Supplementary Information

A Universal Atomically Dispersed Cobalt Catalyst for Alkylation of Ketones Alcohols and Lignin-derived Compounds

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S1. Materials and methods

All substrates including ketones, alcohols and lignin model compounds were obtained commercially from various chemical companies. Cobalt (II) acetate tetrahydrate (cat no. 208396-50G), aniline (cat no. 242284-100mL) and silica suspension (Silica LUDOX® AS-40 colloidal silica, cat no. 420840-1L) were purchased from Sigma Aldrich. p-Phenylenediamine (cat no. A15680-250G), was purchased from Alfa Aesar. The pyrolysis experiments were carried out in Dekema Austromat 624 oven. All catalytic experiments were carried out in ACS pressure tubes. Unless otherwise stated all reagents were used directly without purification.

XRD powder patterns were recorded on a Panalytical X'Pert diffractometer equipped with a Xcelerator detector using automatic divergence slits and Cu $k\alpha_1/\alpha_2$ radiation (40 kV, 40 mA; λ= 0.15406 nm, 0.154443 nm). Cu beta-radiation was excluded using a nickel filter foil. The measurements were performed in 0.0167° steps and 100 s of data collecting time per step. The samples were mounted on silicon zero background holders. The obtained intensities were converted from automatic to fixed divergence slits (0.25°) for further analysis. Peak positions and profile were fitted with Pseudo-Voigt function using the High Score Plus software package (Panalytical). Phase identification was done by using the PDF-2 database of the International Center of Diffraction Data (ICDD).

Transmission Electron Microscopy (TEM) were performed FEI (tecnai F20) microscope operated at 200 kV, equipped with an Oxford X-MAX 80T. High-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) were performed Thermo Scientific themis Z. Before microscopy examination, the sample was ultrasonically dispersed in ethanol for 5-10 min and dropped onto copper grids for observation.

BET surface area and pore size measurements were performed with N_2 adsorption/desorption isotherms at 77 K on a Quantachrome instrument.

The X-ray Photoelectron Spectroscopy (XPS) measurements were recorded by Thermo Scientific ESCALAB 250Xi instrument using Al Ka radiation anode (hv = 1486.6 eV) and the C1s peak (284.6 eV) was used as the internal standard to correct the binding energies (BE). It is noted that C1s peak at 284.6 eV is due to the NC material itself rather than adventitious carbon.

The X-ray absorption spectra (XAS) including X-ray absorption near-edge structure (XANES)

and extended X-ray absorption fine structure (EXAFS) of the samples at Co K-edge (7709 eV) was collected at the the BL14W Beam line at the Shanghai Synchrotron Radiation Facility (SSRF) (Shanghai, China). Co foil, Co_3O_4, CoO and CoPC were used as references. Data reduction, data analysis, and EXAFS fitting is applied through Athena and Artemis software[1]. The energy calibration of the sample was conducted through a standard foil, which as a reference was simultaneously measured. For EXAFS modeling, The global amplitude EXAFS (*CN, R,* σ^2 and ΔE_0) were obtained by nonlinear fitting, with least-squares refinement, of the EXAFS equation to the Fourier-transformed data in R-space, using Artemis software, EXAFS of the foil is fitted and the obtained amplitude reduction factor S_0^2 value was set in the EXAFS analysis to determine the coordination numbers (CNs) in the scattering path in sample. The Debye-Waller factors and delta *R*s are obtained based on the *guessing* parameters and constrained for paths. Wavelet transformation (WT) is also employed using the software package developed by Funke and Chukalina using Morlet wavelet with $\kappa = 10$, $\sigma = 1$[2, 3].

GC and GC-MS analysis were recorded on Agilent 6890N instrument. GC conversion and yields were determined by GC, HP6890 chromatograph with FID detector, column HP 530 m x 250 mm x 0.25 μm. NMR spectra are recorded using Bruker 300 Fourier, Bruker AV 300, and Bruker AV 400 spectrometers. Chemical shifts are reported in ppm relative to the deuterated solvent. Coupling constants are expressed in Hertz (Hz). The following abbreviations are used: s = singlet, bs = broad singlet d = doublet, t = triplet and m = multiple. The residual solvent signals were used as references for ^1H and ^{13}C NMR spectra ($CDCl_3$: $\delta H = 7.26$ ppm, $\delta C = 77.12$ ppm; DMSO-d_6: $\delta H = 2.50$ ppm, $\delta C = 39.52$ ppm).

S2 Procedure for the preparation of catalytic materials

In a 100 mL dried round bottomed flask, 1.0 g p-phenylenediamine (PDA) and 2.5 g colloidal silica aqueous suspension (Ludox HS-40, 40 wt.%) were dissolved in 100 mL HCl solution (0.5 M). After stirring this mixture for 1 hour at room temperature, 4 mL deionized water and 1.0 g ammonium persulfate (APS) was added slowly into the above solution and stirred vigorously. Then, 0.5 mmol $Co(OAc)_2{\cdot}4H_2O$ (125 mg) was added to the above suspension to generate Co-PPDA-SiO_2 complex. The polymerization of PDA and assembly of silicon particles were conducted at room temperature for another 24 h. After reaction, the obtained solid material was freeze-dried and then transferred to crucible. The crucible was closed with a lid and placed in a pyrosis oven and then heated to the defined

