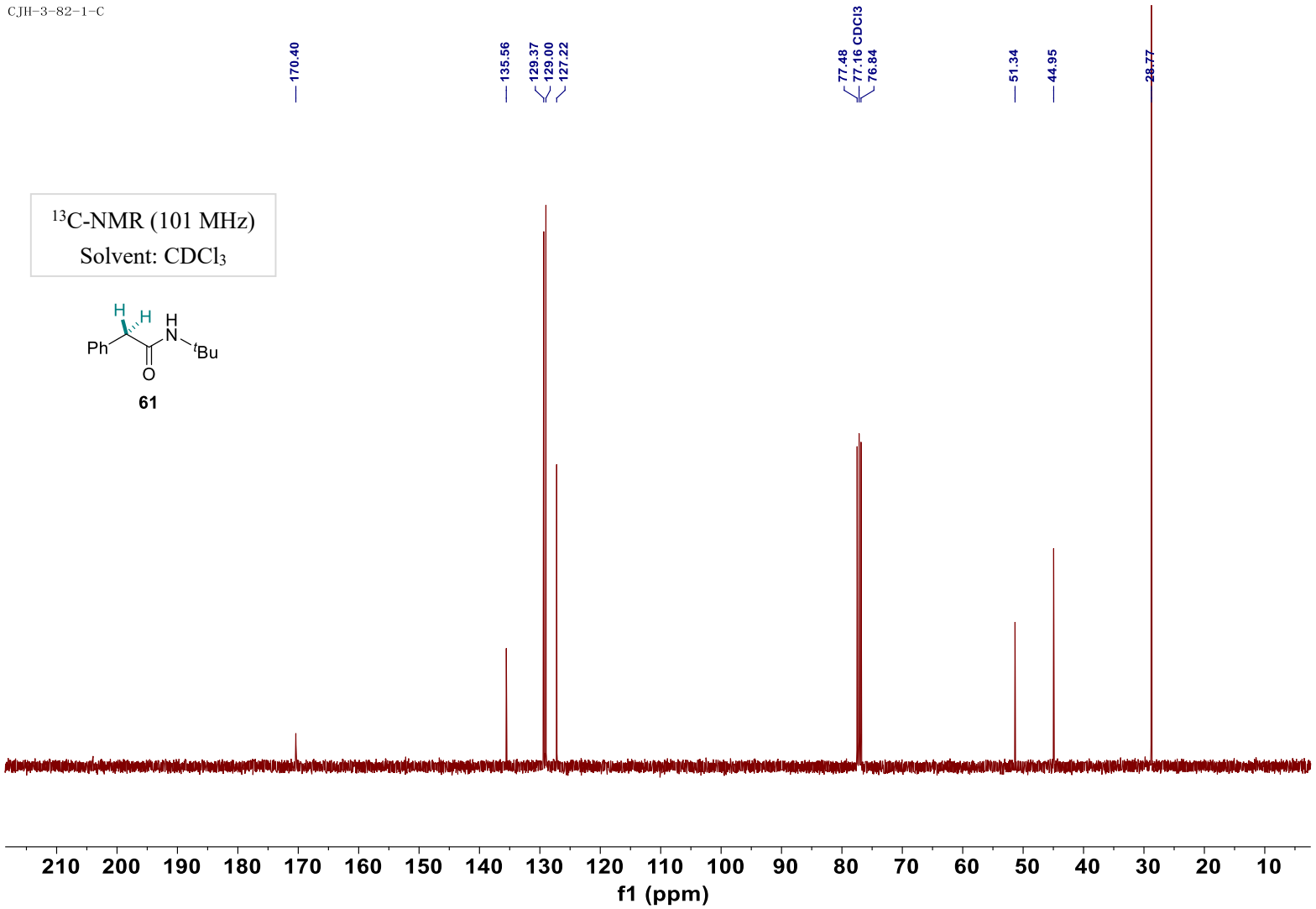

CJH-1-182-1-H
7.6448
7.4615
7.4435
7.4230
7.3817
7.3614
7.3426
7.3135
7.2983
7.2795
7.2600 CDCl3
6.9433
5.7306
5.6030
1.3955
1.3692
1H-NMR (400 MHz)
Solvent: CDCl3
NH2
N
H
N
Ph
tBu
O
59
2.01
4.02
4.00
2.12
1.00
2.05
1.00
9.05
8.63
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

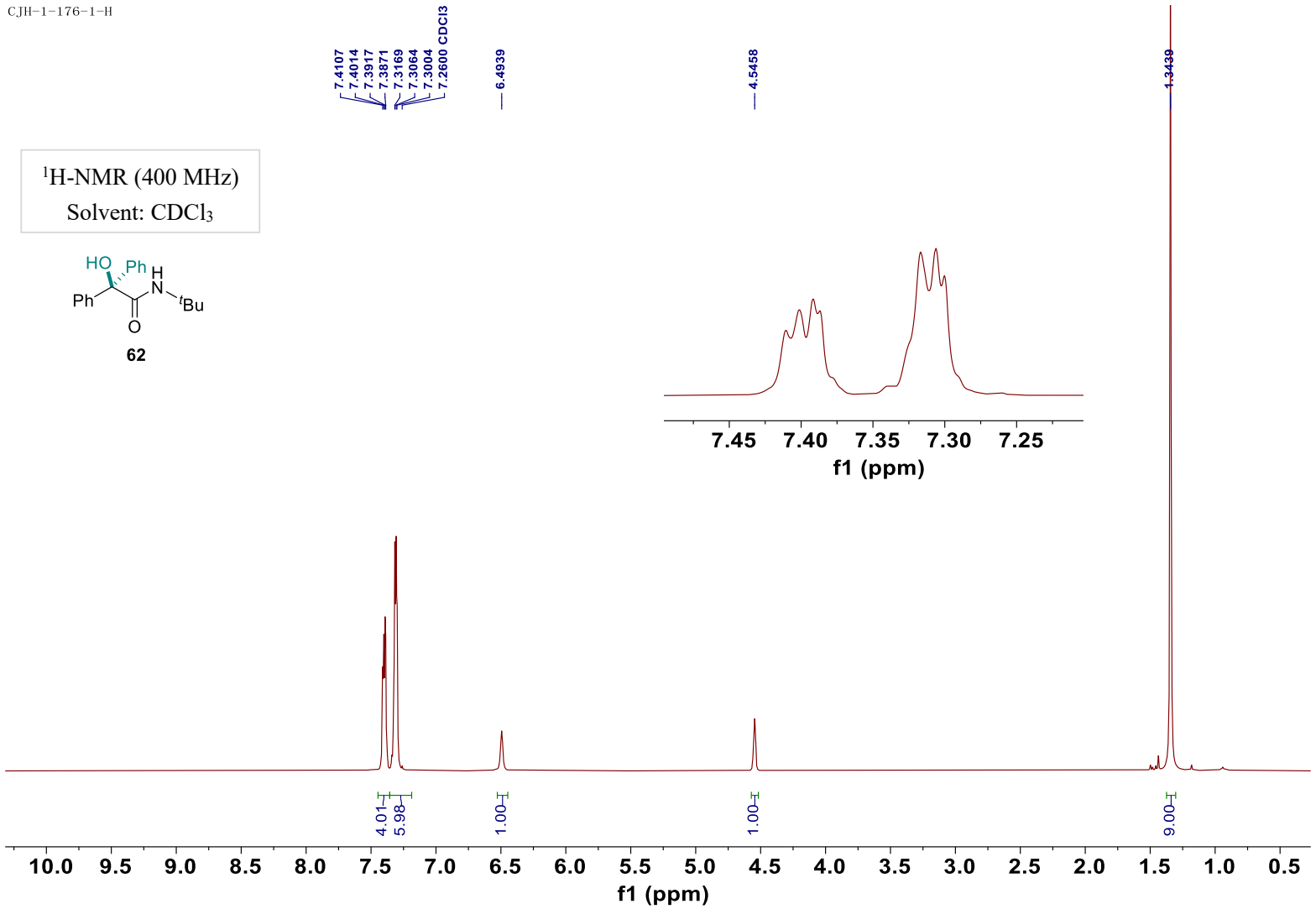

CJH-1-182-1-C
163.63
163.44
142.09
138.10
136.43
129.15
129.09
128.87
128.77
128.43
127.59
77.48
77.16 CDCl3
76.84
51.97
50.81
28.93
28.79
13C-NMR (101 MHz)
Solvent: CDCl3
NH2
N
H
N
Ph
tBu
O
59
129.5 129.0 128.5 128.0 127.5 127.0
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

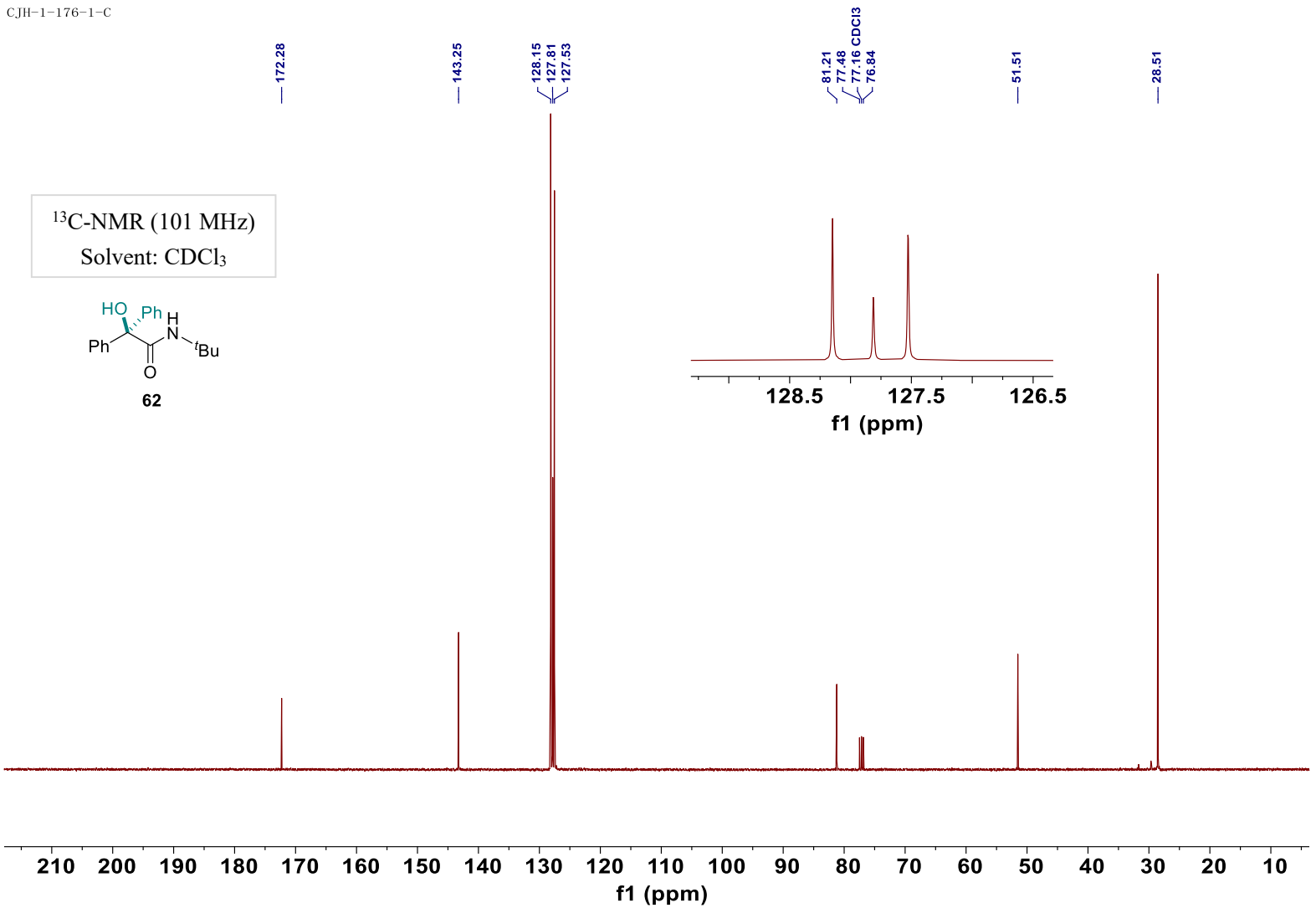

CJH-1-181-1-H
7.3082
7.2600 CDCl3
6.3208
4.7678
4.2448
1.2847
1H-NMR (400 MHz)
Solvent: CDCl3
HO
H
H
N
Ph
tBu
O
60
5.5 5.0 4.5 4.0 3.5 3.0 2.5
f1 (ppm)
5.01
1.00
1.00
1.10
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


CJH-1-181-1-C
171.64
140.02
128.76
128.40
126.86
77.48
77.16 CDCl3
76.84
74.21
51.35
28.68
13C-NMR (101 MHz)
Solvent: CDCl3
HO
H
H
N
Ph
tBu
O
60
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

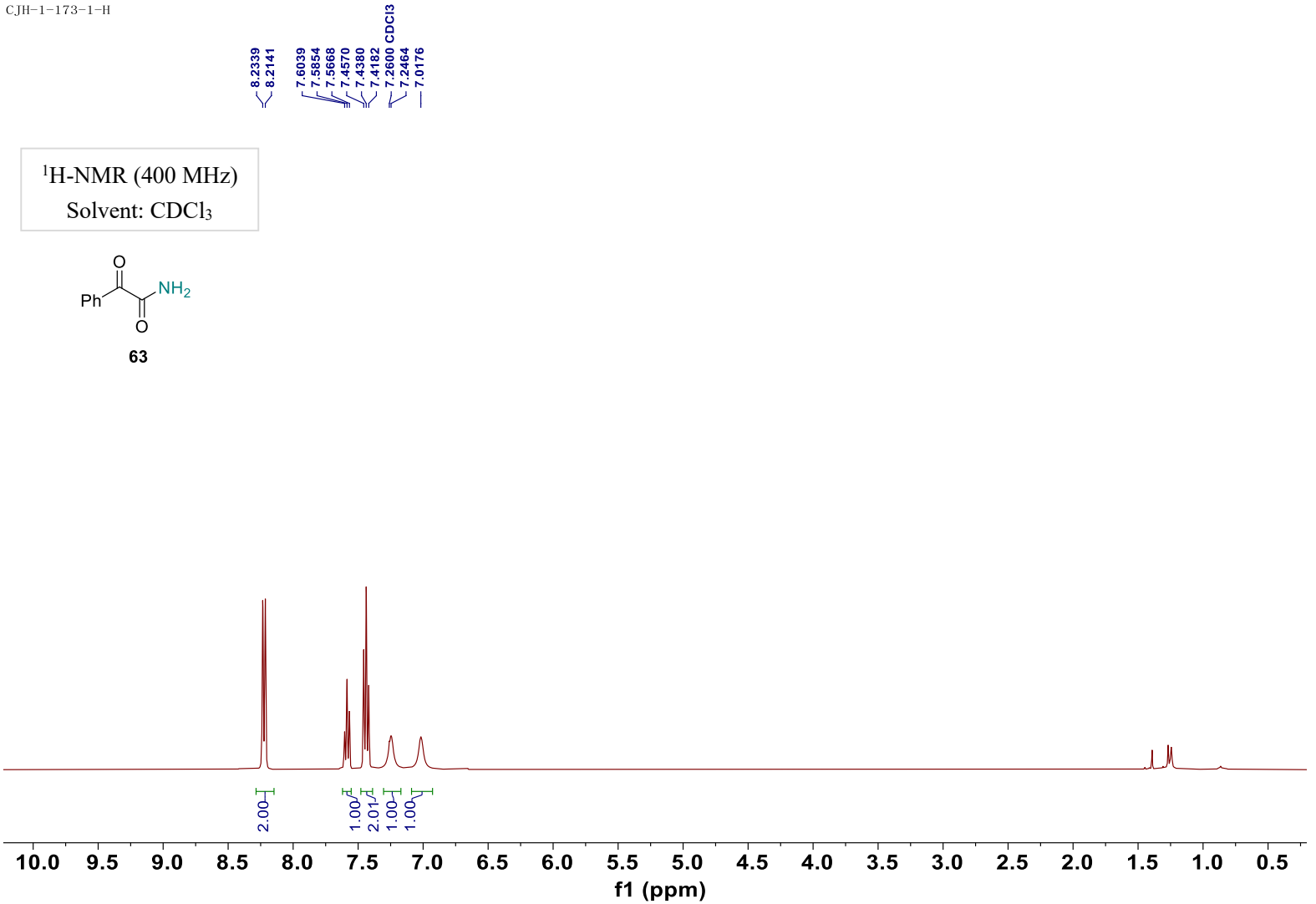

CJH-3-82-1-H
7.3555
7.3380
7.3195
7.2858
7.2680
7.2600 CDCl3
7.2472
7.2271
5.2526
3.4775
1.2769
1H-NMR (400 MHz)
Solvent: CDCl3
Ph
H
H
N
tBu
O
61
1.97
0.99
2.00
1.00
2.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


CJH-3-82-1-C
170.40
135.56
129.37
129.00
127.22
77.48
77.16 CDCl3
76.84
51.34
44.95
28.77
13C-NMR (101 MHz)
Solvent: CDCl3
Ph
H
H
N
tBu
O
61
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-1-176-1-H
7.4107
7.4014
7.3917
7.3871
7.3169
7.3064
7.3004
7.2600 CDCl3
6.4939
4.5458
1.3439
1H-NMR (400 MHz)
Solvent: CDCl3
HO
Ph
H
N
tBu
Ph
O
62
7.45 7.40 7.35 7.30 7.25
f1 (ppm)
4.01
5.98
1.00
1.00
9.00
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
f1 (ppm)

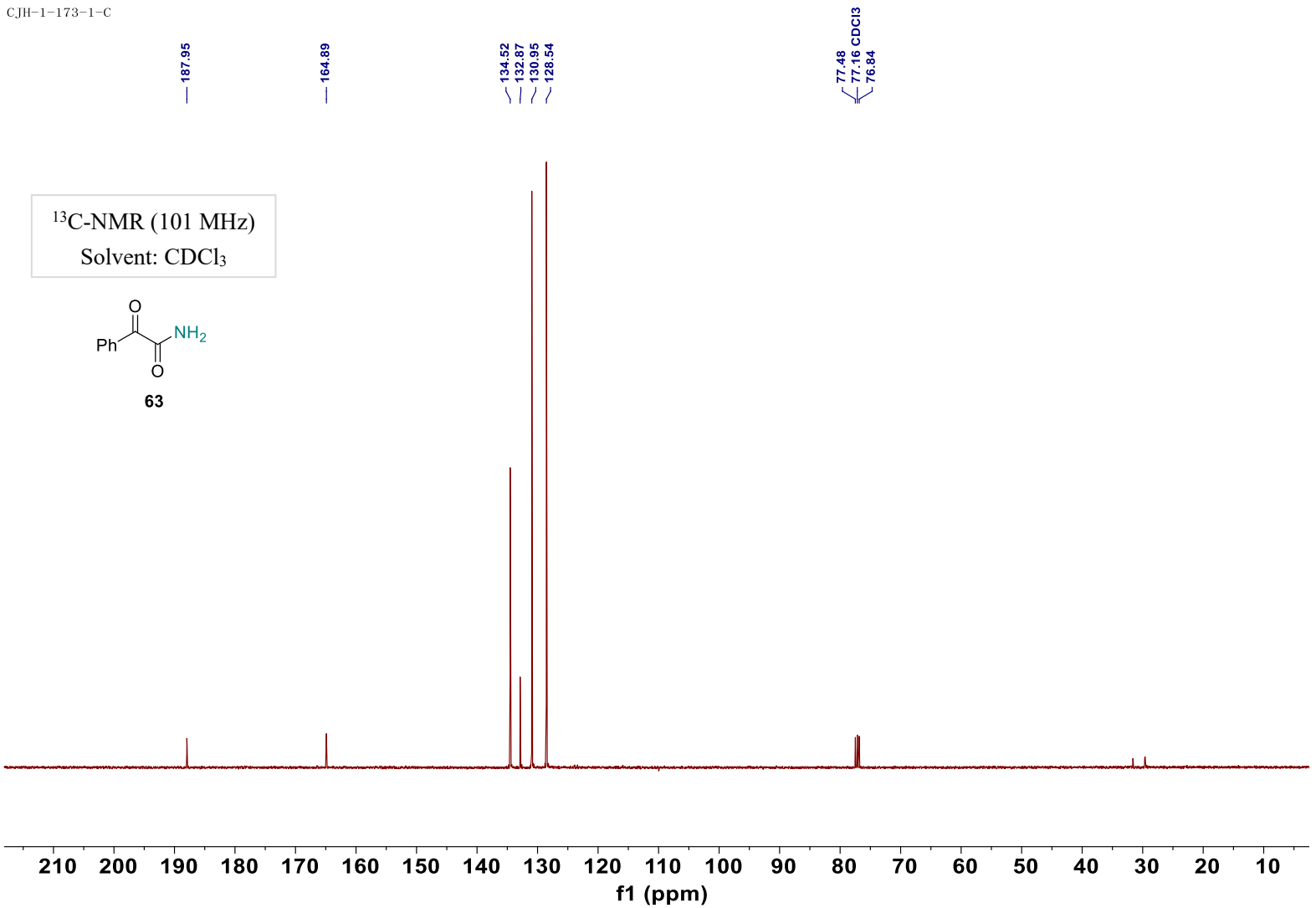

CJH-1-176-1-C
172.28
143.25
128.15
127.81
127.53
81.21
77.48
77.16 CDCl3
76.84
51.51
28.51
13C-NMR (101 MHz)
Solvent: CDCl3
HO
Ph
H
N
Ph
tBu
O
62
128.5
127.5
126.5
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