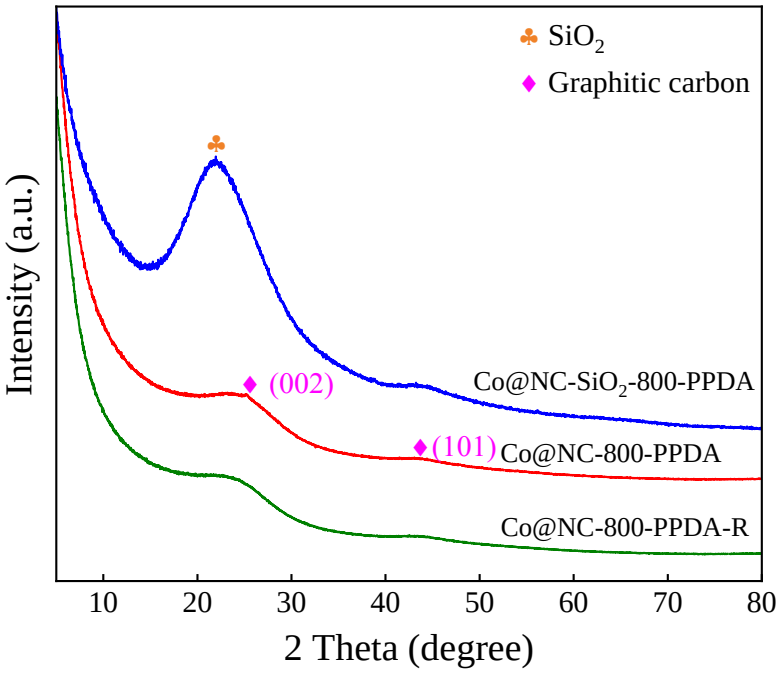
temperature (400-1000 ºC) for 2 h at the heating rate of 5 ºC/min under argon atmosphere. After the completion of pyrolysis, the oven was cooled down to room temperature and the material was removed from the oven (Co@NC-SiO_2-800-PPDA). Next, this pyrolyzed material was etched in 4 M NH_4HF_2 aqueous solution at room temperature for 24 h to remove the SiO_2 template and larger particles. Then the resulting catalytic material was filtered and washed subsequently with deionized water and ethanol three times and finally dried under vacuum (Co@NC-800-PPDA). The resulting catalyst was named as Co@NC-T-PPDA, where T represents the pyrolysis temperature.

Elemental analysis of the optimal catalyst, Co@NC-800-PPDA: C = 64 wt.%, N = 8.5 wt.%, H = 0.72 wt.%, Si = 0.30 wt.%. The cobalt content was measured by ICP-OES to be approximately 1.24 wt.%. Furthermore, the cobalt contents for Co@NC-800-PANI, Co@NC-400-PPDA, Co@NC-600-PPDA, Co@NC-1000-PPDA, Co-NPs-800, Co@NC-SiO_2-800-PPDA are 1.22, 1.45, 1.34, 1.17, 2.12, 1.86 wt%, respectively.

The same procedure was applied for the preparation of other Co-based catalysts using aniline (phenylamine: PA) as ligand and the corresponding catalytic material was noted as Co@NC-800-PA.

S3 Characterization of catalytic materials

XRD patterns

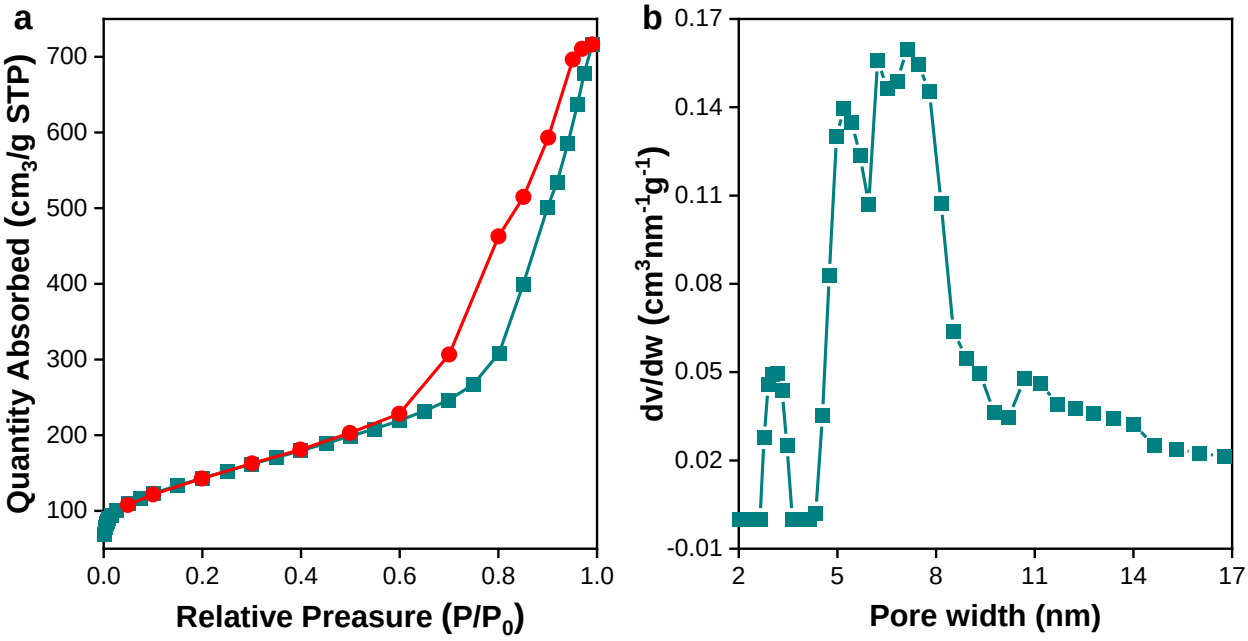


Supplementary Fig. 1. XRD patterns of different cobalt materials.