CJH-1-173-1-H



^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$

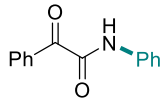
63


CJH-1-173-1-C
187.95
164.89
134.52
132.87
130.95
128.54
77.48
77.16 CDCl3
76.84
^{13}C-NMR (101 MHz)
Solvent: $CDCl_3$
O
Ph
NH_2
O
63
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

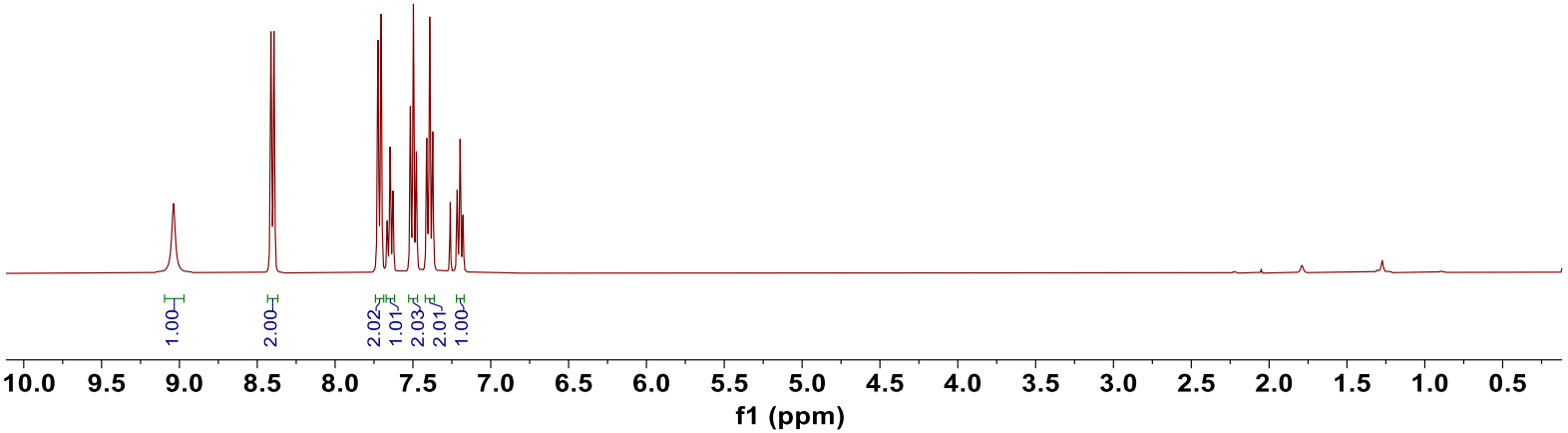
CJH-1-184-1-H

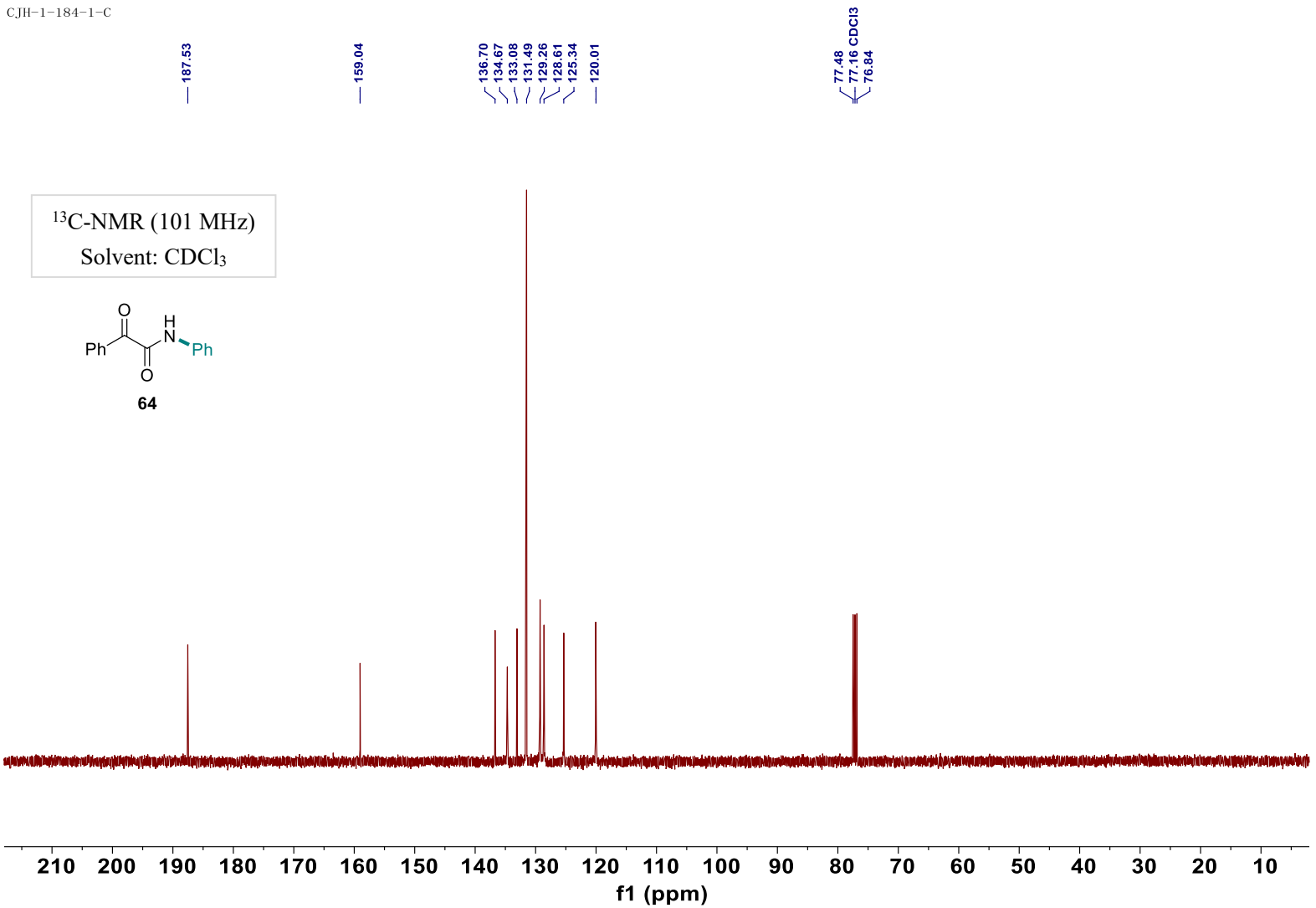
9.0378
8.4120
8.3925
7.7245
7.7044
7.6651
7.6465
7.6281
7.5163
7.4970
7.4776
7.4115
7.3922
7.3724
7.2600 CDCl3
7.2155
7.1969
7.1784

^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$

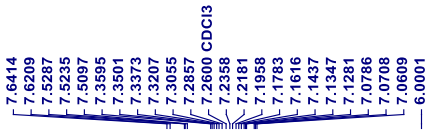


64

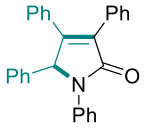



CJH-1-184-1-C
187.53
159.04
136.70
134.67
133.08
131.49
129.26
128.61
125.34
120.01
77.48
77.16 CDCl3
76.84
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
Ph
Ph
O
64
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

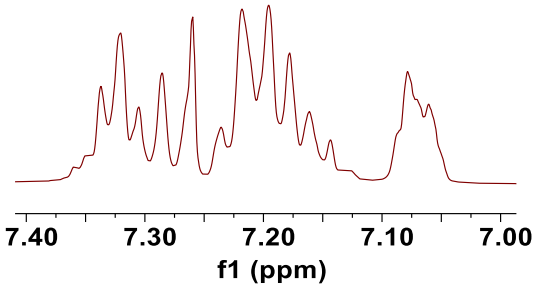
CJH-1-174-2-H

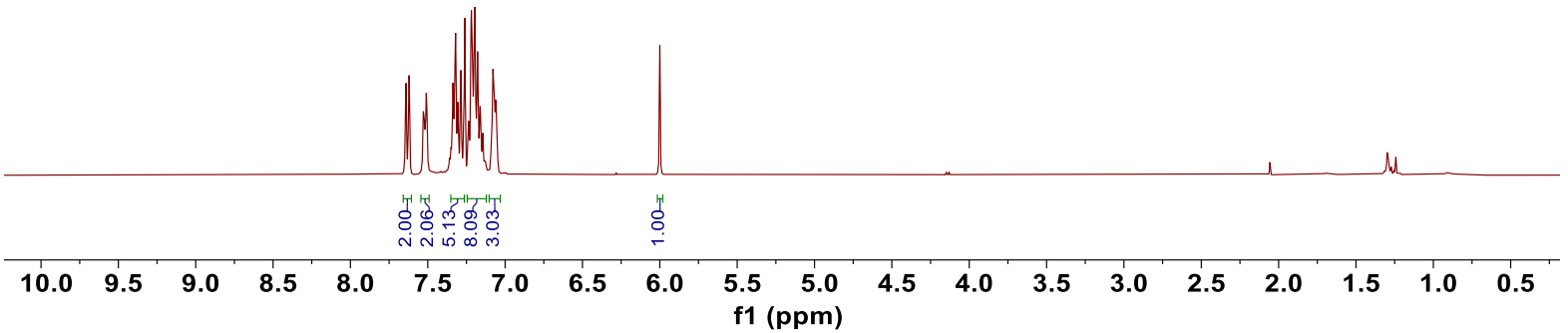


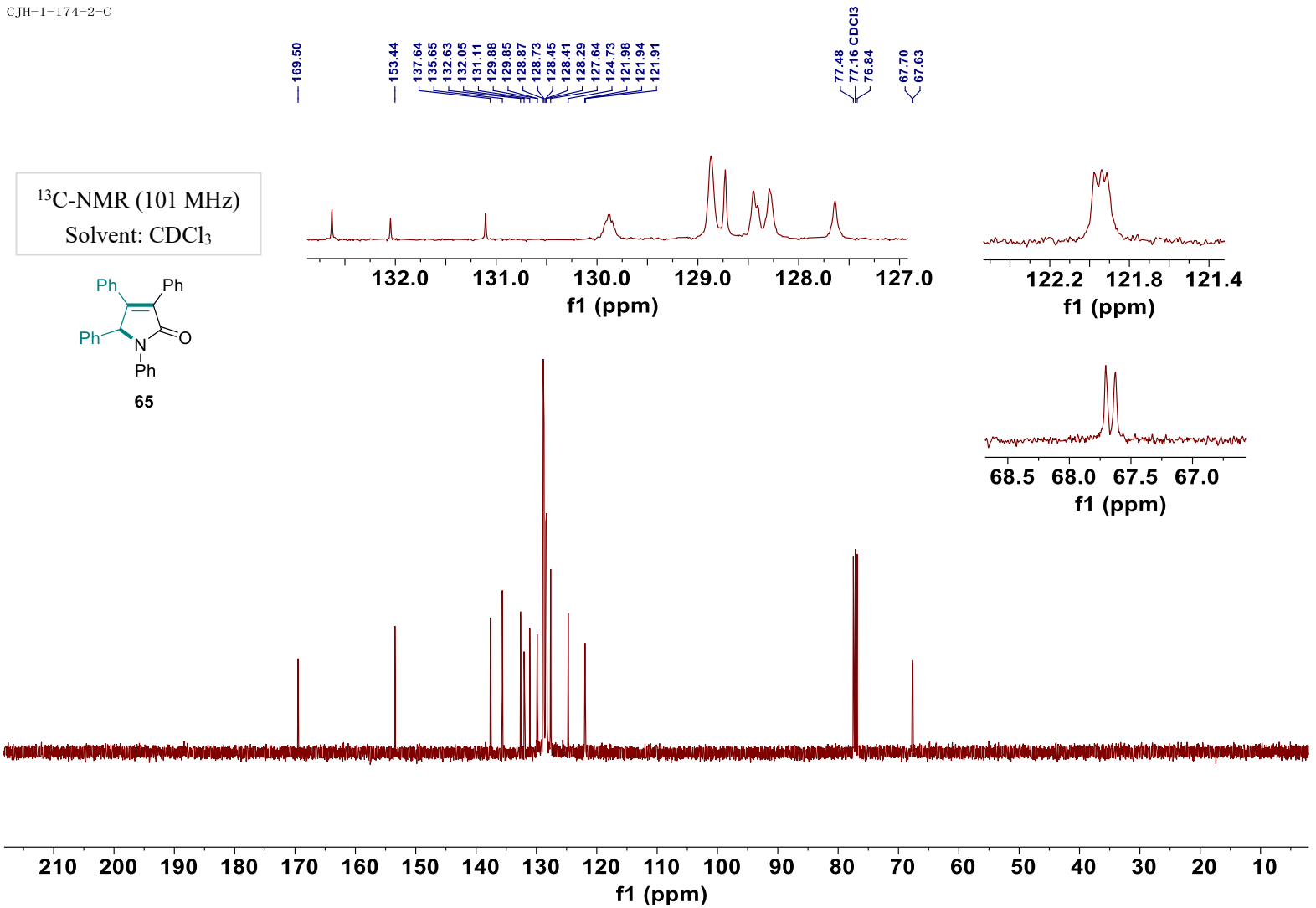
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$

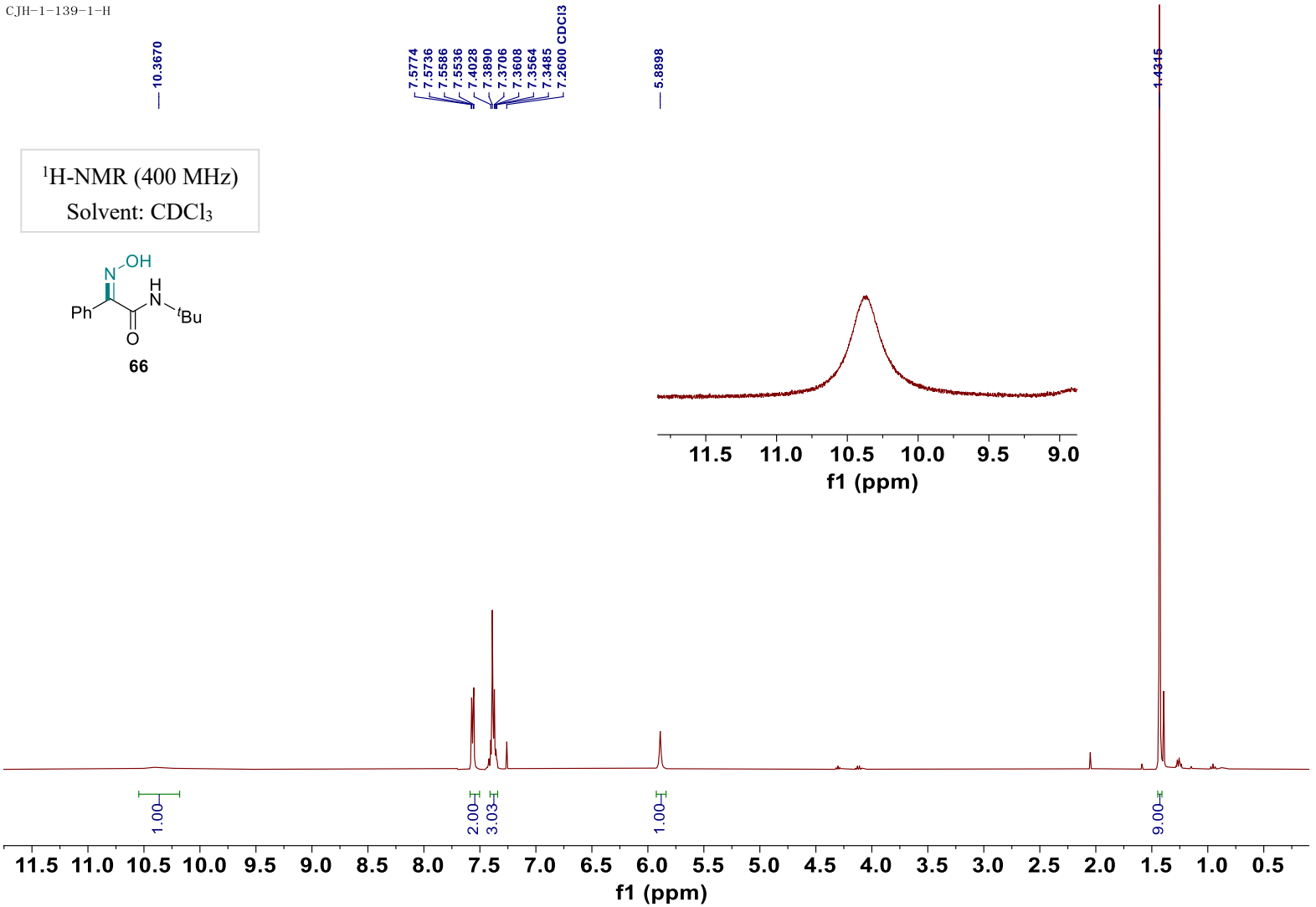


65

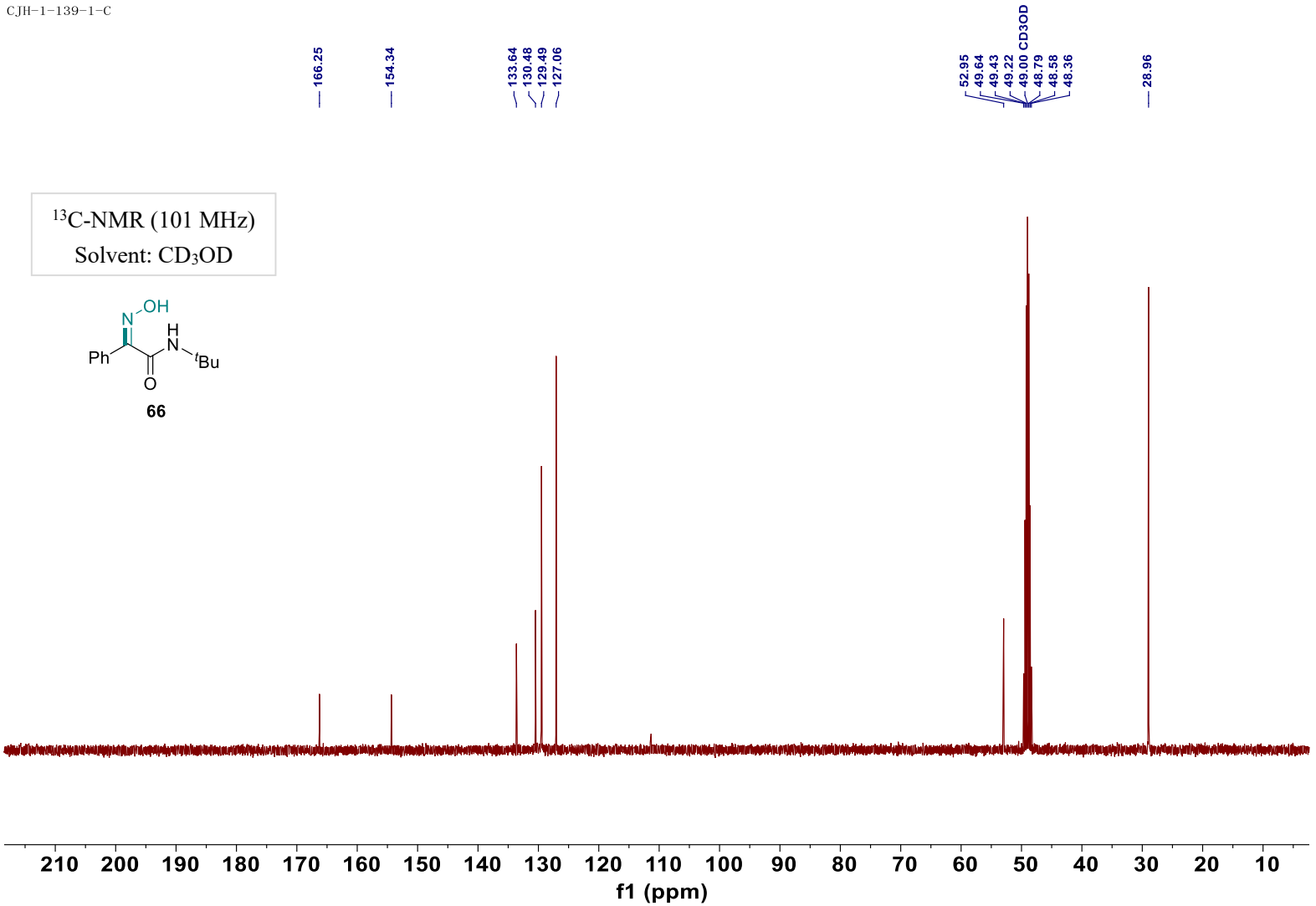





CJH-1-174-2-C
169.50
153.44
137.64
135.65
132.63
132.05
131.11
129.88
129.85
128.87
128.73
128.45
128.41
128.29
127.64
124.73
121.98
121.94
121.91
77.48
77.16 CDCl3
76.84
67.70
67.63
13C-NMR (101 MHz)
Solvent: CDCl3
Ph
Ph
Ph
N
O
Ph
65
132.0
131.0
130.0
129.0
128.0
127.0
f1 (ppm)
122.2
121.8
121.4
f1 (ppm)
68.5
68.0
67.5
67.0
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

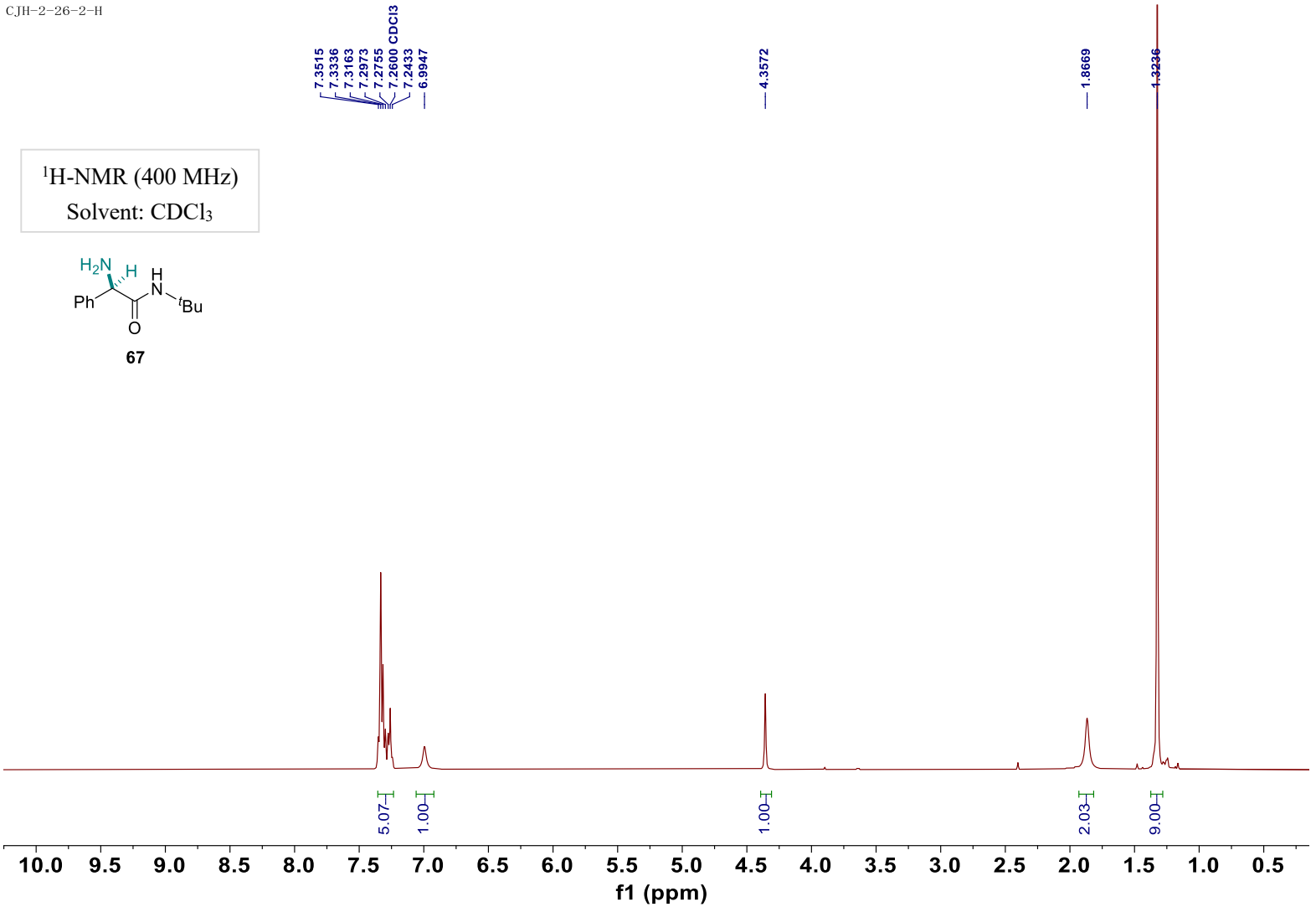

CJH-1-139-1-H
10.3670
7.5774
7.5736
7.5586
7.5536
7.4028
7.3890
7.3706
7.3608
7.3564
7.3485
7.2600 CDCl3
5.8898
1.4315
1H-NMR (400 MHz)
Solvent: CDCl3
N
OH
H
N
Ph
tBu
O
66
11.5 11.0 10.5 10.0 9.5 9.0
f1 (ppm)
1.00
2.00
3.03
1.00
9.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

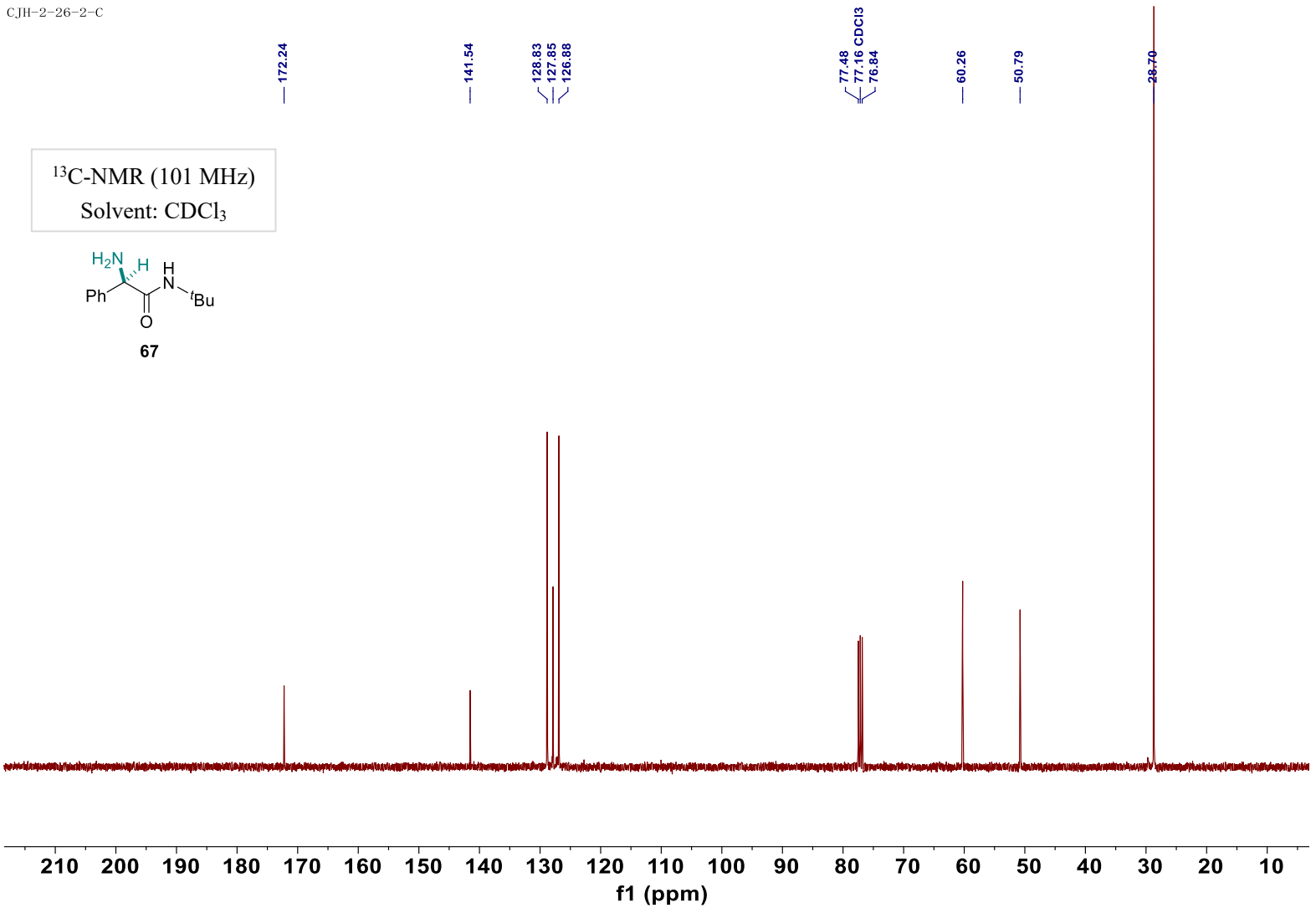
CJH-1-139-1-C



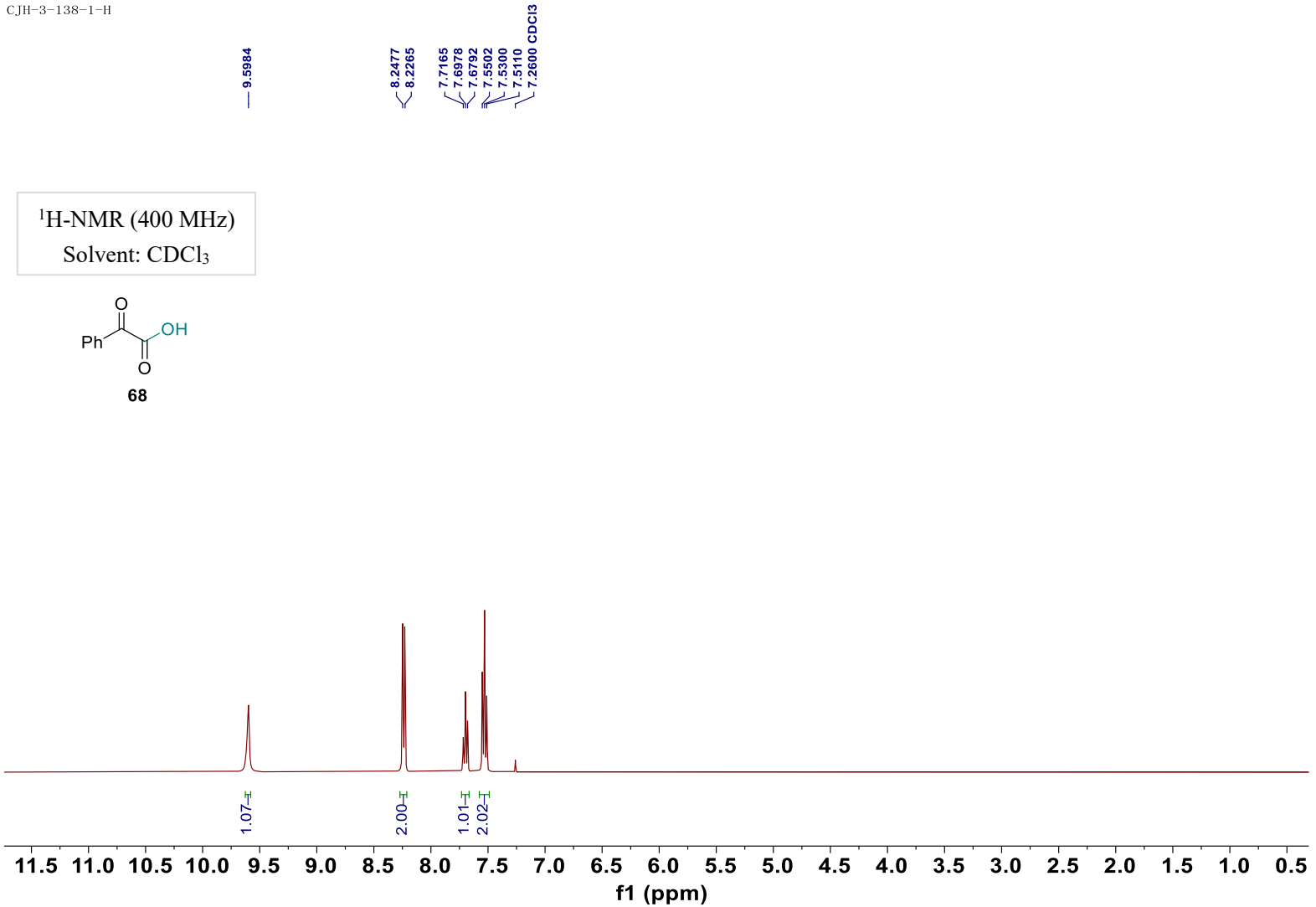
^{13}C-NMR (101 MHz)
Solvent: CD_3OD

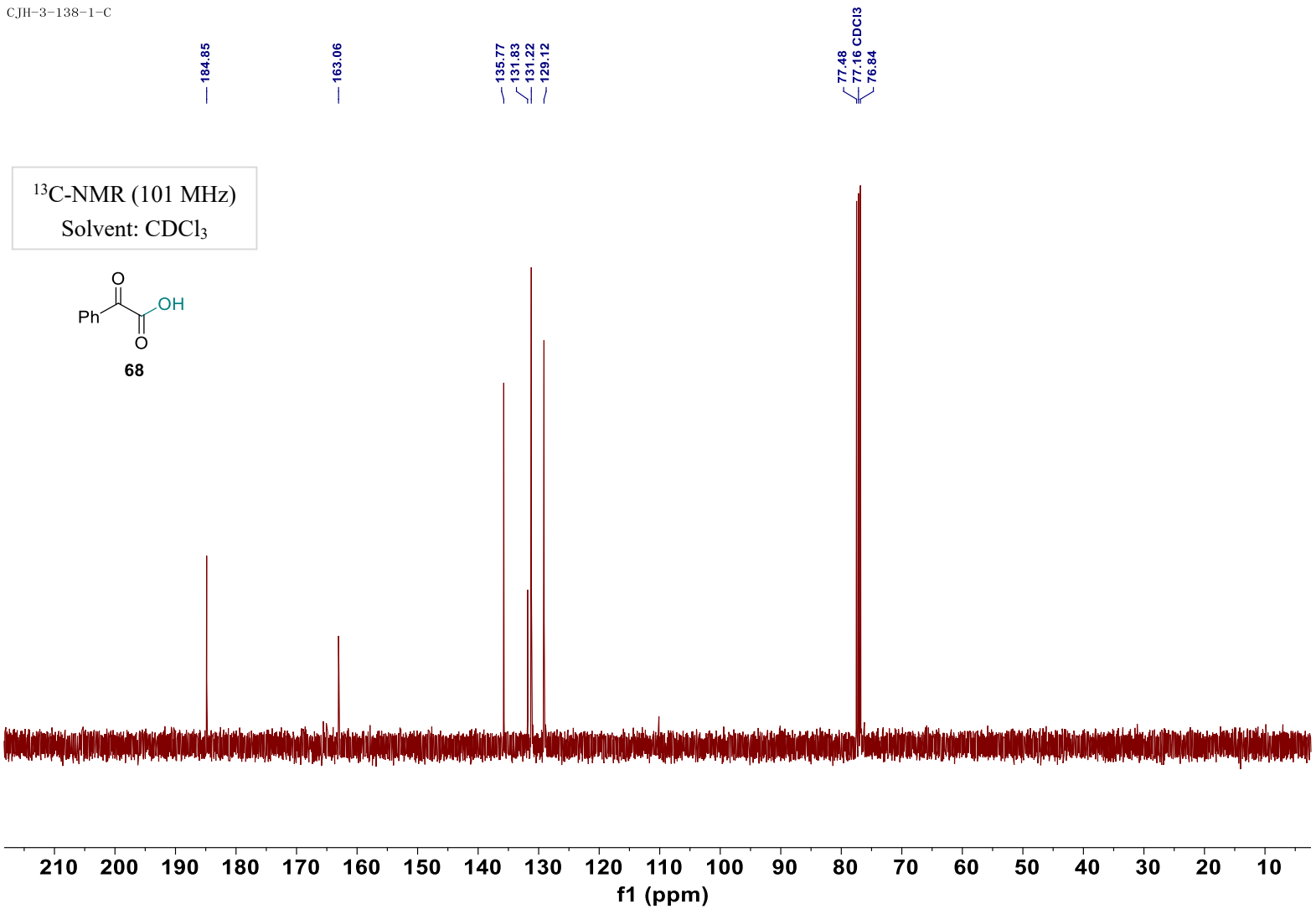
66

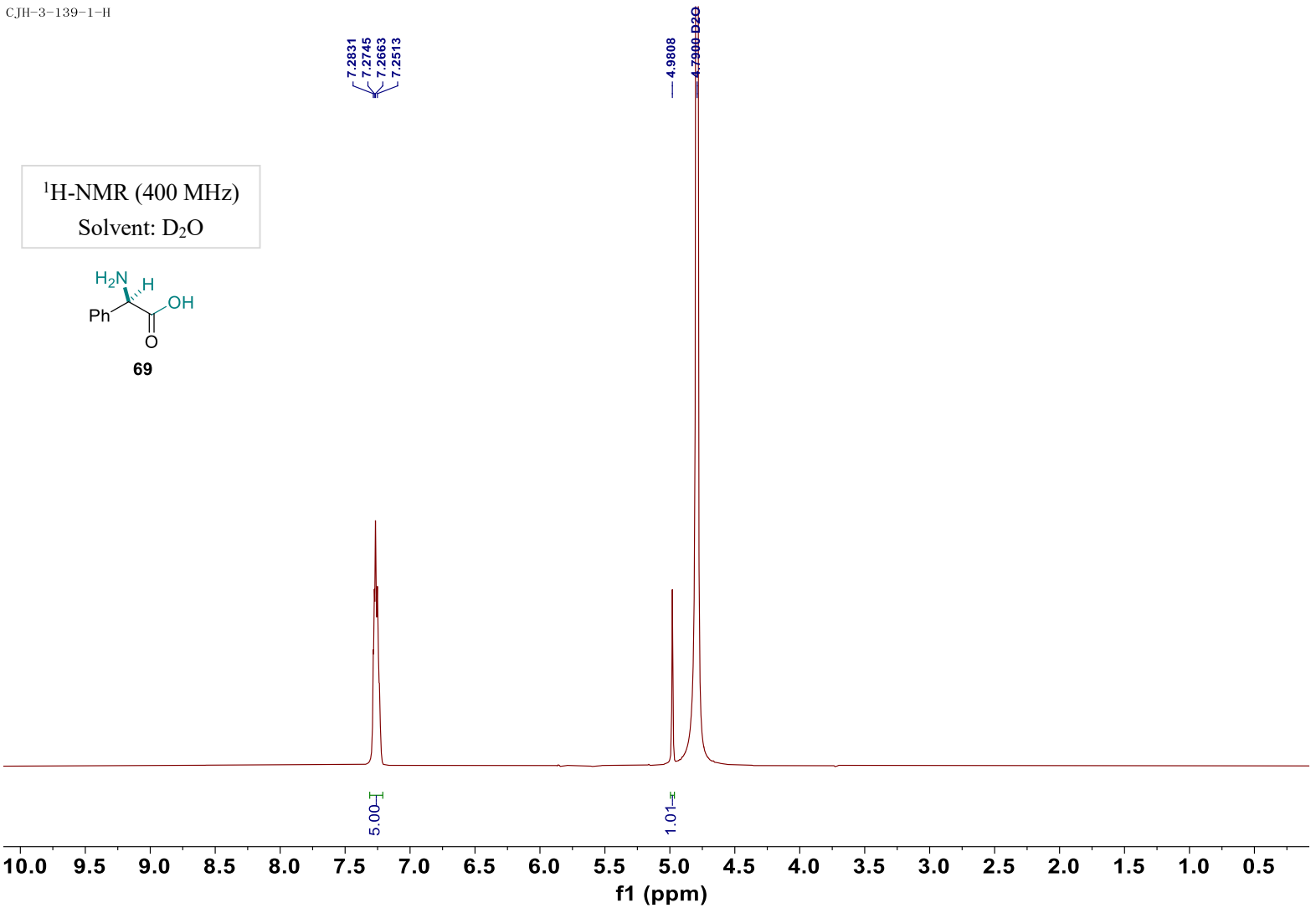

CJH-2-26-2-H
7.3515
7.3336
7.3163
7.2973
7.2755
7.2600 CDCl3
7.2433
6.9947
4.3572
1.8669
1.3236
1H-NMR (400 MHz)
Solvent: CDCl3
H2N
H
H
N
Ph
tBu
O
67
5.07
1.00
1.00
2.03
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