BET analysis

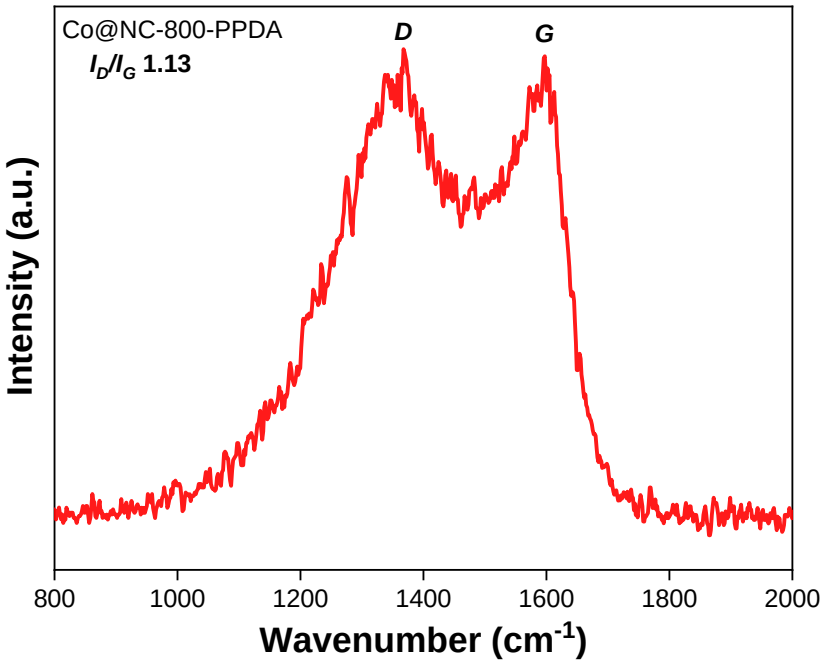
Supplementary Table 1. BET surface area of Co-based materials.

Catalyst	S_{BET} (m^2/g)	Pore volume ($cm^{-3}*g^{-1}$)
Co@NC-SiO_2-800-PPDA	11.3	0.007193
Co@NC-800-PPDA	563.1	0.113791
Co@NC-800-PPDA-R	552.3	0.113427



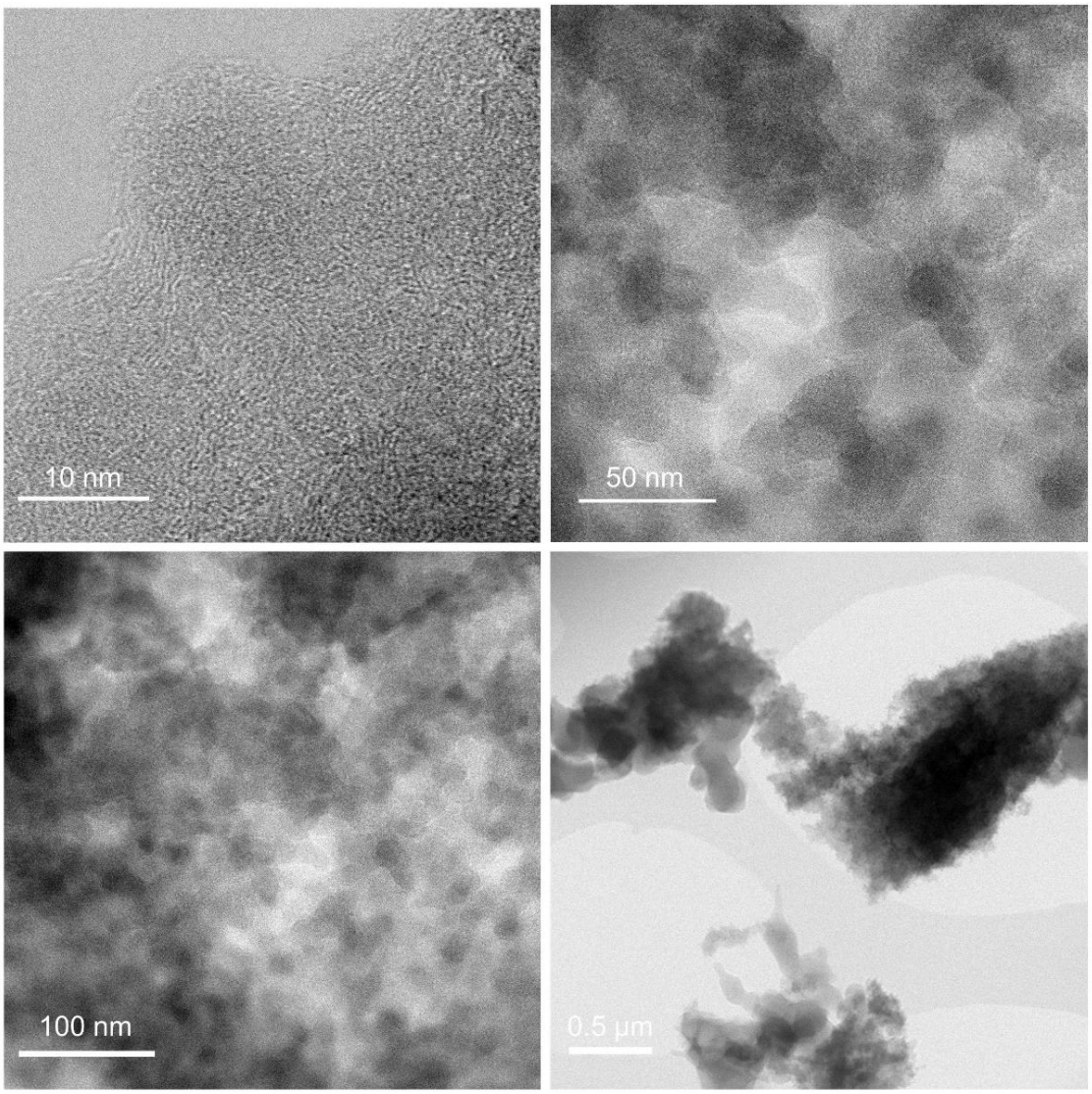
Supplementary Fig. 2. Adsorption-desorption isotherms (a) and pore width (b) of Co@NC-800-PPDA.

Raman spectra

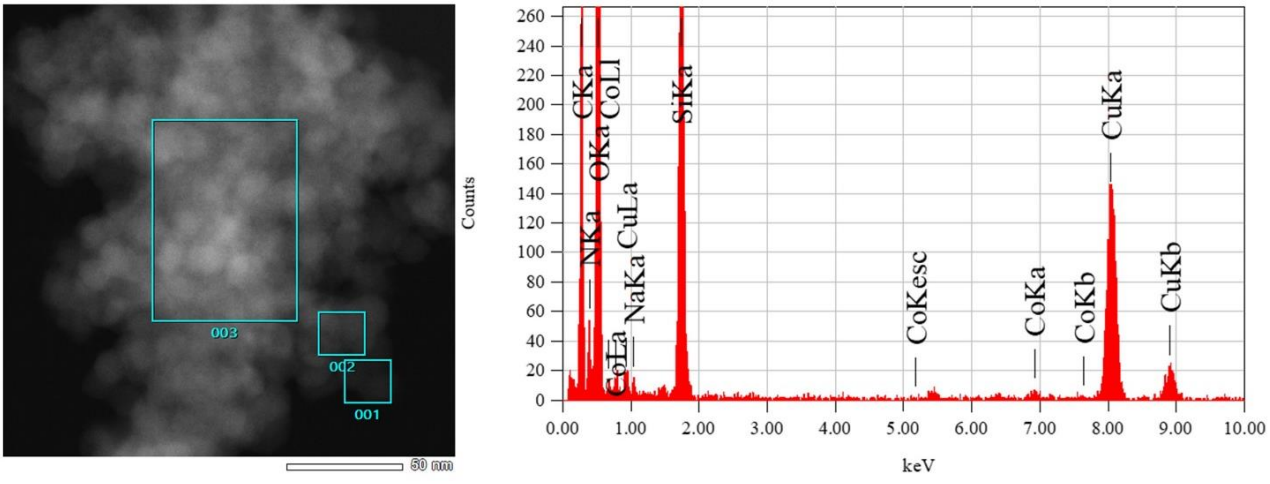


Supplementary Fig. 3. Raman spectra of Co@NC-800-PPDA.

STEM images

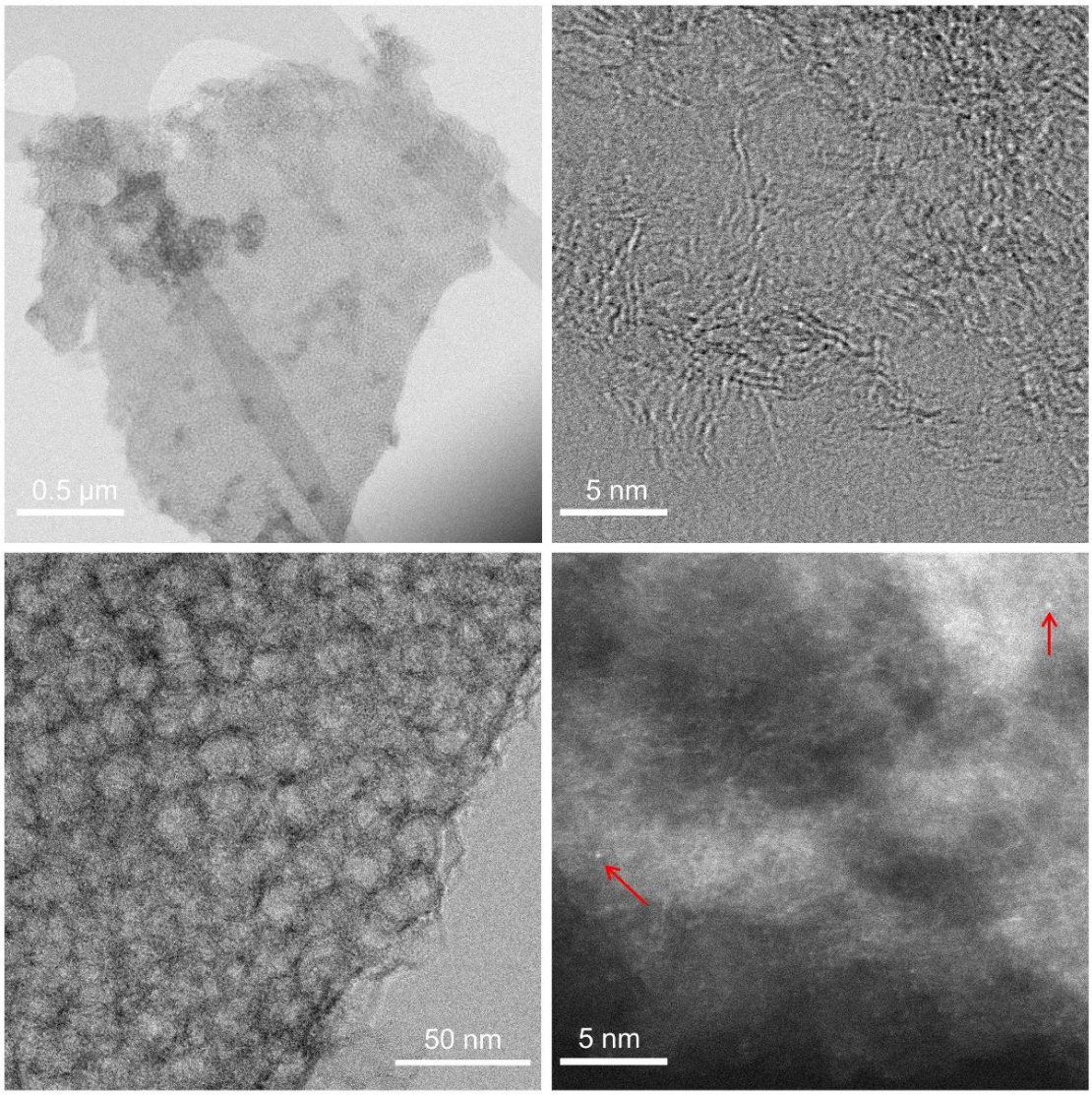


Supplementary Fig. 4. HAADF-STEM images of Co@NC-SiO_2-800-PPDA.