CJH-2-26-2-C
172.24
141.54
128.83
127.85
126.88
77.48
77.16 CDCl3
76.84
60.26
50.79
28.70
13C-NMR (101 MHz)
Solvent: CDCl3
H2N
H
H
N
Ph
tBu
O
67
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

CJH-3-138-1-H


9.5984
8.2477
8.2265
7.7165
7.6978
7.6792
7.5502
7.5300
7.5110
7.2600 CDCl3
1H-NMR (400 MHz)
Solvent: CDCl3
O
Ph
OH
O
68
1.07
2.00
1.01
2.02
11.5 11.0 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
f1 (ppm)


CJH-3-138-1-C
184.85
163.06
135.77
131.83
131.22
129.12
77.48
77.16 CDCl3
76.84
^{13}C-NMR (101 MHz)
Solvent: $CDCl_3$
Ph
OH
O
O
68
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-3-139-1-H
7.2831
7.2745
7.2663
7.2513
4.9808
4.7900 D2O
^{1}H-NMR (400 MHz)
Solvent: D_2O
H_2N
H
OH
Ph
O
69
5.00
1.01
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
f1 (ppm)

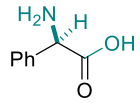
CJH-3-139-1-C

170.48

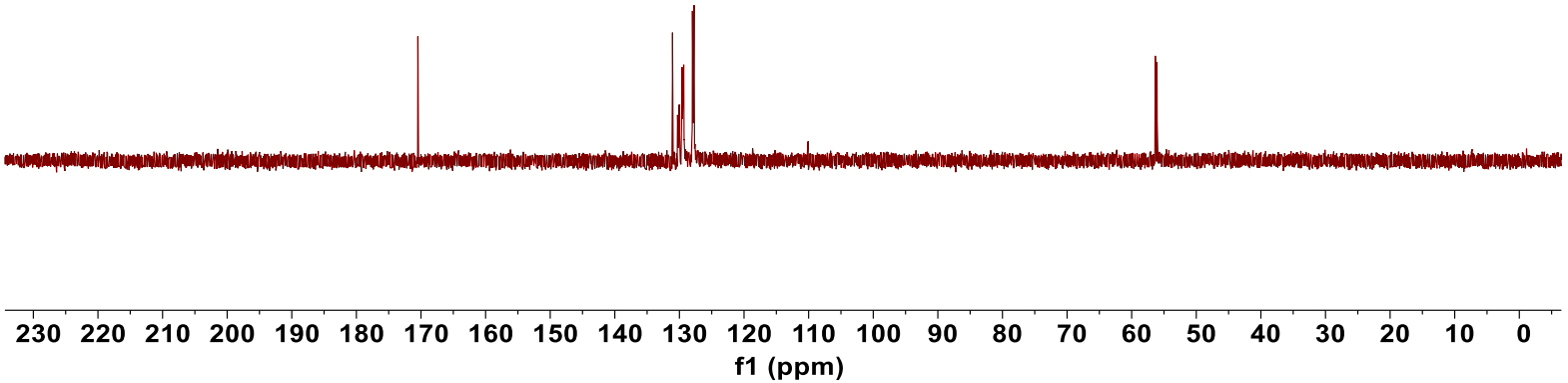
131.07
130.29
129.60
127.99

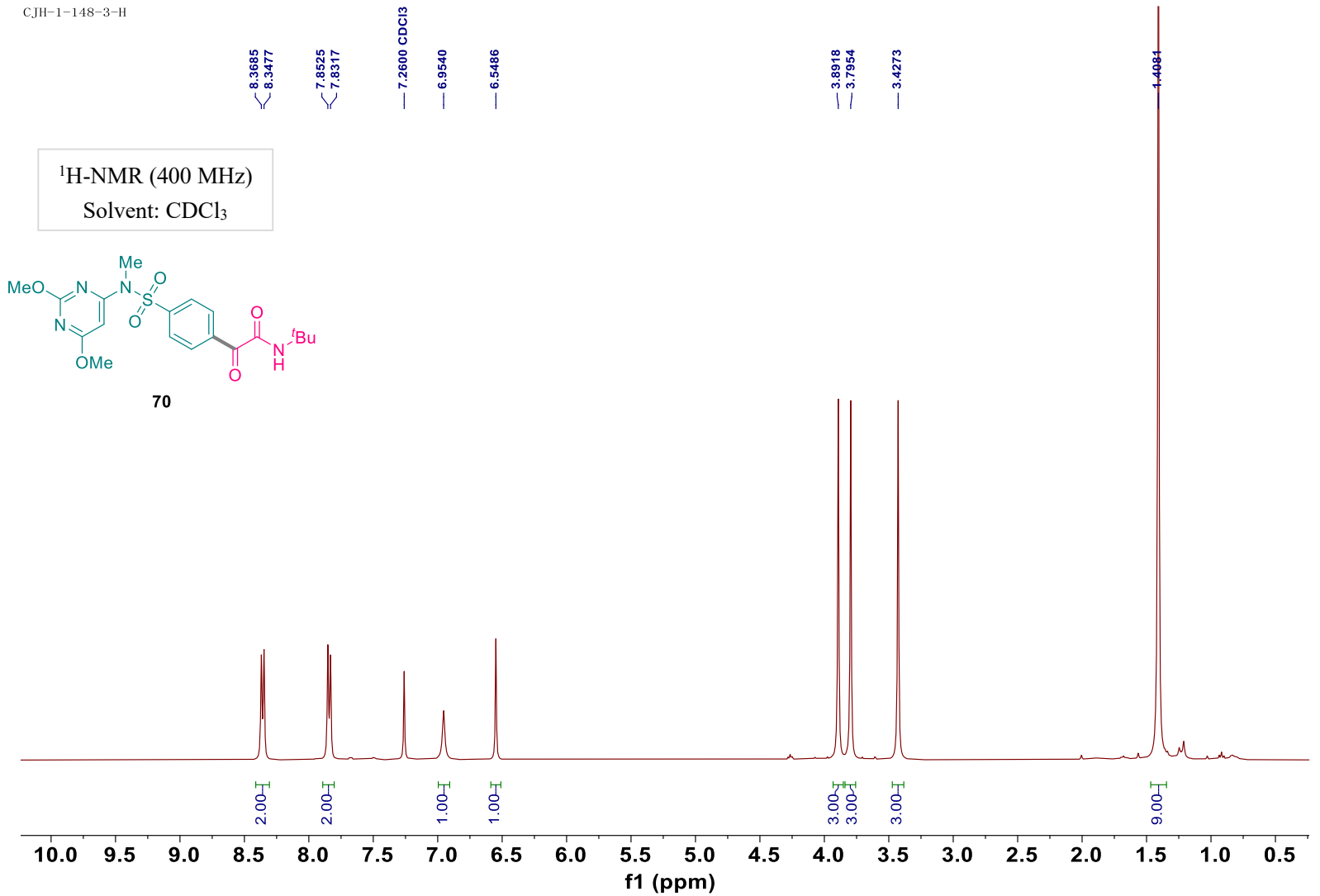
56.34

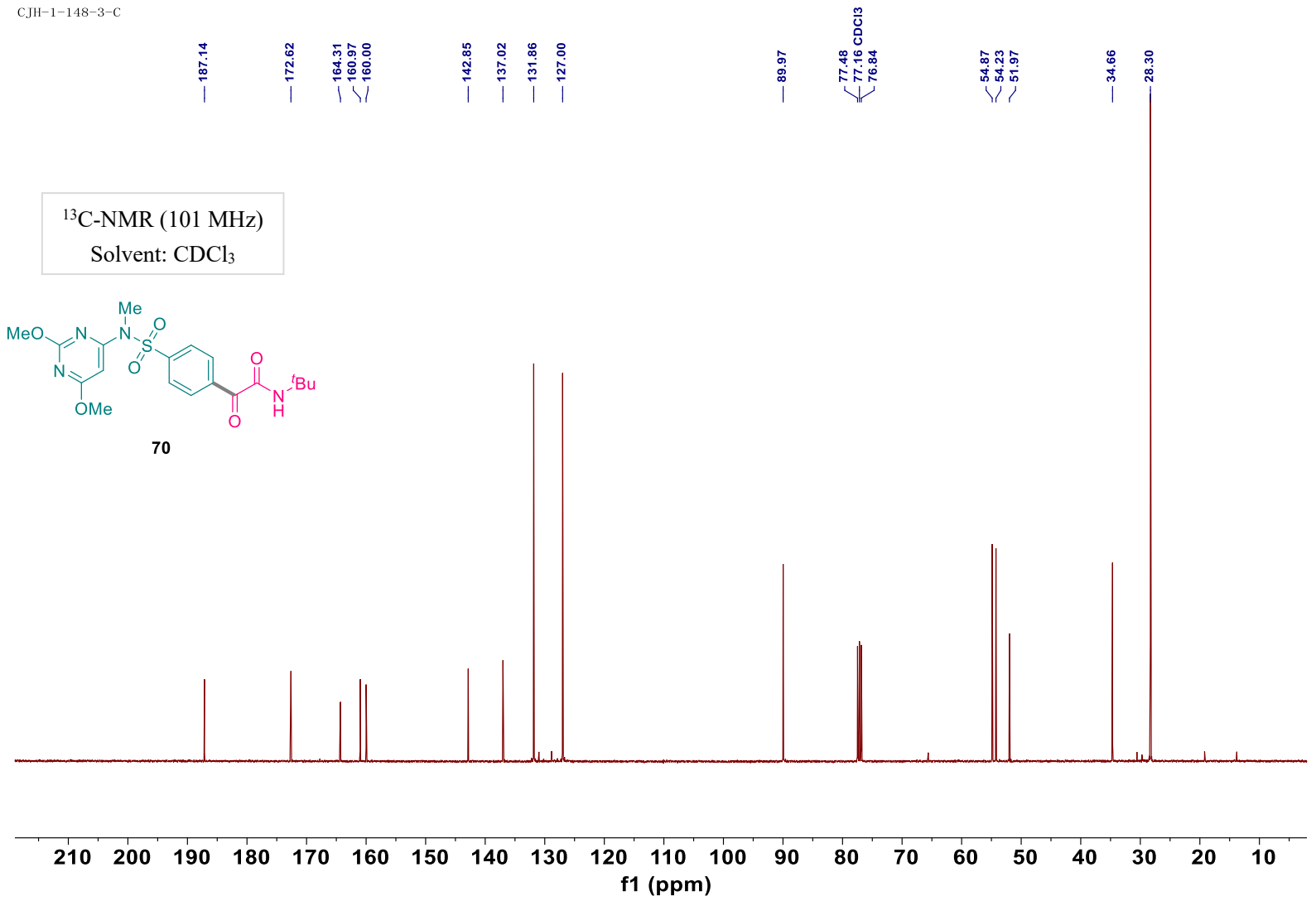
^{13}C-NMR (101 MHz)
Solvent: D_2O

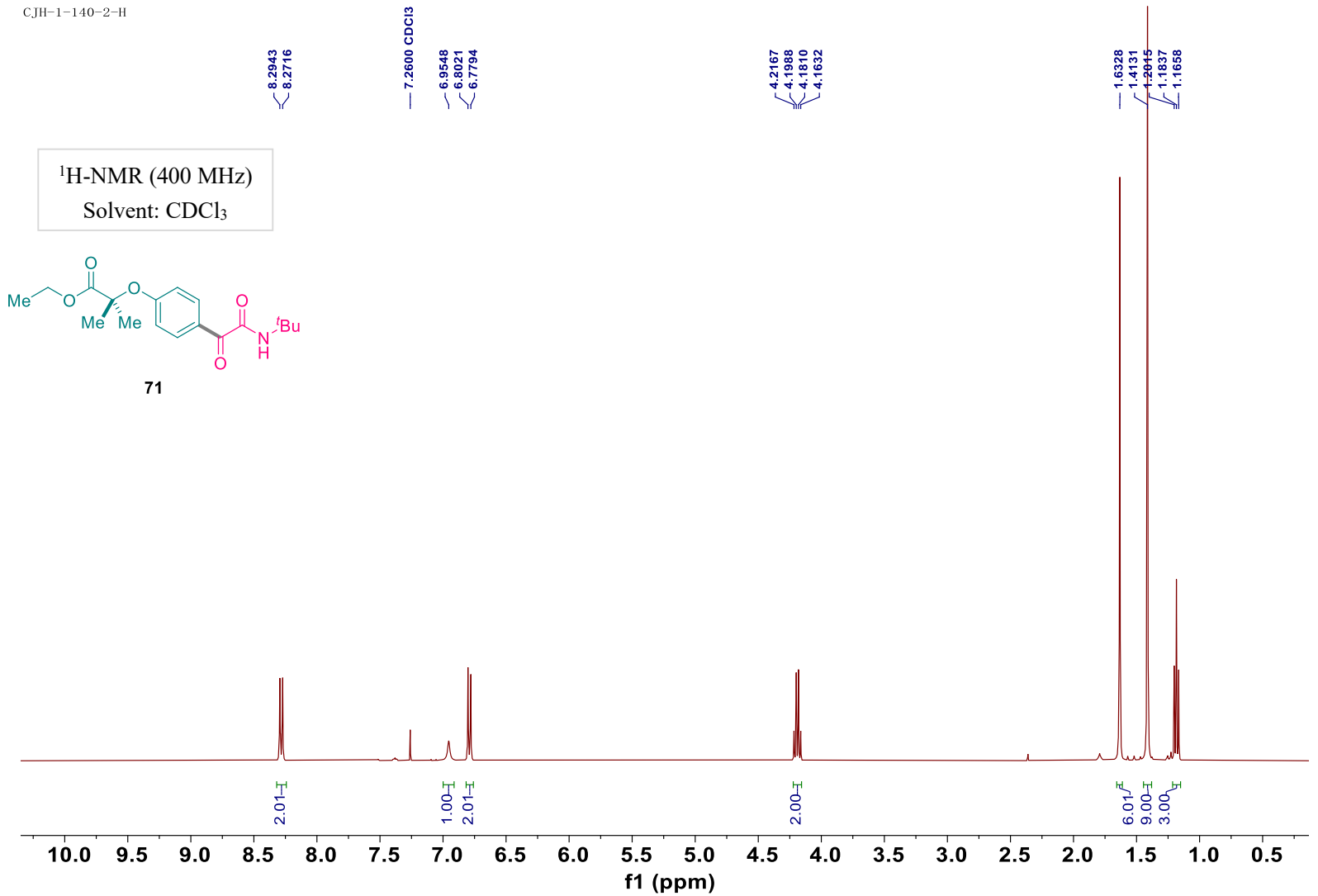


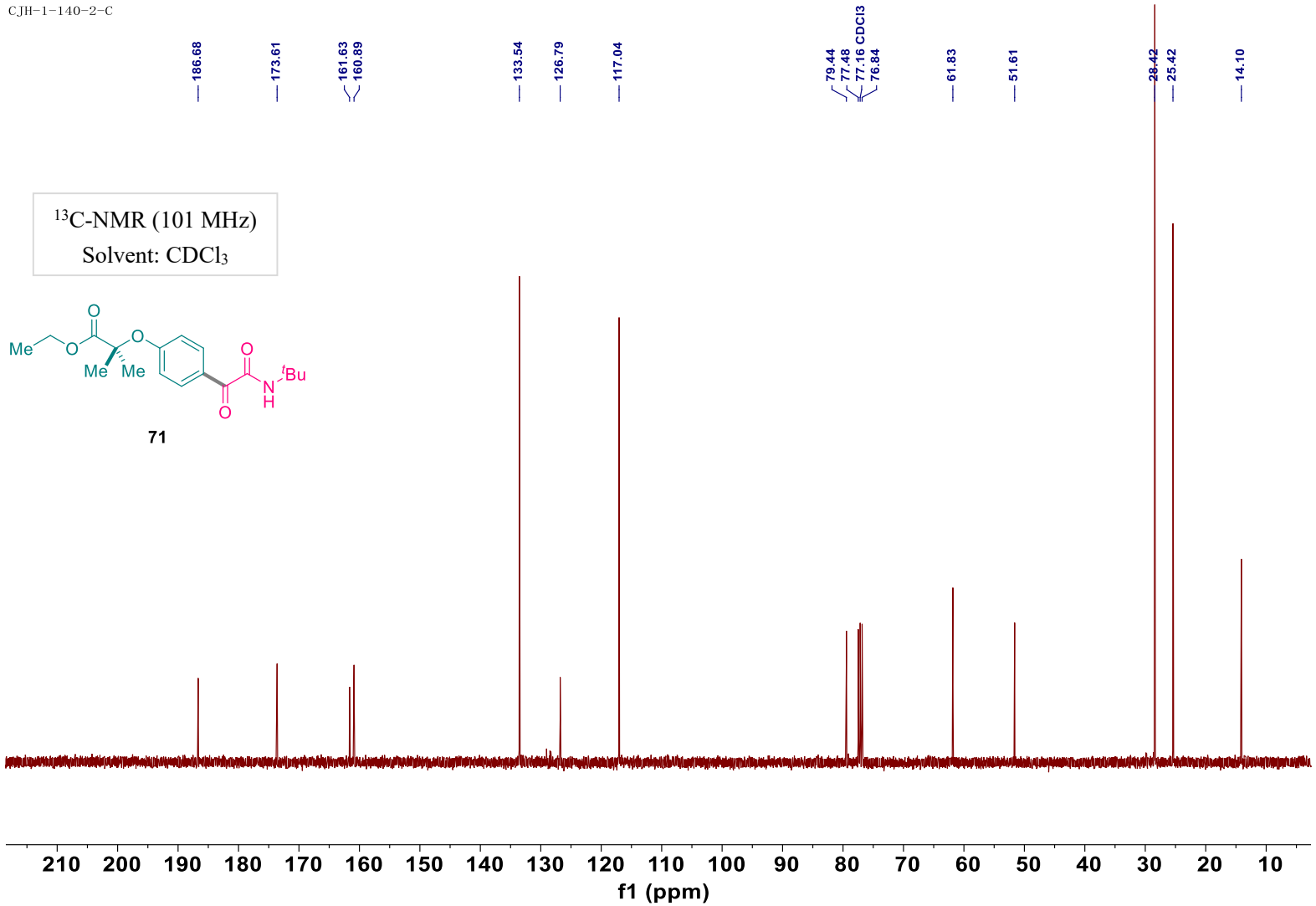
69

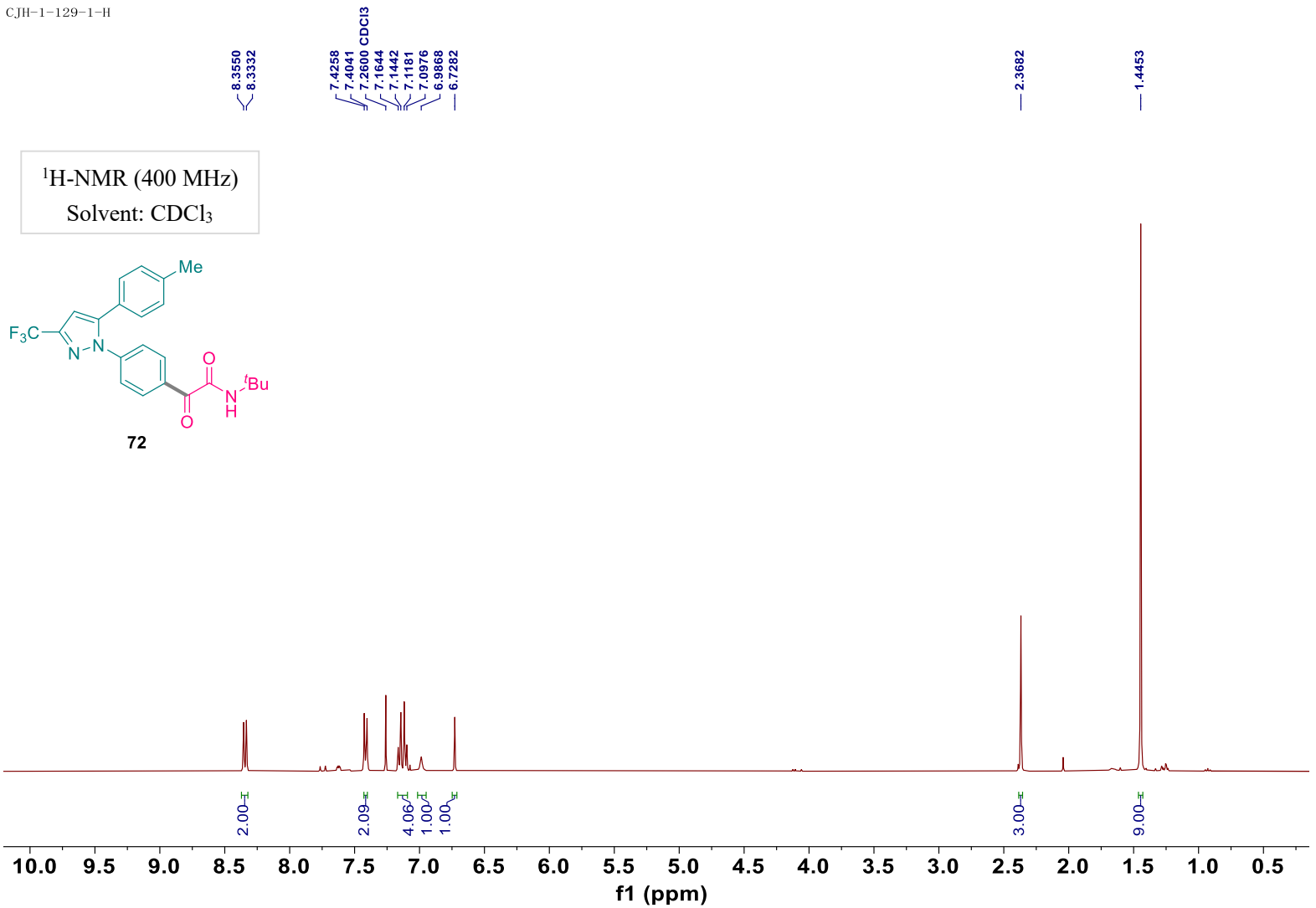