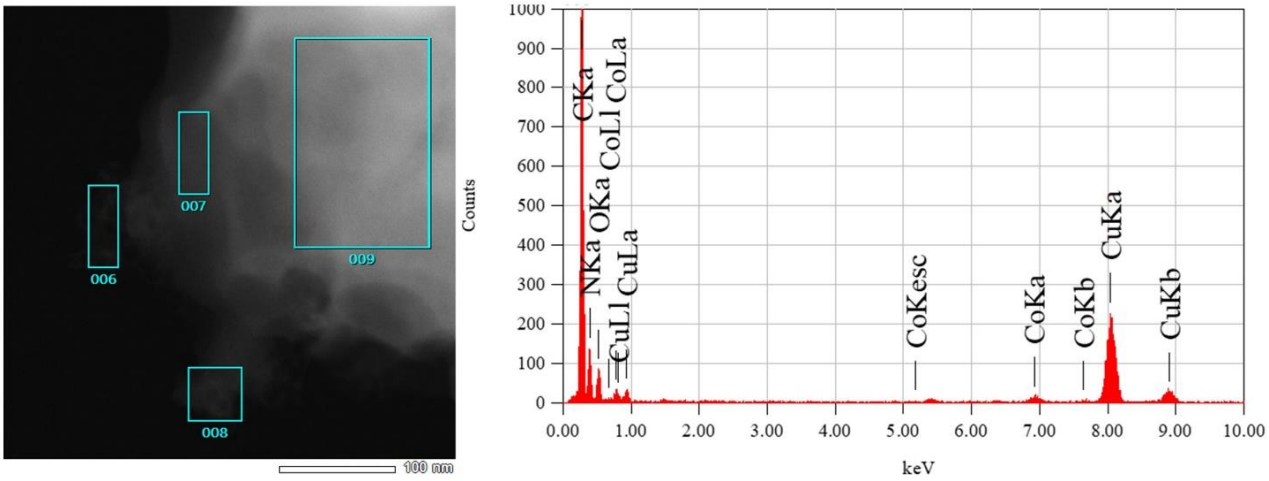


Supplementary Fig. 5. HAADF-STEM image of Co@NC-SiO_2-800-PPDA and corresponding EDX

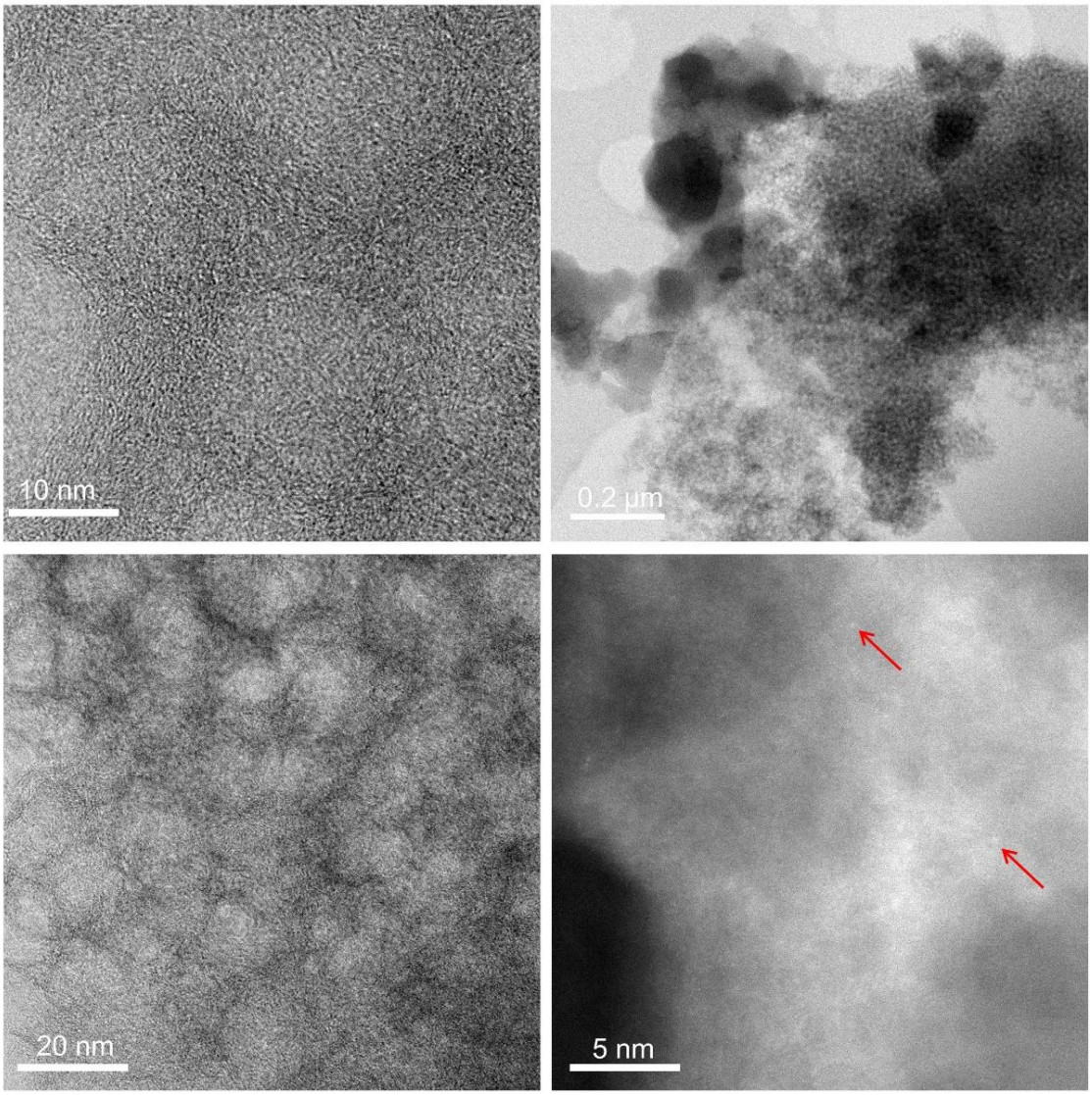
spectra of marked regions.



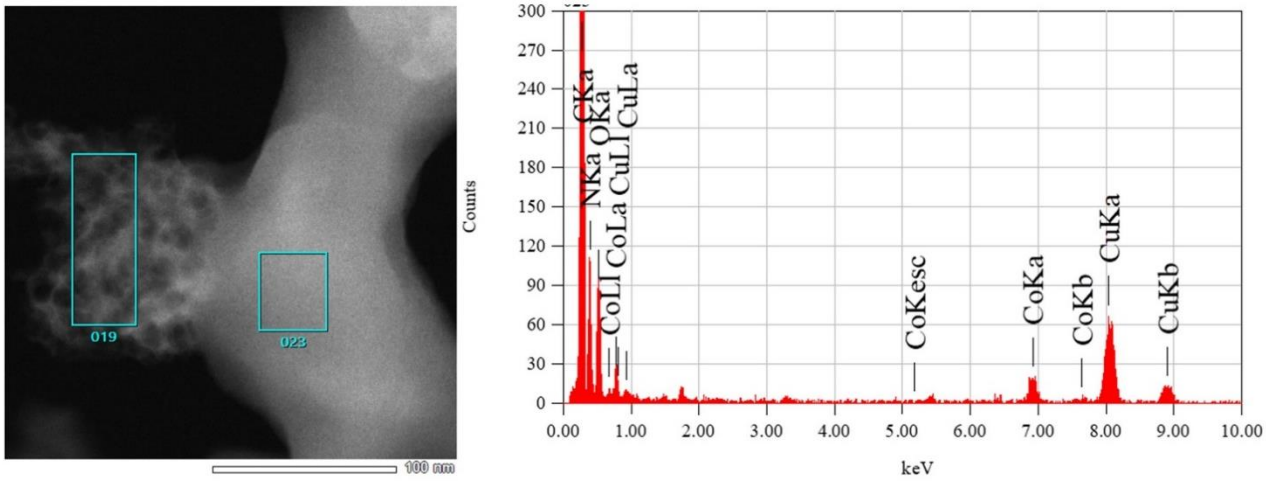
Supplementary Fig. 6. HAADF-STEM images Co@NC-800-PPDA. Cobalt single atoms were marked by red arrows.



Supplementary Fig. 7. HAADF-STEM image of Co@NC-800-PPDA and corresponding EDX spectra of marked regions.



Supplementary Fig. 8. HAADF-STEM images of Co@NC-800-PPDA-R (after one run). Cobalt single atoms were marked by red arrows.

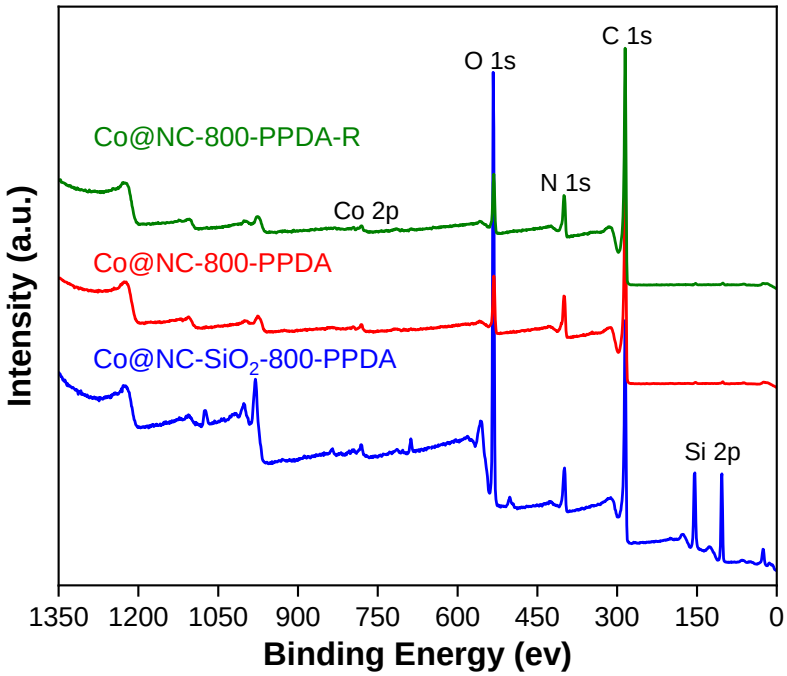


Supplementary Fig. 9. HAADF-STEM image of Co@NC-800-PPDA-R (after one run) and corresponding EDX spectra of marked regions.