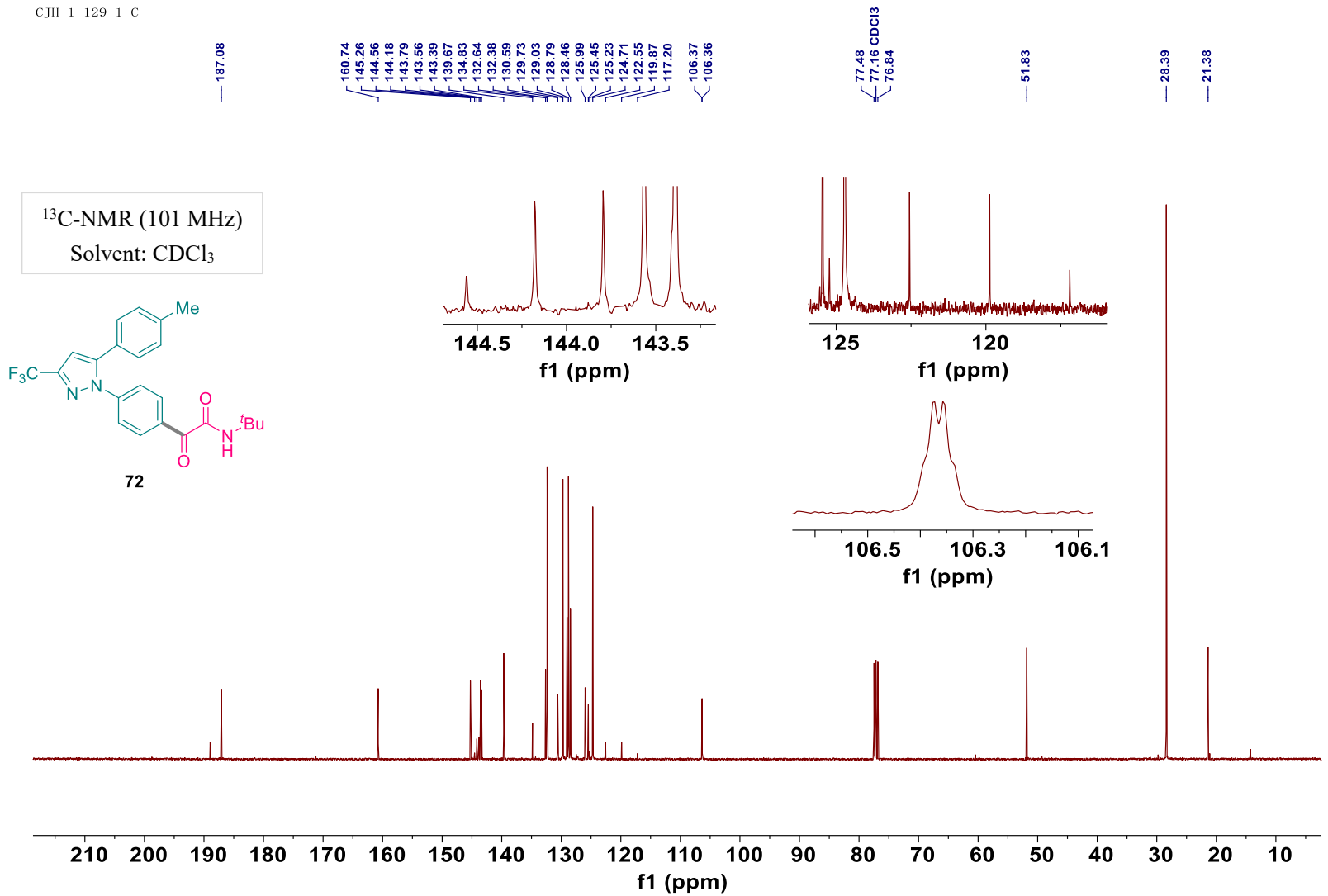

CJH-1-148-3-H
8.3685
8.3477
7.8525
7.8317
7.2600 CDCl3
6.9540
6.5486
3.8918
3.7954
3.4273
1.4081
1H-NMR (400 MHz)
Solvent: CDCl3
Me
MeO
N
N
N
S
O
O
O
O
N
H
tBu
OMe
70
2.00
2.00
1.00
1.00
3.00
3.00
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

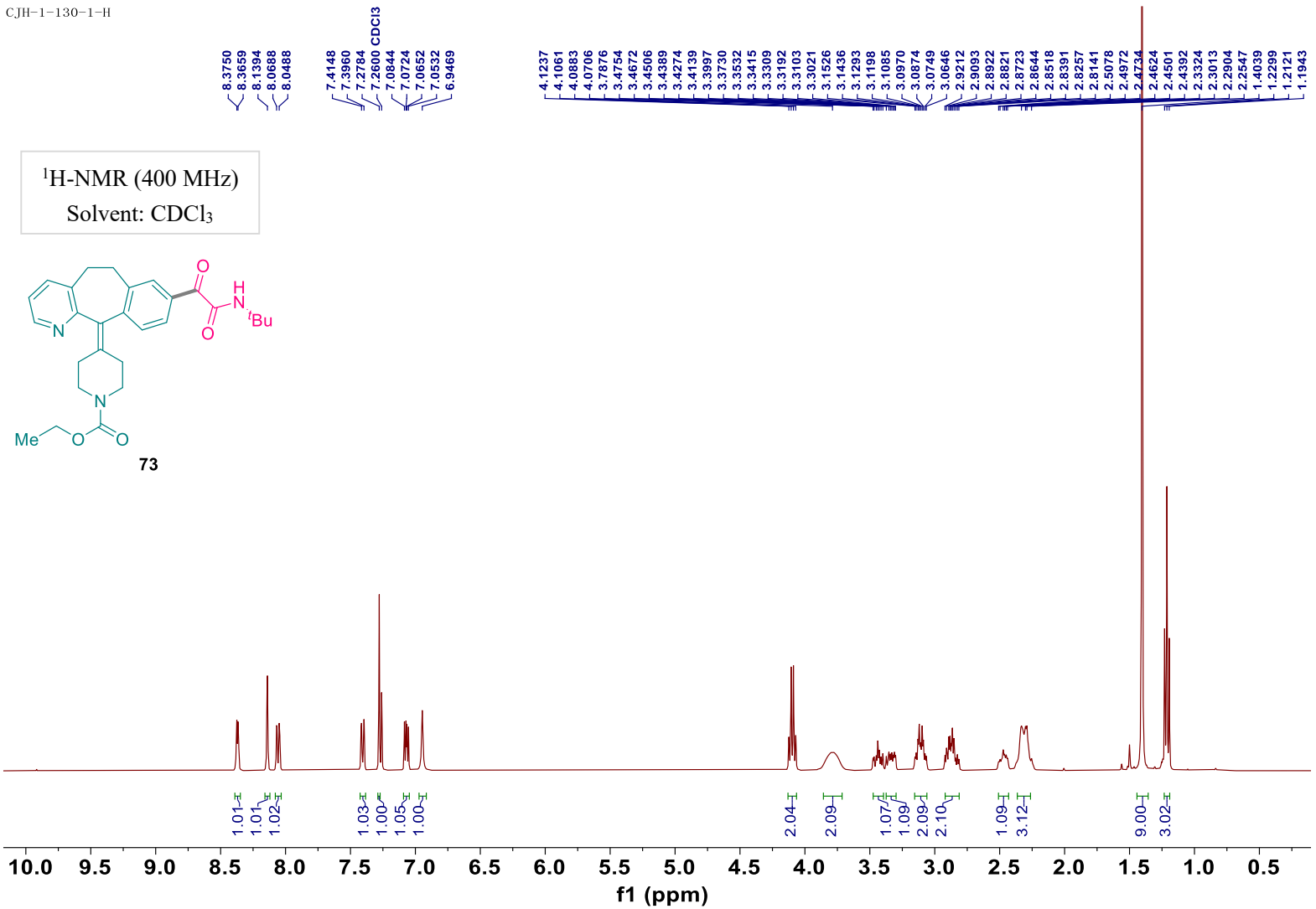

CJH-1-148-3-C
187.14
172.62
164.31
160.97
160.00
142.85
137.02
131.86
127.00
89.97
77.48
77.16 CDCl3
76.84
54.87
54.23
51.97
34.66
28.30
13C-NMR (101 MHz)
Solvent: CDCl3
Me
MeO
N
N
N
S
O
O
O
O
N
H
tBu
OMe
70
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

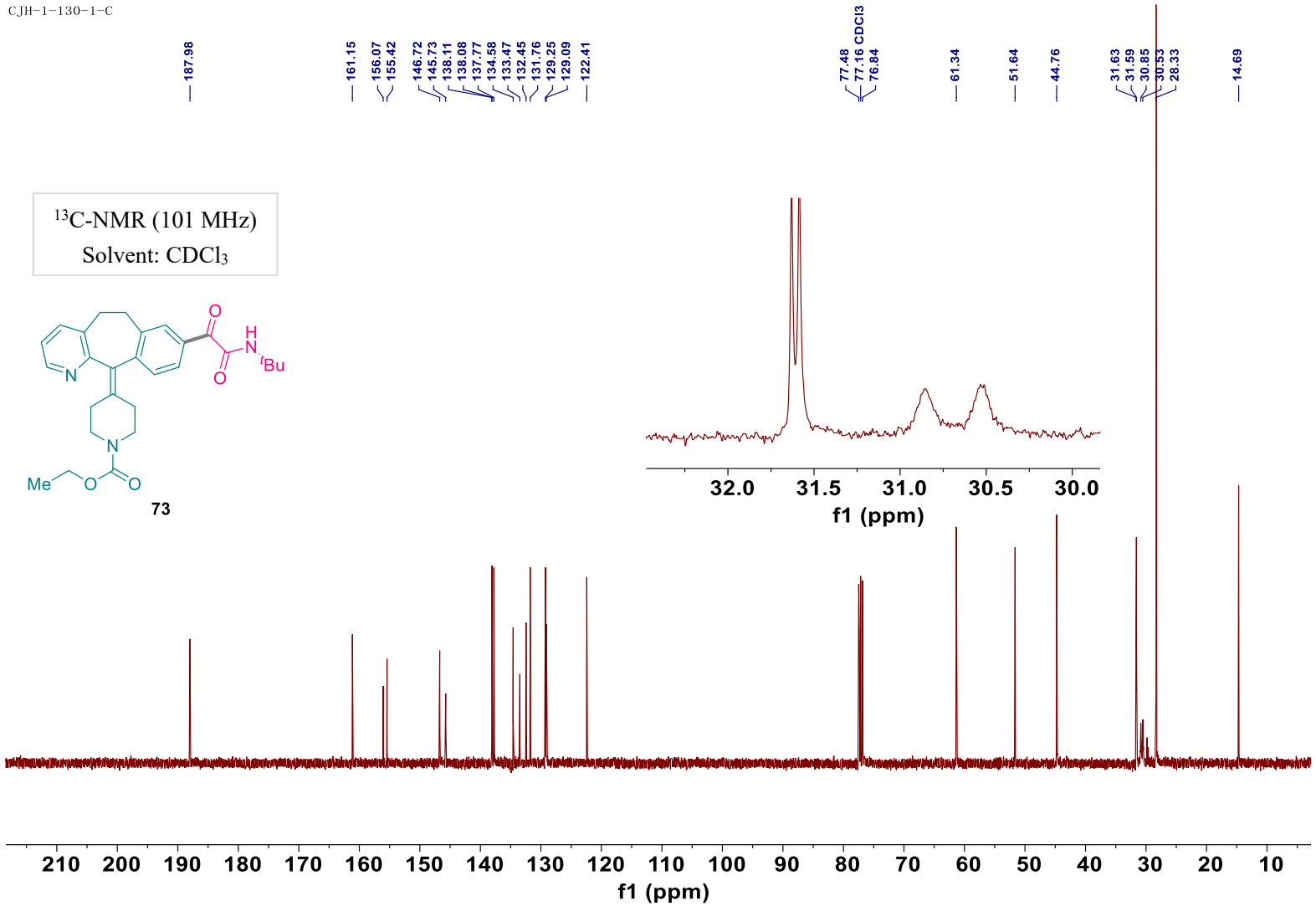

CJH-1-140-2-H
8.2943
8.2716
7.2600 CDCl3
6.9548
6.8021
6.7794
4.2167
4.1988
4.1810
4.1632
1.6328
1.4131
1.2045
1.1837
1.1658
1H-NMR (400 MHz)
Solvent: CDCl3
Me
O
O
Me
Me
O
O
N
H
tBu
71
2.01
1.00
2.01
2.00
6.01
9.00
3.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

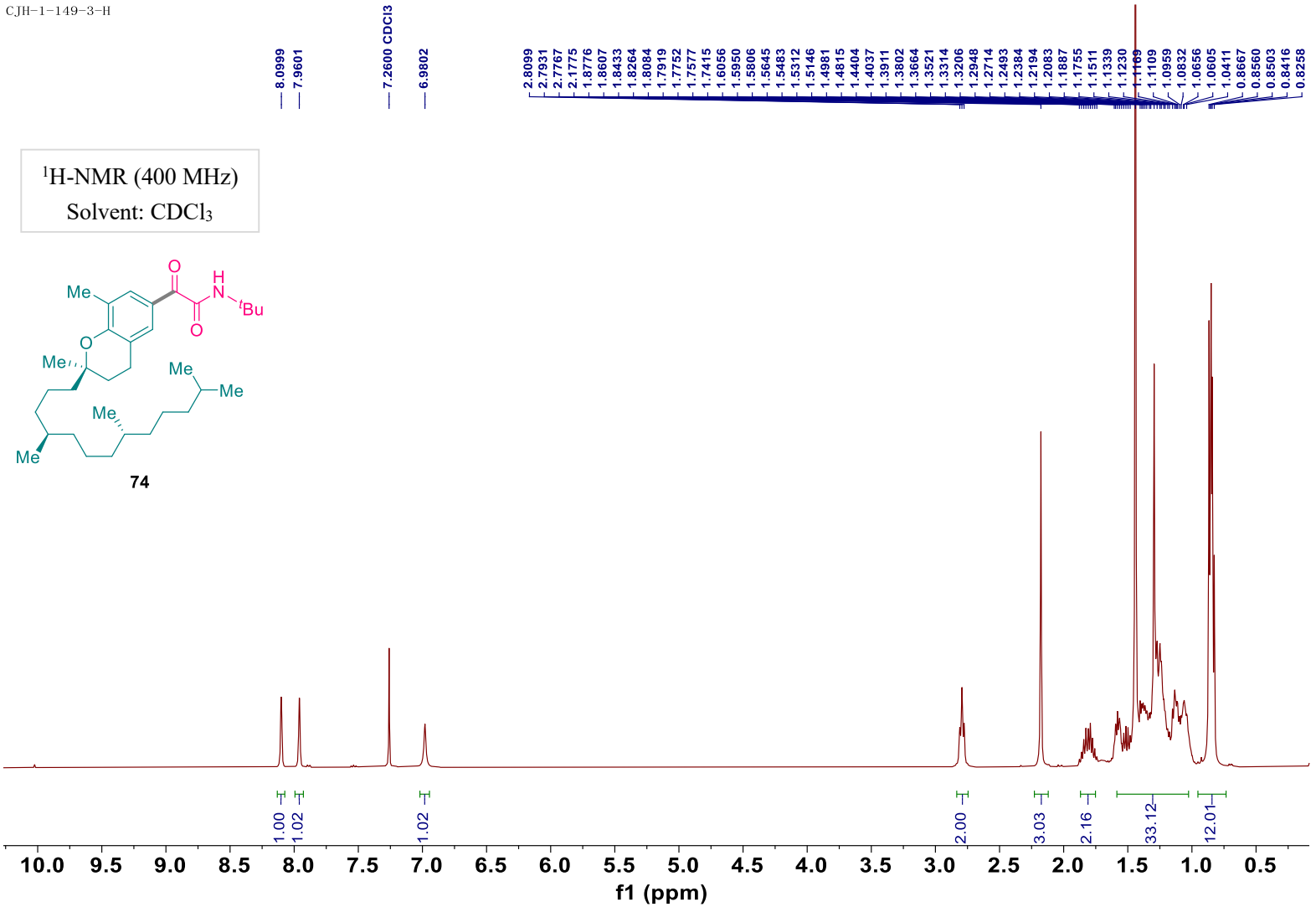

CJH-1-140-2-C
186.68
173.61
161.63
160.89
133.54
126.79
117.04
79.44
77.48
77.16 CDCl3
76.84
61.83
51.61
28.42
25.42
14.10
13C-NMR (101 MHz)
Solvent: CDCl3
Me
O
O
O
Me
Me
O
N
H
tBu
71
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

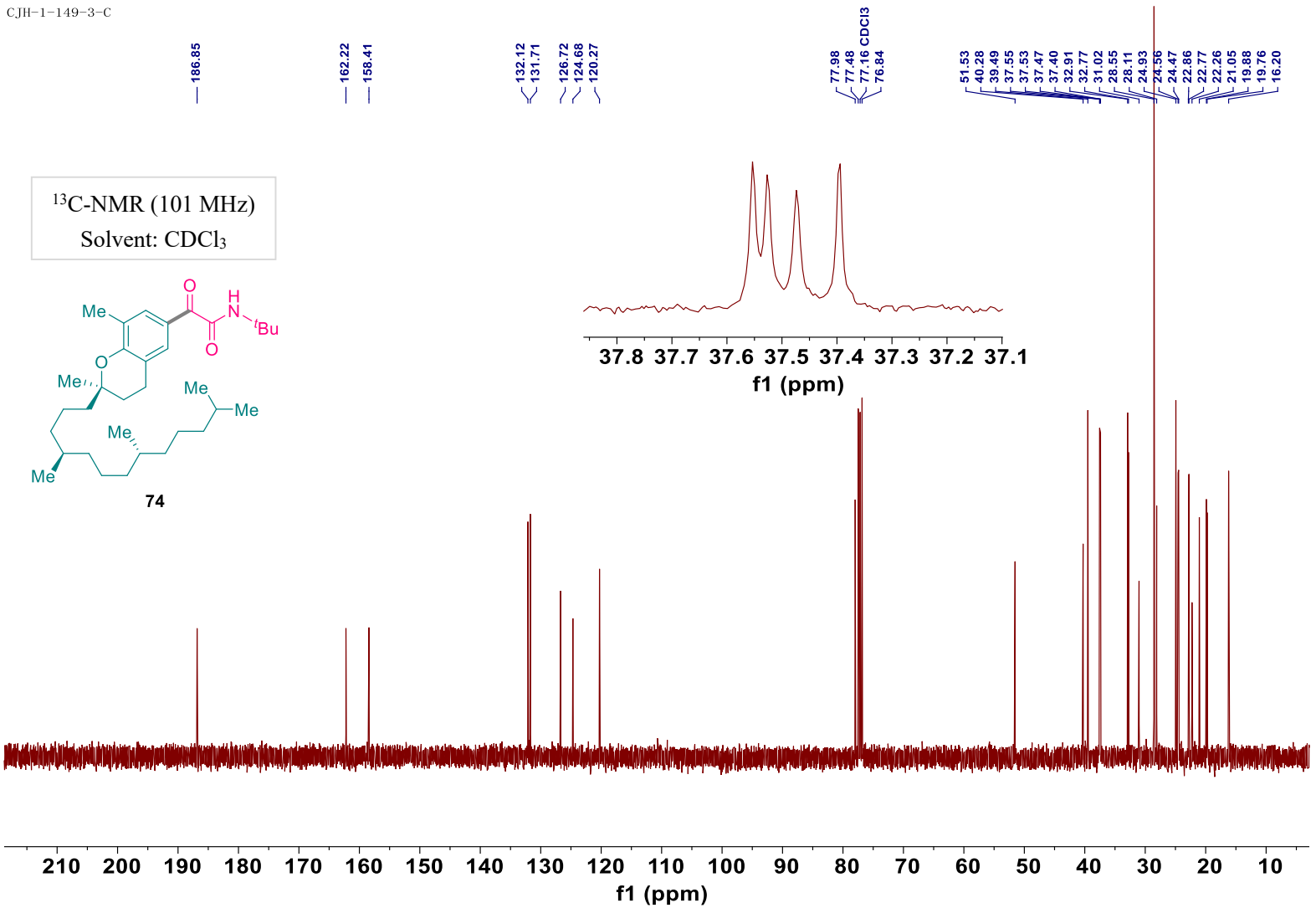

CJH-1-129-1-H
8.3550
8.3332
7.4258
7.4041
7.2600 CDCl3
7.1644
7.1442
7.1181
7.0976
6.9868
6.7282
2.3682
1.4453
1H-NMR (400 MHz)
Solvent: CDCl3
Me
F3C
N
N
O
O
N
H
tBu
72
2.00
2.09
4.06
1.00
1.00
3.00
9.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

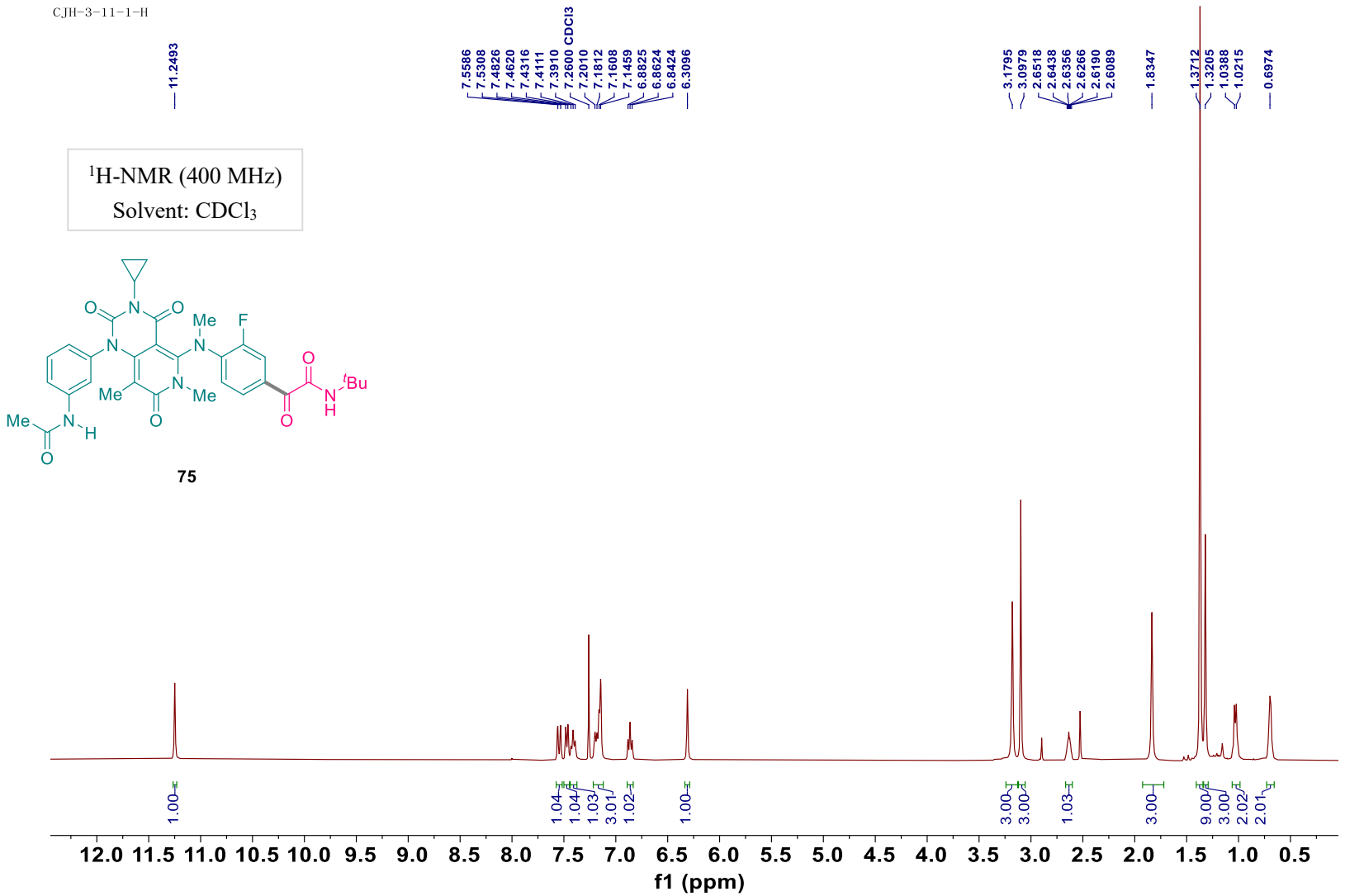

CJH-1-129-1-C
187.08
160.74
145.26
144.56
144.18
143.79
143.56
143.39
139.67
134.83
132.64
132.38
130.59
129.73
129.03
128.79
128.46
125.99
125.45
125.23
124.71
122.55
119.87
117.20
106.37
106.36
77.48
77.16 CDCl3
76.84
51.83
28.39
21.38
13C-NMR (101 MHz)
Solvent: CDCl3
Me
F3C
N
N
O
N
H
tBu
O
72
144.5
144.0
143.5
f1 (ppm)
125
120
f1 (ppm)
106.5
106.3
106.1
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

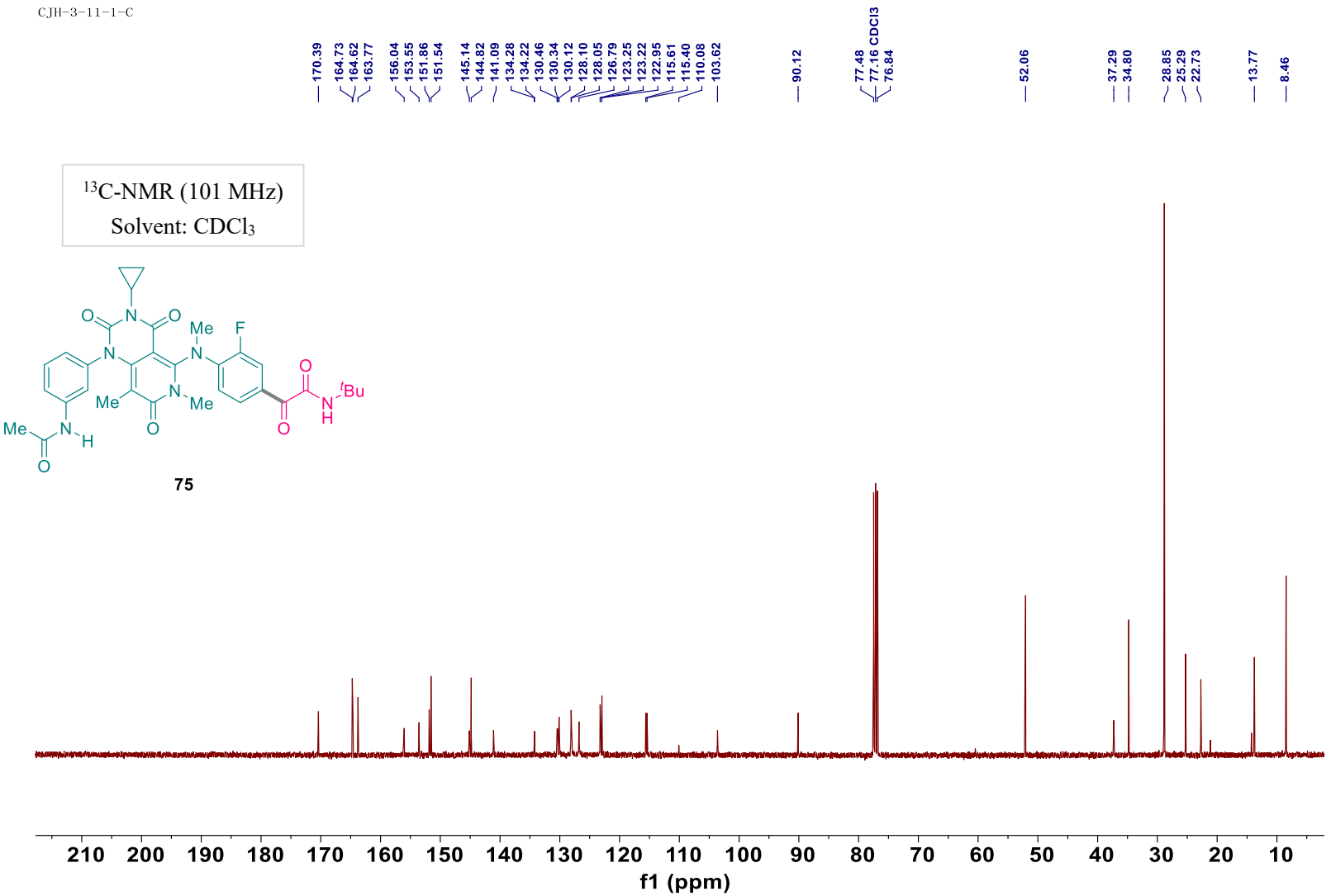

CJH-1-130-1-H
8.3750
8.3659
8.1394
8.0688
8.0488
7.4148
7.3960
7.2784
7.2600 CDCl3
7.0844
7.0724
7.0652
7.0532
6.9469
4.1237
4.1061
4.0883
4.0706
3.7876
3.4754
3.4672
3.4506
3.4389
3.4274
3.4139
3.3997
3.3730
3.3532
3.3415
3.3309
3.3192
3.3103
3.3021
3.1526
3.1436
3.1293
3.1198
3.1085
3.0970
3.0874
3.0749
3.0646
2.9212
2.9093
2.8922
2.8821
2.8723
2.8644
2.8518
2.8391
2.8257
2.8141
2.5078
2.4972
2.4734
2.4624
2.4501
2.4392
2.3324
2.3013
2.2904
2.2547
1.4039
1.2299
1.2121
1.1943
1H-NMR (400 MHz)
Solvent: CDCl3
O
H
N
tBu
O
N
N
Me
O
O
73
1.01
1.01
1.02
1.03
1.00
1.05
1.00
2.04
2.09
1.07
1.09
2.09
2.10
1.09
3.12
9.00
3.02
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
f1 (ppm)

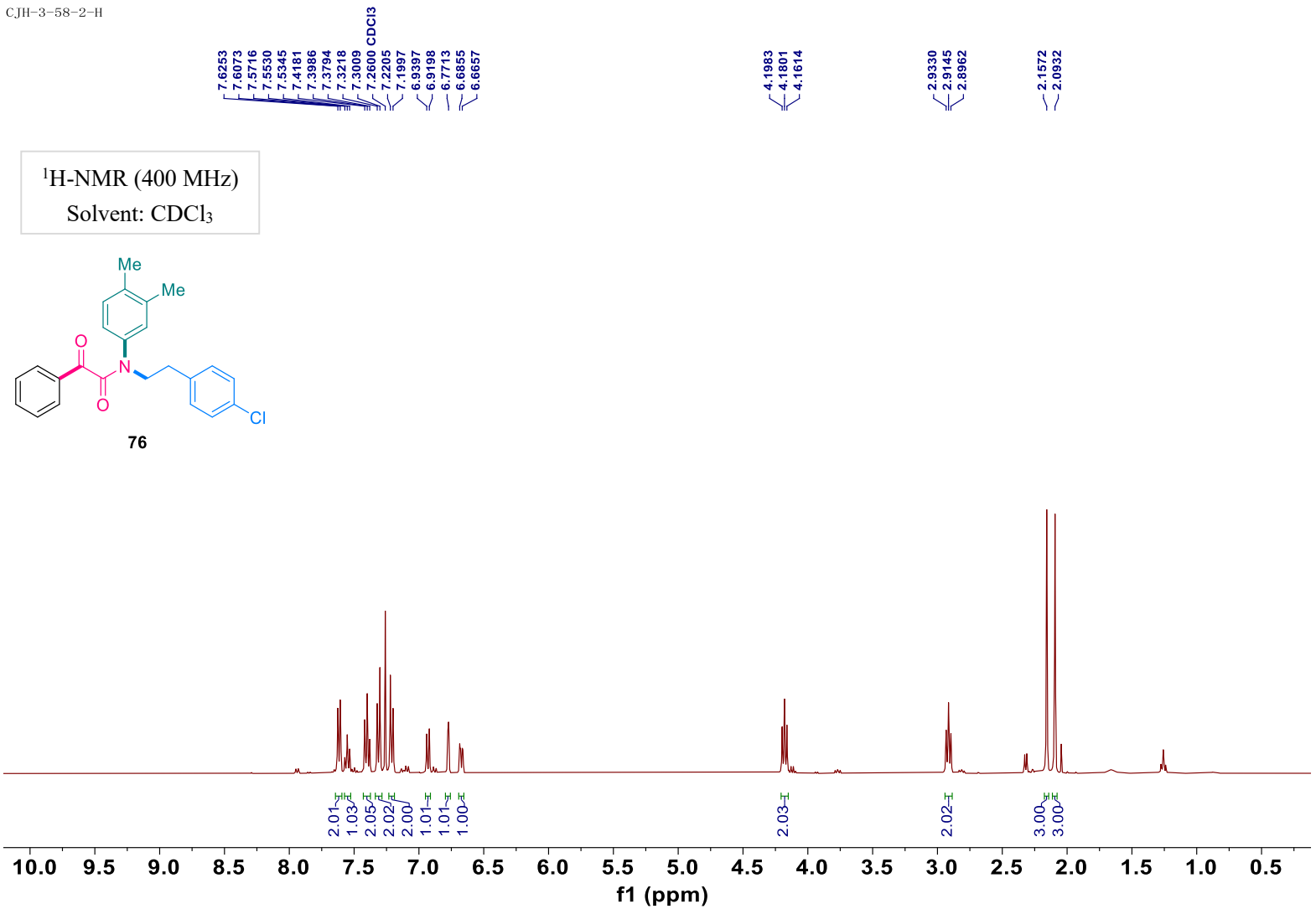

CJH-1-130-1-C
187.98
161.15
156.07
155.42
146.72
145.73
138.11
138.08
137.77
134.58
133.47
132.45
131.76
129.25
129.09
122.41
77.48
77.16 CDCl3
76.84
61.34
51.64
44.76
31.63
31.59
30.85
30.53
28.33
14.69
13C-NMR (101 MHz)
Solvent: CDCl3
Me
O
O
N
O
H
N
tBu
O
73
32.0
31.5
31.0
30.5
30.0
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