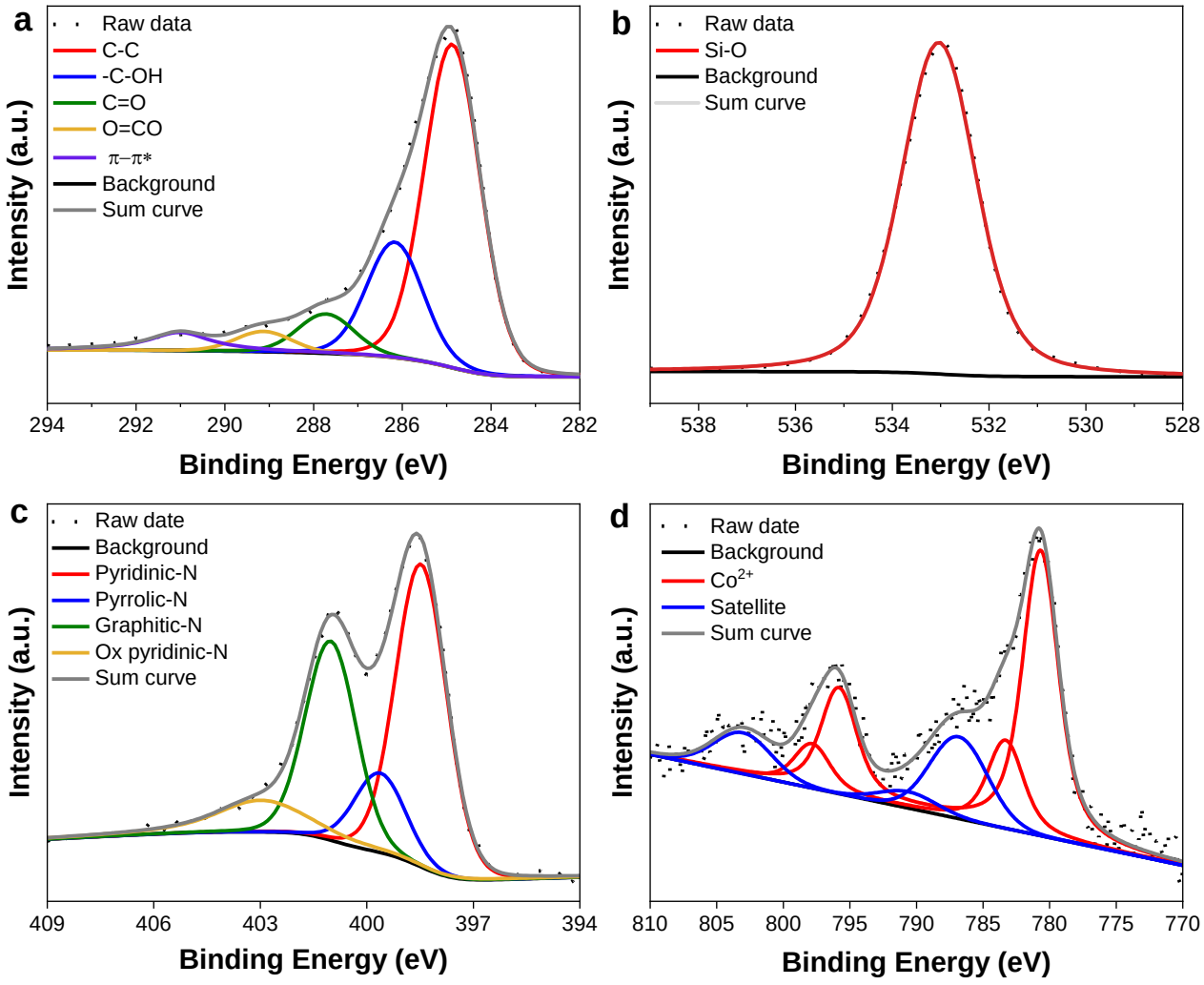
XPS spectra

Supplementary Table 2. Surface composition of different cobalt materials obtained by XPS. (All values are given in at.%.)

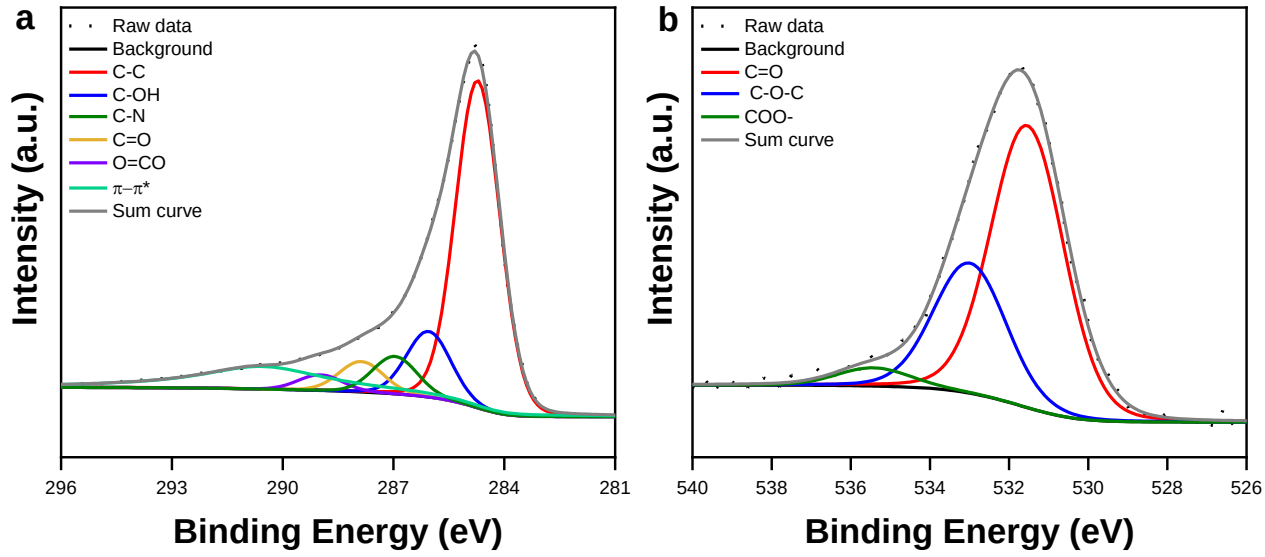
Catalyst	C	O	N	Co	Si	F
Co@NC-SiO_2-800-PPDA	43.5	30.8	6.1	0.4	17.3	0.7
Co@NC-800-PPDA	80.0	7.5	11.6	0.3	0.7	-
Co@NC-800-PPDA-R	80.8	7.6	10.7	0.3	0.5	0.1