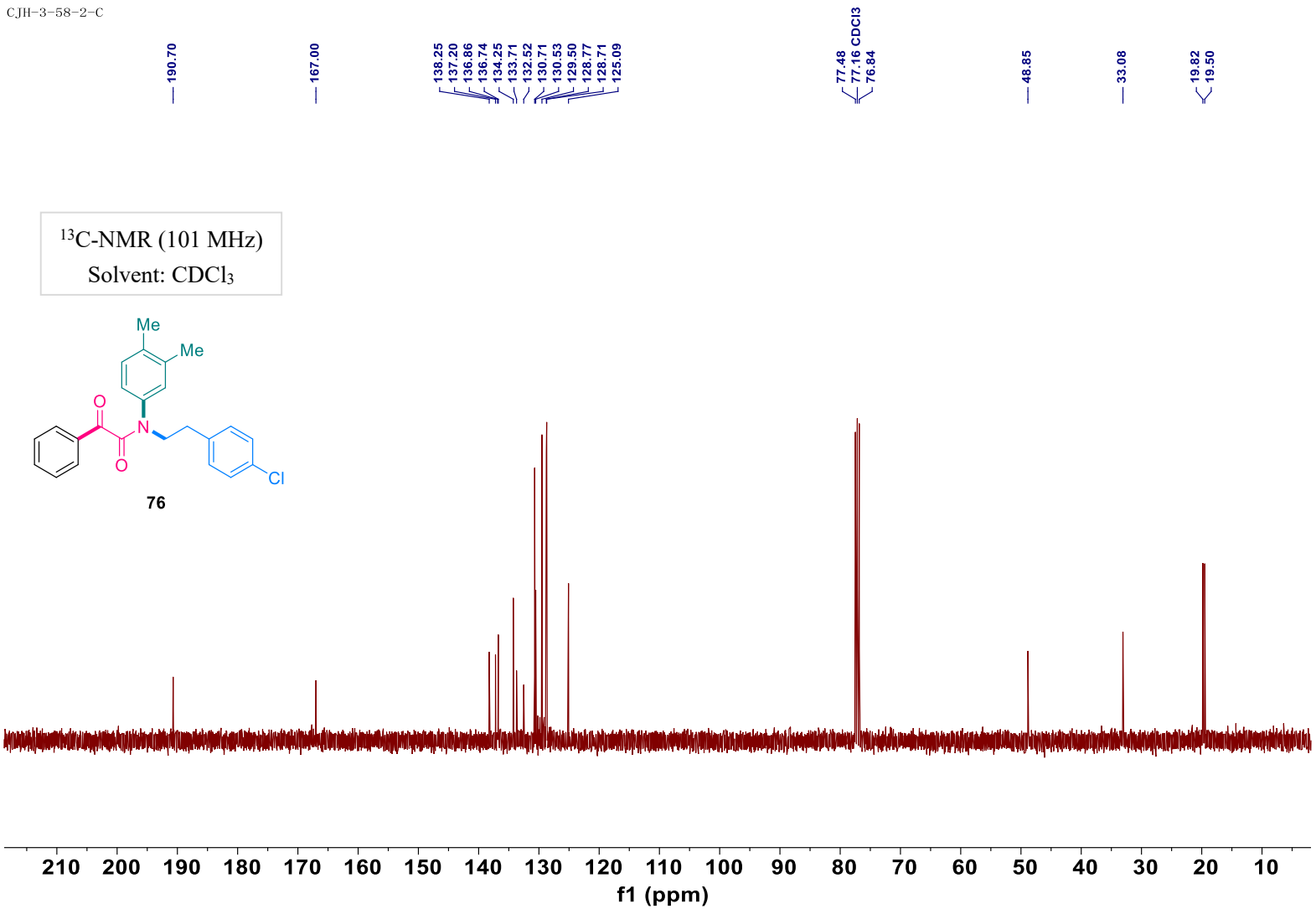

CJH-1-149-3-H
8.0999
7.9601
7.2600 CDCl3
6.9802
2.8099
2.7931
2.7767
2.1775
1.8776
1.8607
1.8433
1.8264
1.8084
1.7919
1.7752
1.7577
1.7415
1.6056
1.5950
1.5806
1.5645
1.5483
1.5312
1.5146
1.4981
1.4815
1.4404
1.4037
1.3911
1.3802
1.3664
1.3521
1.3314
1.3206
1.2948
1.2714
1.2493
1.2384
1.2194
1.2083
1.1887
1.1755
1.1511
1.1339
1.1230
1.1169
1.1109
1.0959
1.0832
1.0656
1.0605
1.0411
0.8667
0.8560
0.8503
0.8416
0.8258
1H-NMR (400 MHz)
Solvent: CDCl3
Me
O
H
N
tBu
O
Me
O
Me
Me
Me
Me
74
1.00
1.02
1.02
2.00
3.03
2.16
33.12
12.01
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
f1 (ppm)


CJH-1-149-3-C
186.85
162.22
158.41
132.12
131.71
126.72
124.68
120.27
77.98
77.48
77.16 CDCl3
76.84
51.53
40.28
39.49
37.55
37.53
37.47
37.40
32.91
32.77
31.02
28.55
28.11
24.93
24.56
24.47
22.86
22.77
22.26
21.05
19.88
19.76
16.20
13C-NMR (101 MHz)
Solvent: CDCl3
Me
O
H
N
tBu
O
O
Me
Me
Me
Me
Me
74
37.8 37.7 37.6 37.5 37.4 37.3 37.2 37.1
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

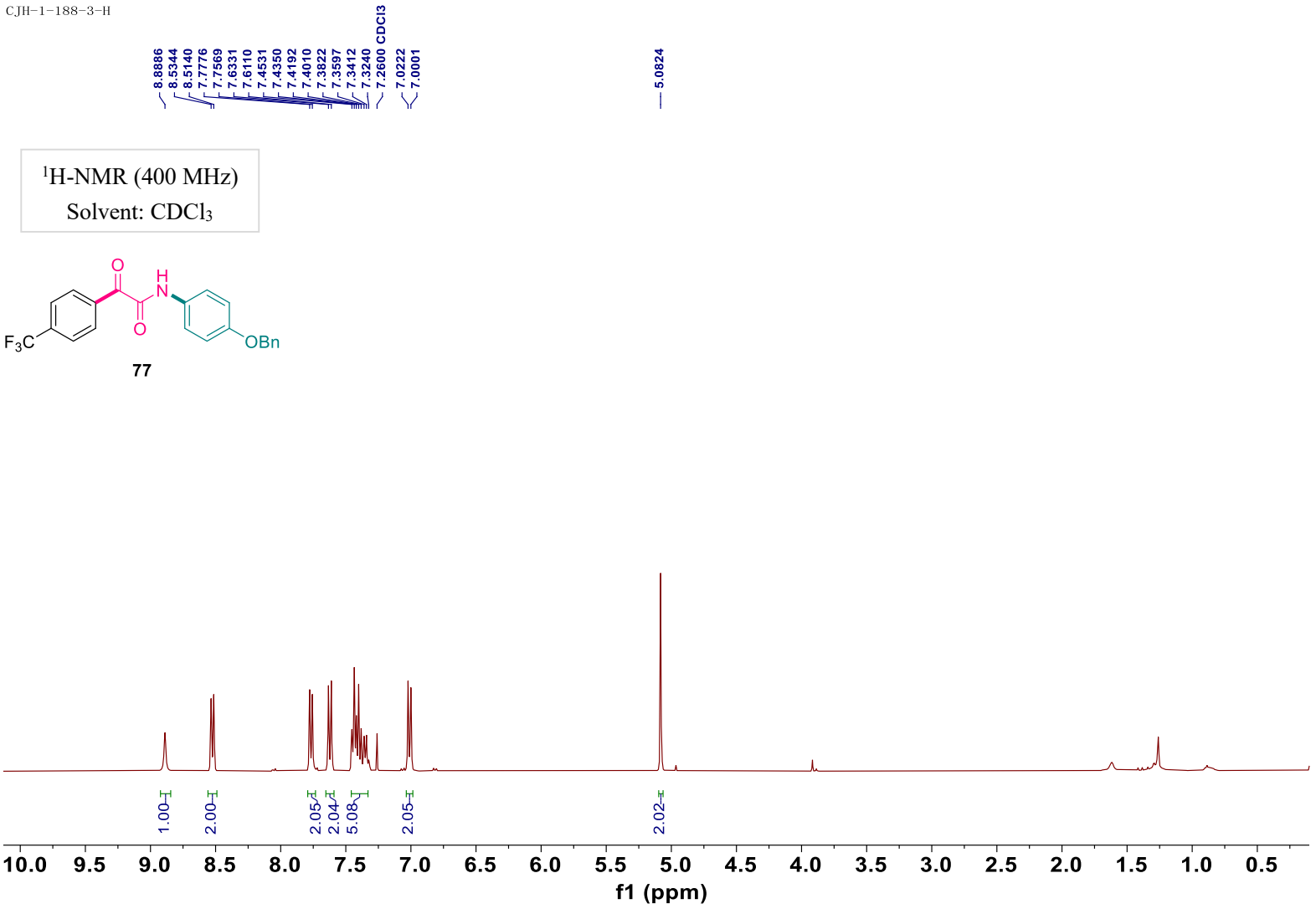

CJH-3-11-1-H
11.2493
7.5586
7.5308
7.4826
7.4620
7.4316
7.4111
7.3910
7.2600 CDCl3
7.2010
7.1812
7.1608
7.1459
6.8825
6.8624
6.8424
6.3096
3.1795
3.0979
2.6518
2.6438
2.6356
2.6266
2.6190
2.6089
1.8347
1.3712
1.3205
1.0388
1.0215
0.6974
1H-NMR (400 MHz)
Solvent: CDCl3
75
1.00
1.04
1.04
1.03
3.01
1.02
1.00
3.00
3.00
1.03
3.00
9.00
3.00
2.02
2.01
12.0 11.5 11.0 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
f1 (ppm)


CJH-3-11-1-C
170.39
164.73
164.62
163.77
156.04
153.55
151.86
151.54
145.14
144.82
141.09
134.28
134.22
130.46
130.34
130.12
128.10
128.05
126.79
123.25
123.22
122.95
115.61
115.40
110.08
103.62
90.12
77.48
77.16 CDCl3
76.84
52.06
37.29
34.80
28.85
25.29
22.73
13.77
8.46
13C-NMR (101 MHz)
Solvent: CDCl3
75
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-3-58-2-H
7.6253
7.6073
7.5716
7.5530
7.5345
7.4181
7.3986
7.3794
7.3218
7.3009
7.2600 CDCl3
7.2205
7.1997
6.9397
6.9198
6.7713
6.6855
6.6657
4.1983
4.1801
4.1614
2.9330
2.9145
2.8962
2.1572
2.0932
1H-NMR (400 MHz)
Solvent: CDCl3
Me
Me
O
N
O
Cl
76
2.01
1.03
2.05
2.02
2.00
1.01
1.01
1.00
2.03
2.02
3.00
3.00
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
f1 (ppm)

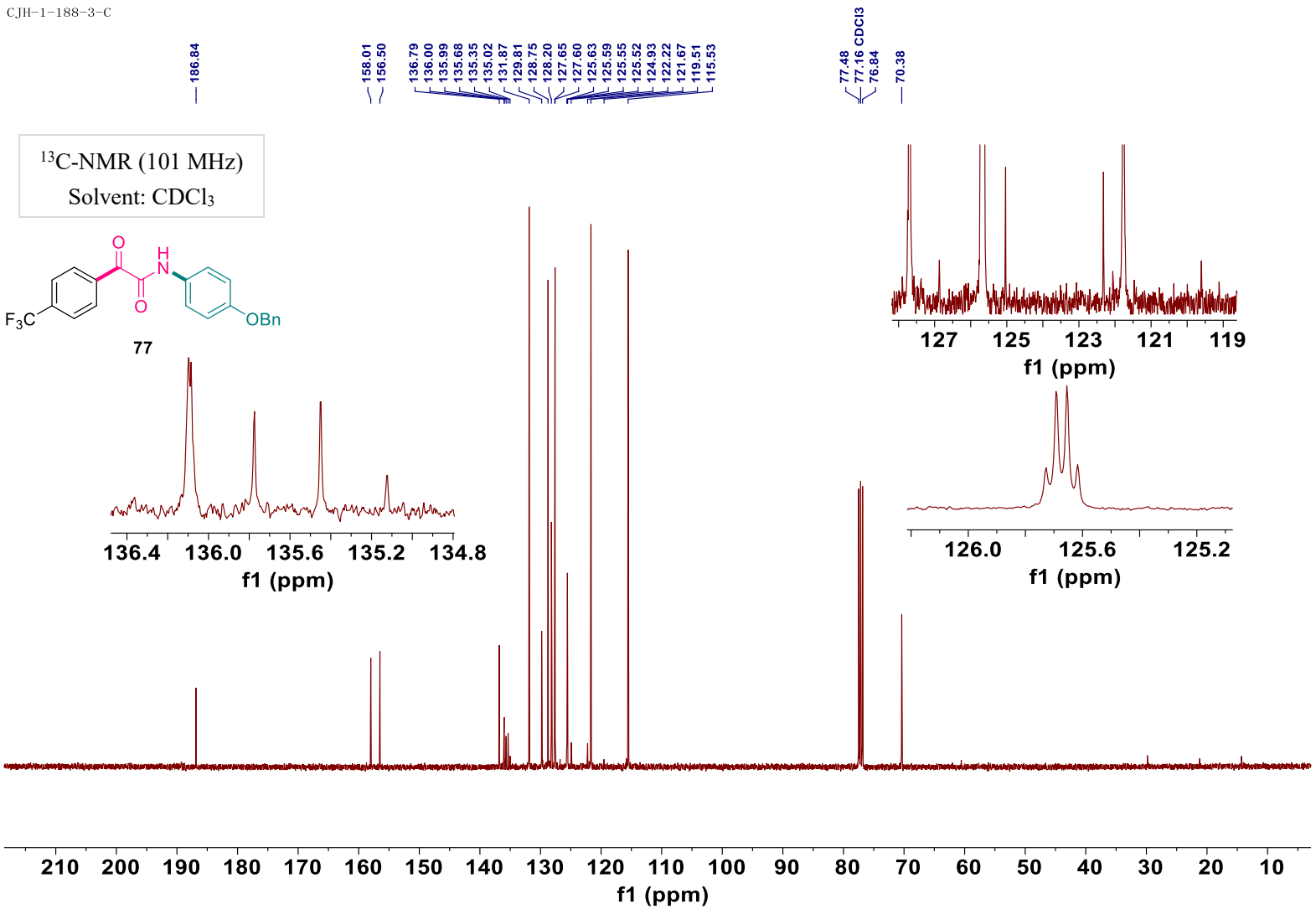

CJH-3-58-2-C
190.70
167.00
138.25
137.20
136.86
136.74
134.25
133.71
132.52
130.71
130.53
129.50
128.77
128.71
125.09
77.48
77.16 CDCl3
76.84
48.85
33.08
19.82
19.50
13C-NMR (101 MHz)
Solvent: CDCl3
Me
Me
O
N
O
Cl
76
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

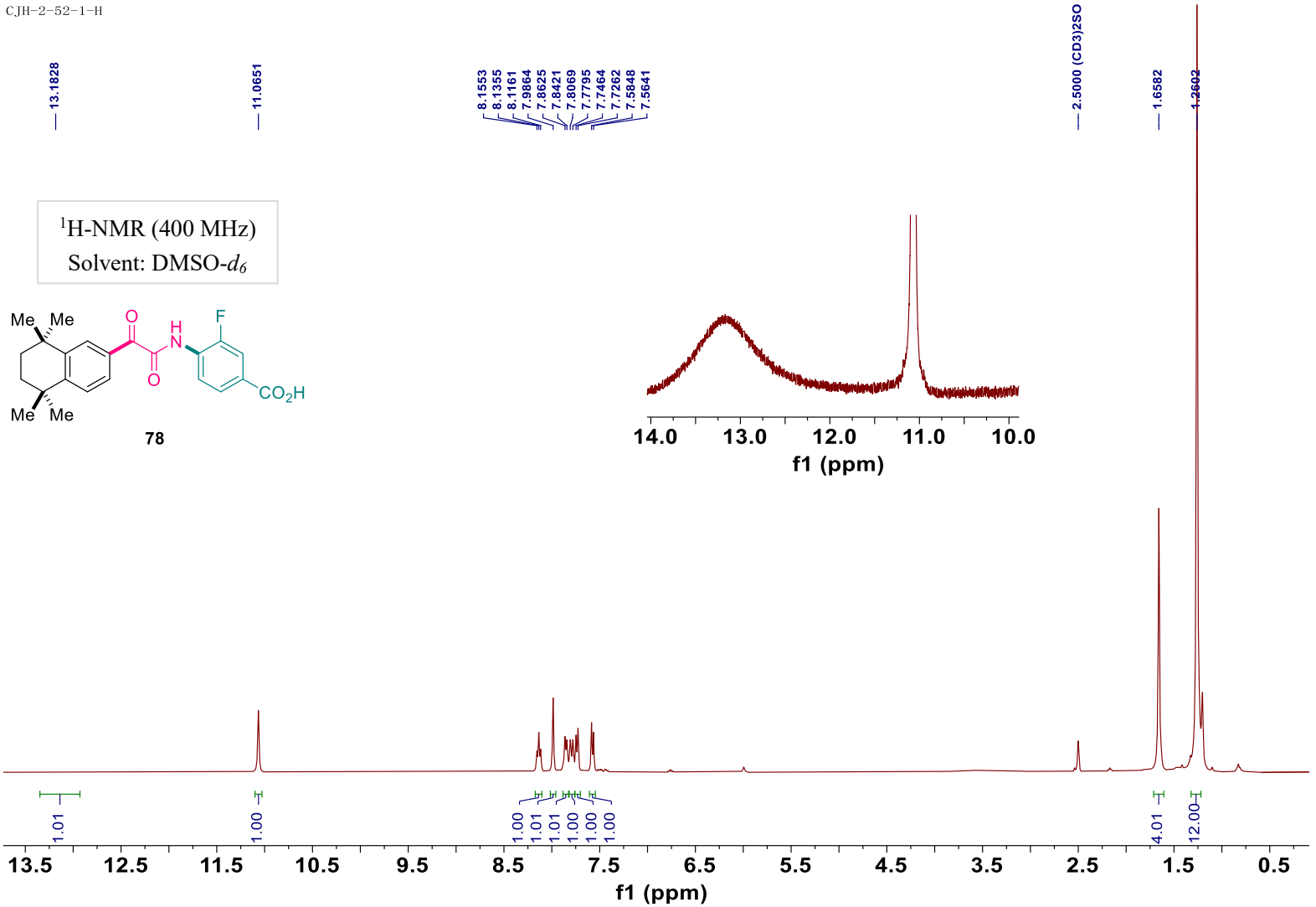
CJH-1-188-3-H

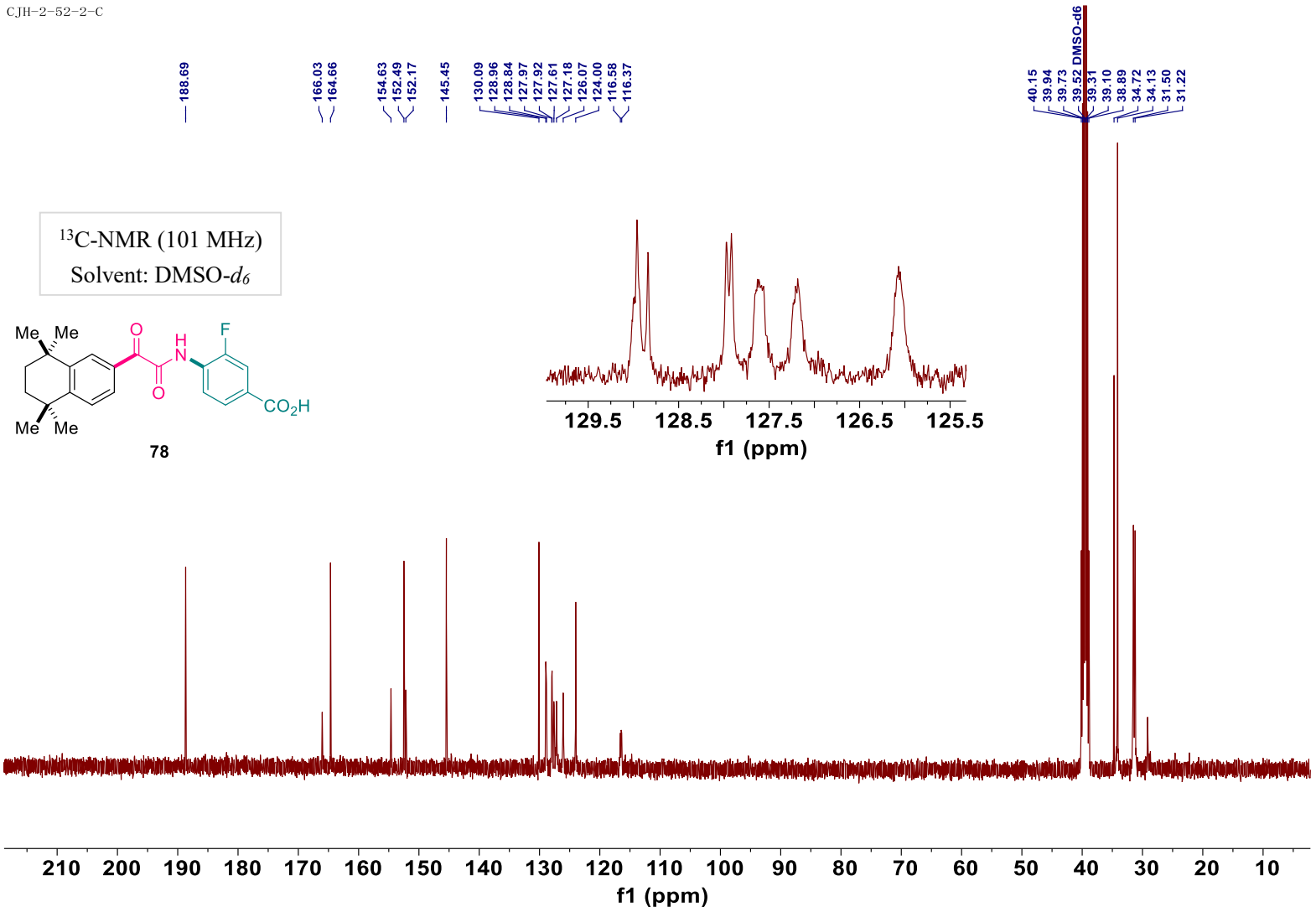


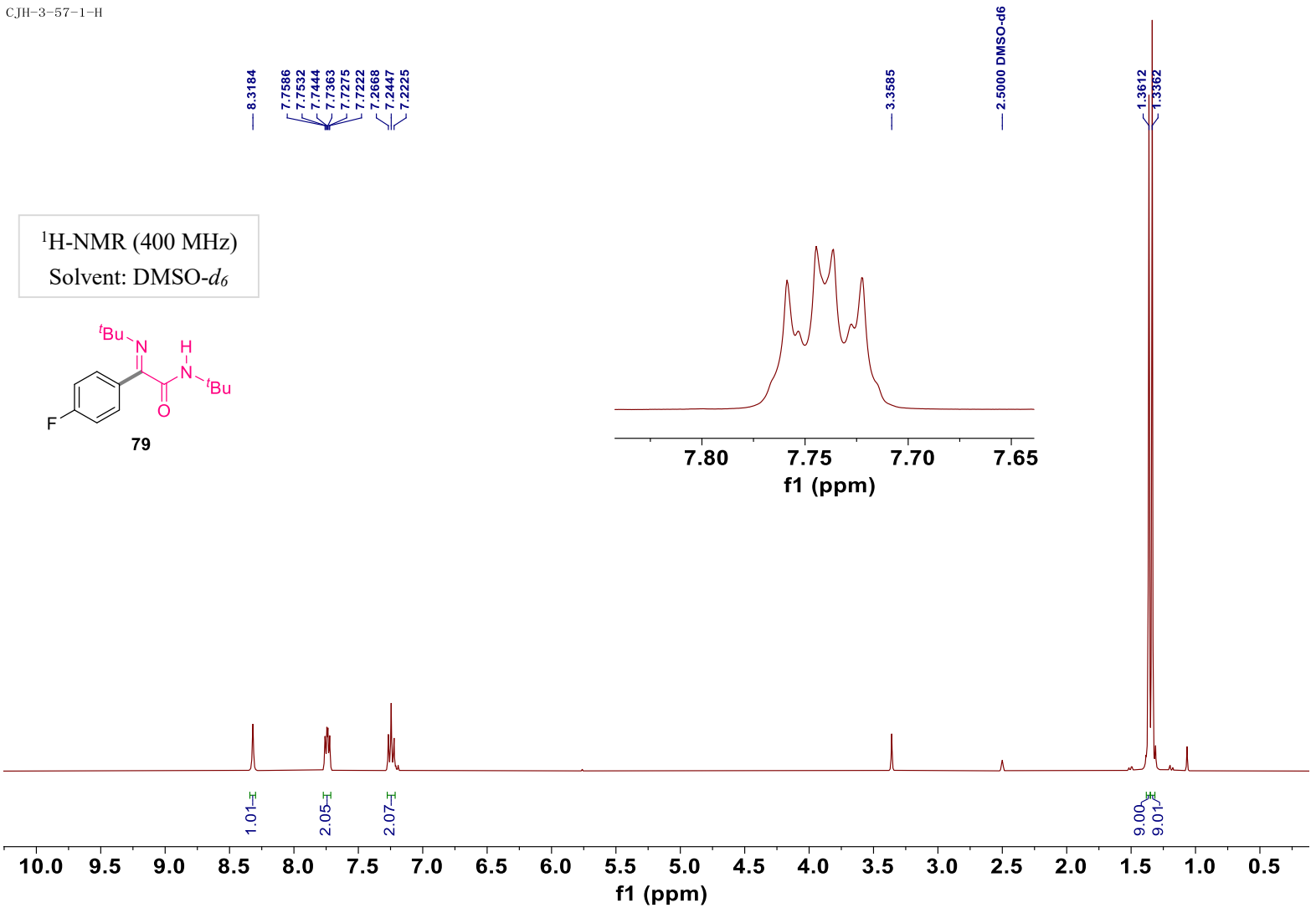
^{1}H-NMR (400 MHz)
Solvent: $CDCl_3$

77

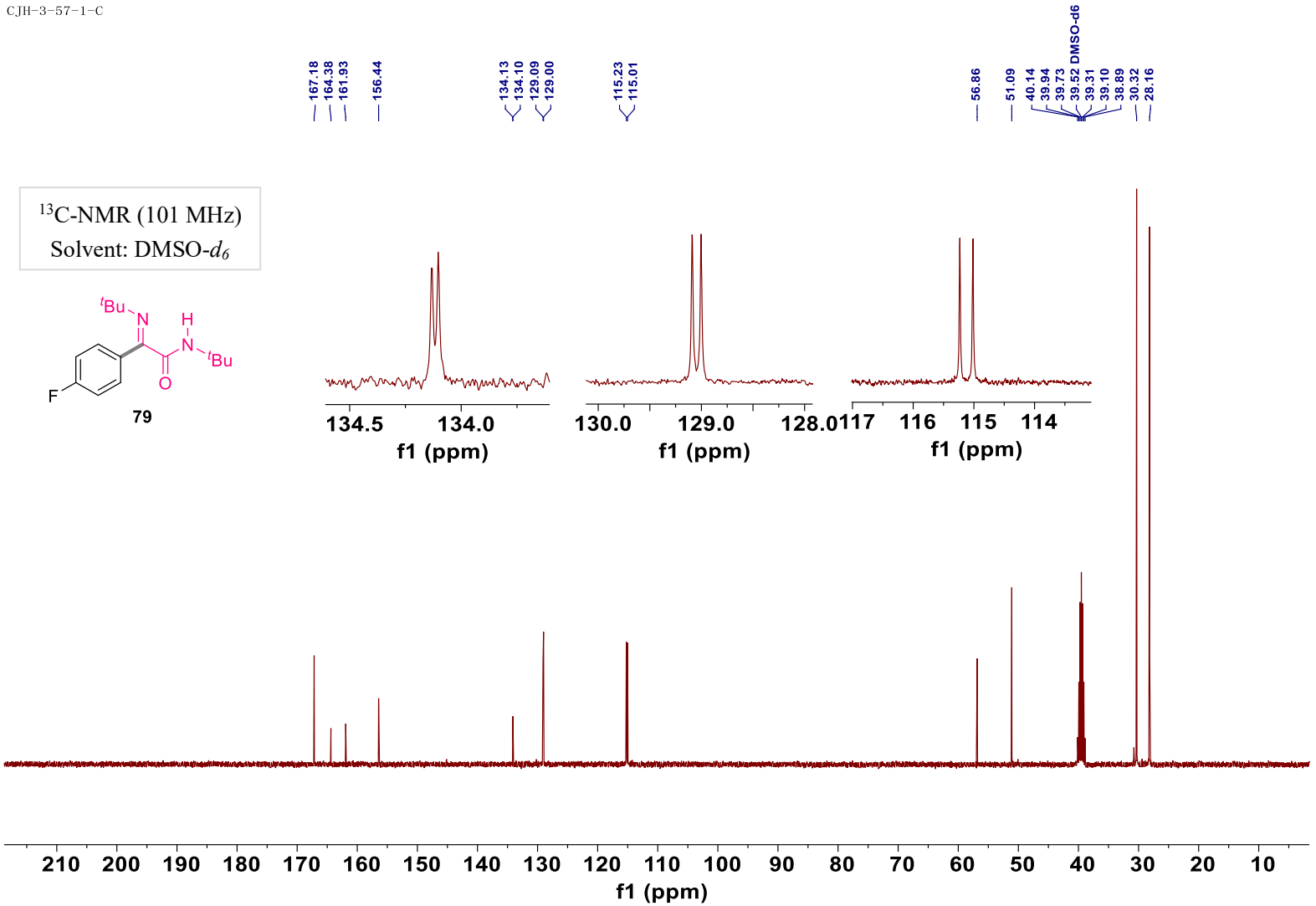

CJH-1-188-3-C
186.84
158.01
156.50
136.79
136.00
135.99
135.68
135.35
135.02
131.87
129.81
128.75
128.20
127.65
127.60
125.63
125.59
125.55
125.52
124.93
122.22
121.67
119.51
115.53
77.48
77.16 CDCl3
76.84
70.38
13C-NMR (101 MHz)
Solvent: CDCl3
O
H
N
O
F3C
OBn
77
136.4 136.0 135.6 135.2 134.8
f1 (ppm)
127 125 123 121 119
f1 (ppm)
126.0 125.6 125.2
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CJH-2-52-1-H
13.1828
11.0651
8.1553
8.1355
8.1161
7.9864
7.8625
7.8421
7.8069
7.7795
7.7464
7.7262
7.5848
7.5641
2.5000 (CD3)2SO
1.6582
1.2602
1H-NMR (400 MHz)
Solvent: DMSO-d6
Me
Me
Me
Me
O
H
N
O
F
CO2H
78
14.0
13.0
12.0
11.0
10.0
f1 (ppm)
1.01
1.00
1.00
1.01
1.01
1.00
1.00
1.00
4.01
12.00
13.5
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
f1 (ppm)


CJH-2-52-2-C
188.69
166.03
164.66
154.63
152.49
152.17
145.45
130.09
128.96
128.84
127.97
127.92
127.61
127.18
126.07
124.00
116.58
116.37
40.15
39.94
39.73
39.52 DMSO-d6
39.31
39.10
38.89
34.72
34.13
31.50
31.22
13C-NMR (101 MHz)
Solvent: DMSO-d6
Me Me
O
H
N
F
O
CO2H
Me Me
78
129.5
128.5
127.5
126.5
125.5
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


CJH-3-57-1-H
8.3184
7.7586
7.7532
7.7444
7.7363
7.7275
7.7222
7.2668
7.2447
7.2225
3.3585
2.5000 DMSO-d6
1.3612
1.3362
1H-NMR (400 MHz)
Solvent: DMSO-d6
tBu
N
H
N
tBu
O
F
79
7.80
7.75
7.70
7.65
f1 (ppm)
1.01
2.05
2.07
9.00
9.01
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
f1 (ppm)

CJH-3-57-1-C

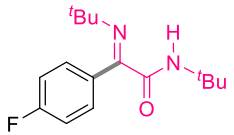


^{13}C-NMR (101 MHz)
Solvent: DMSO-d_6

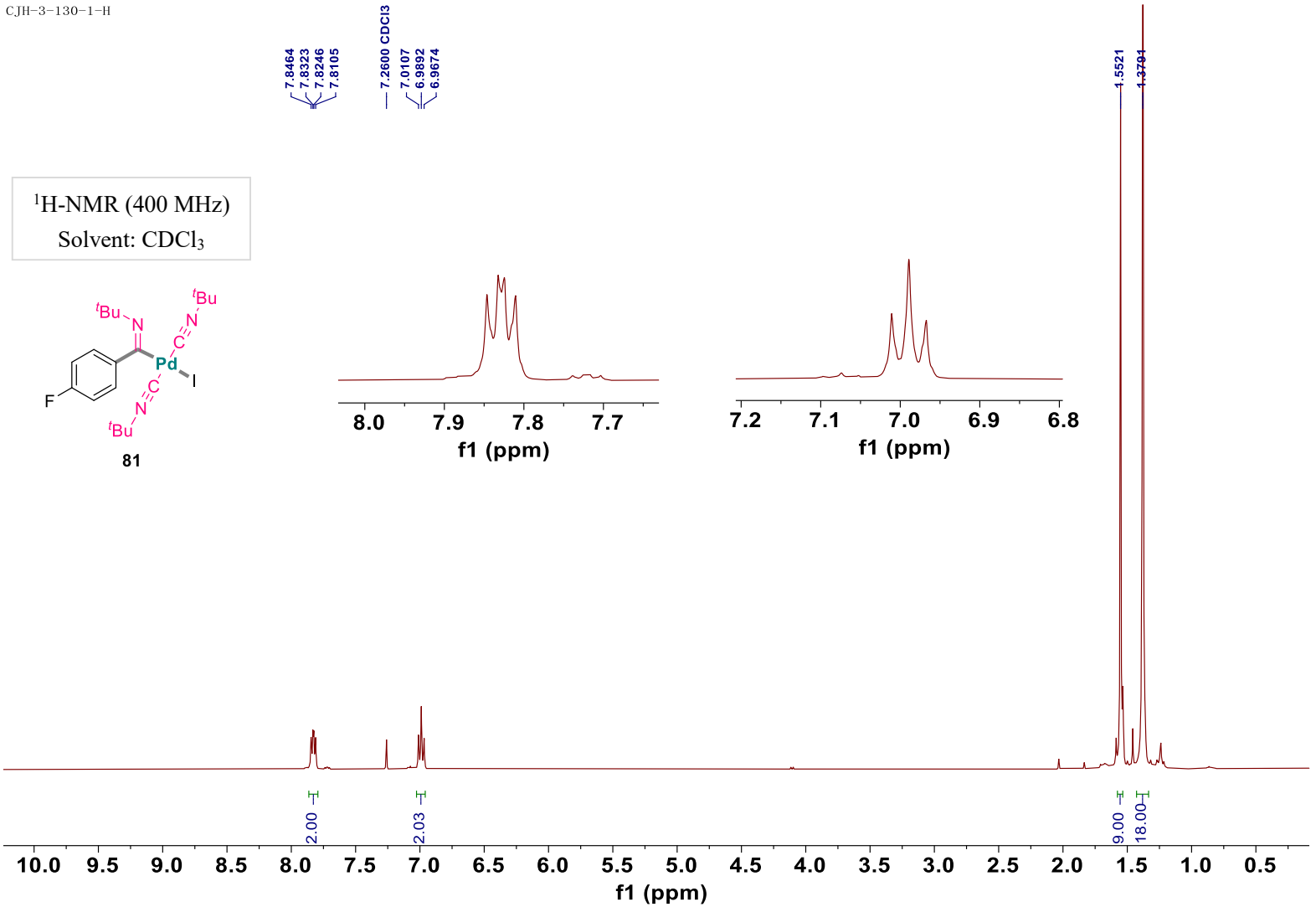
79

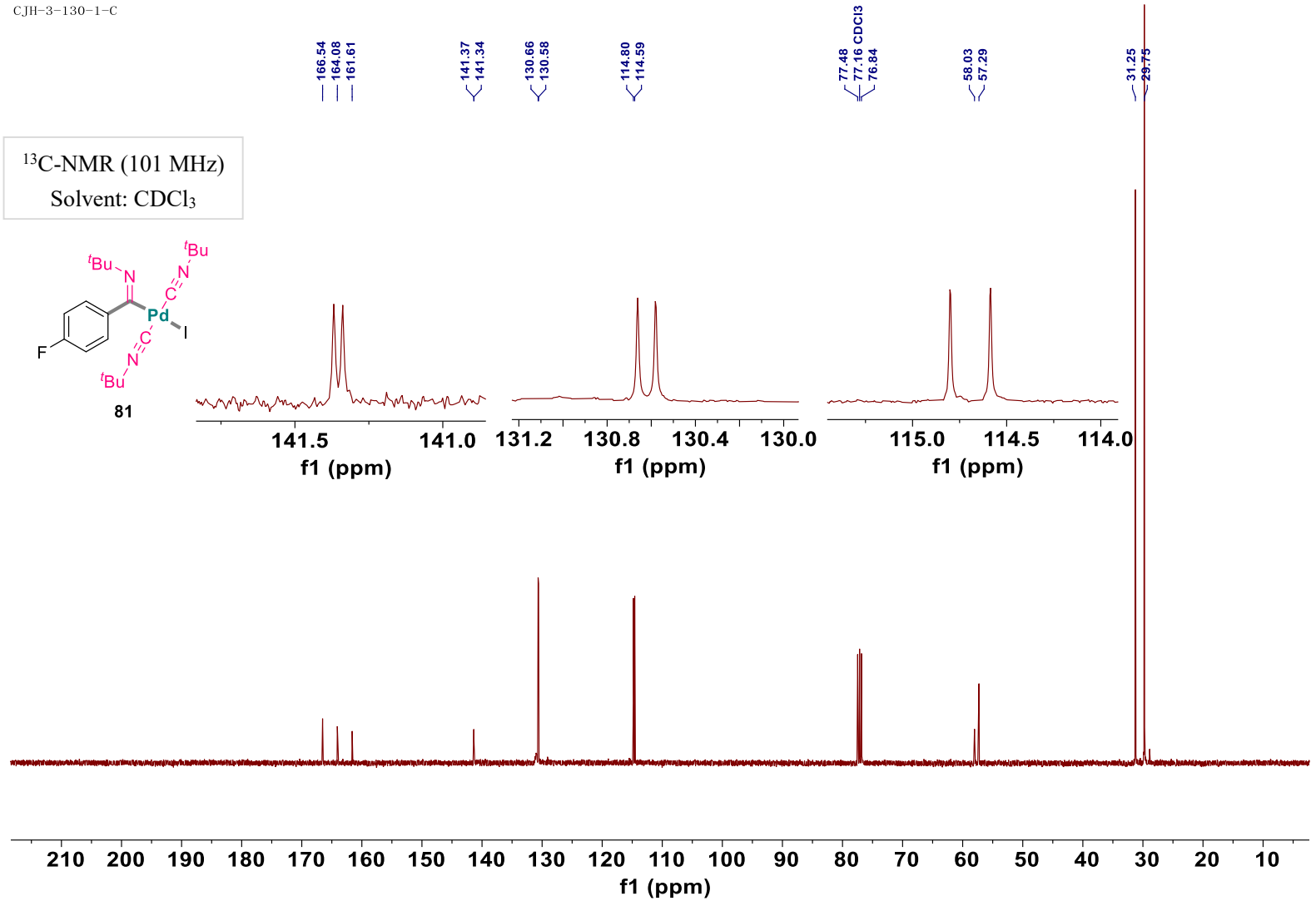
CJH-3-57-1-F

^{19}F-NMR (376 MHz)
Solvent: DMSO-d_6



79

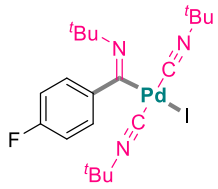

CJH-3-130-1-H
7.8464
7.8323
7.8246
7.8105
7.2600 CDCl3
7.0107
6.9892
6.9674
1.5521
1.3791
1H-NMR (400 MHz)
Solvent: CDCl3
81
8.0
7.9
7.8
7.7
f1 (ppm)
7.2
7.1
7.0
6.9
6.8
f1 (ppm)
2.00
2.03
9.00
18.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


CJH-3-130-1-C
166.54
164.08
161.61
141.37
141.34
130.66
130.58
114.80
114.59
77.48
77.16 CDCl3
76.84
58.03
57.29
31.25
29.75
13C-NMR (101 MHz)
Solvent: CDCl3
81
f1 (ppm)

CJH-3-130-1-F

-113.3310

^{19}F-NMR (376 MHz)
Solvent: $CDCl_3$



81

30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200

f1 (ppm)

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