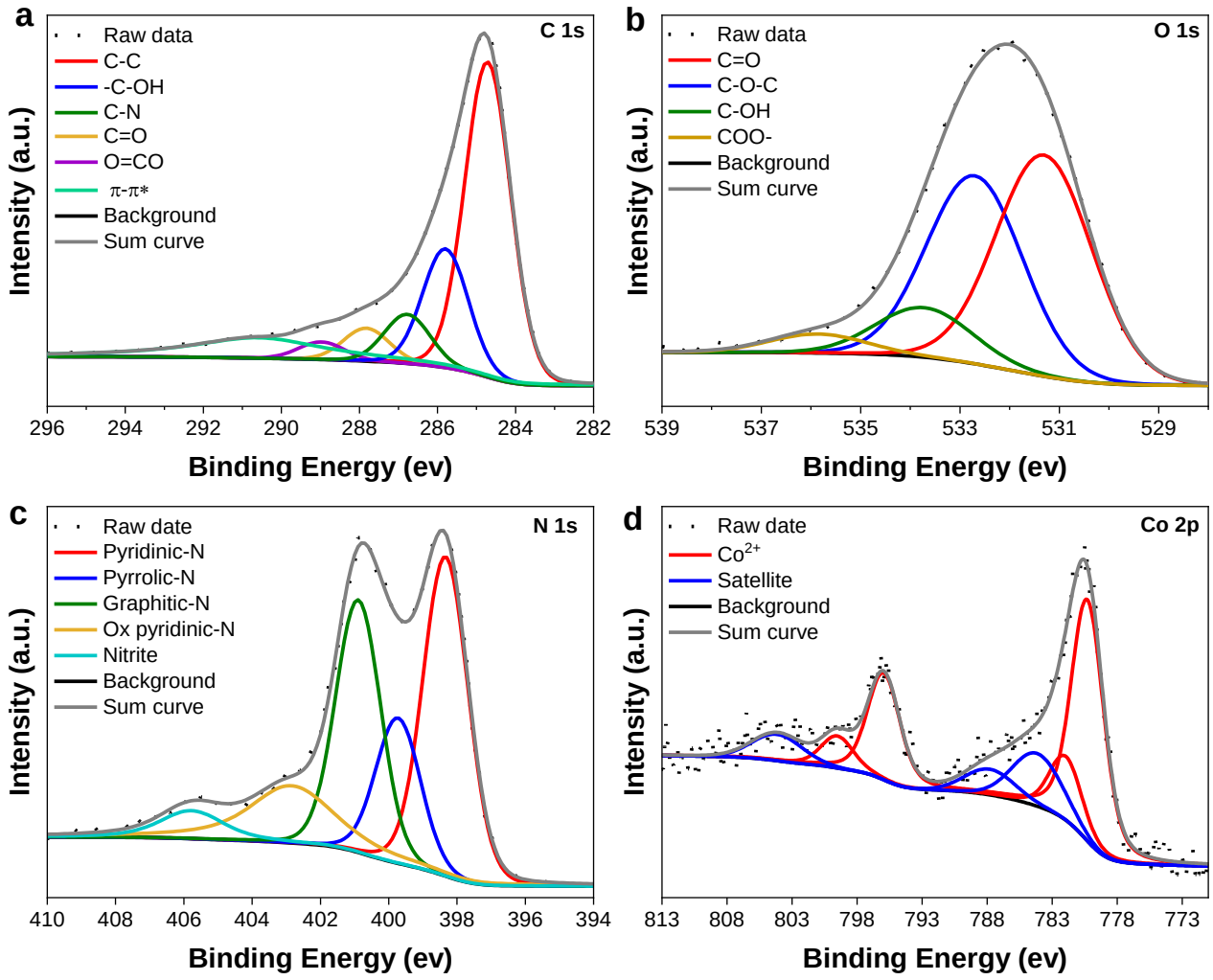
Supplementary Fig. 10. XPS survey spectrum of cobalt materials.



Supplementary Fig. 11. XPS of C 1s (a), O 1s (b), N 1s (c) and Co 2p (d) region of Co@NC-SiO_2-800-PPDA.

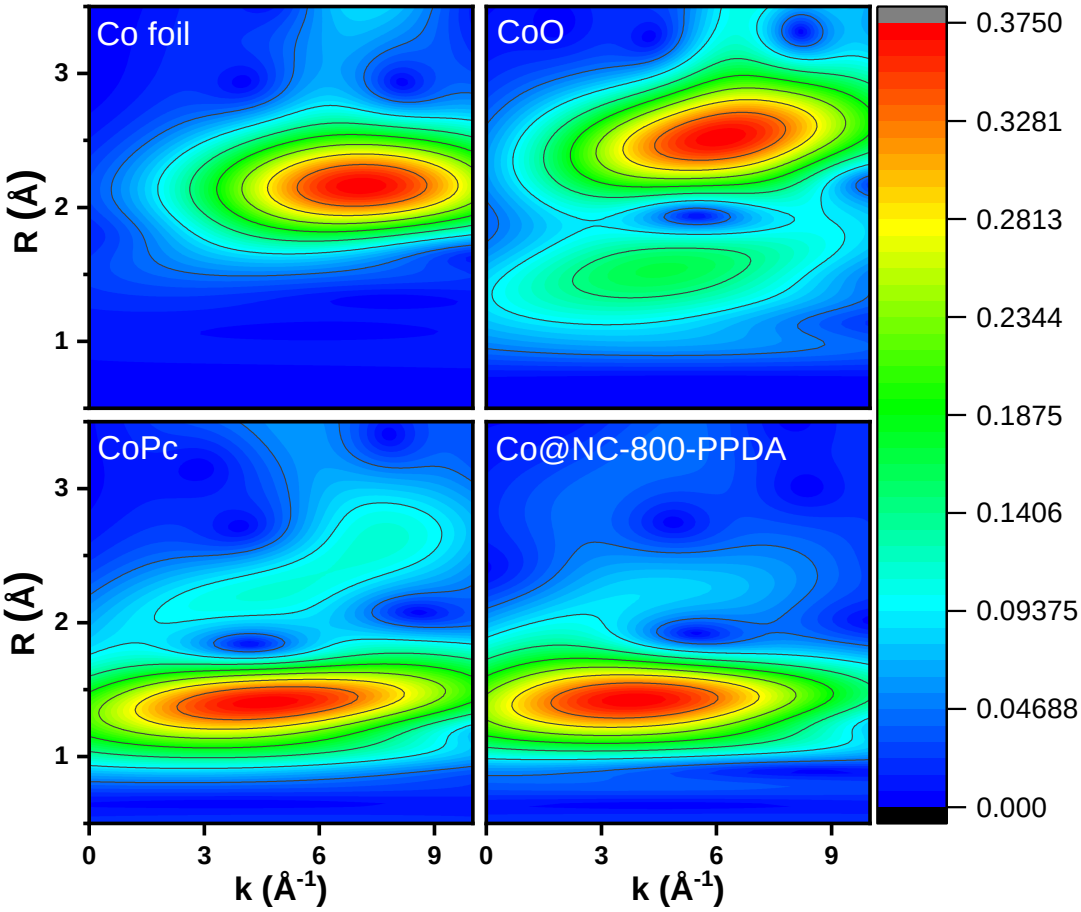


Supplementary Fig. 12. XPS of C 1s (a) and O 1s (b) region of Co@NC-800-PPDA.

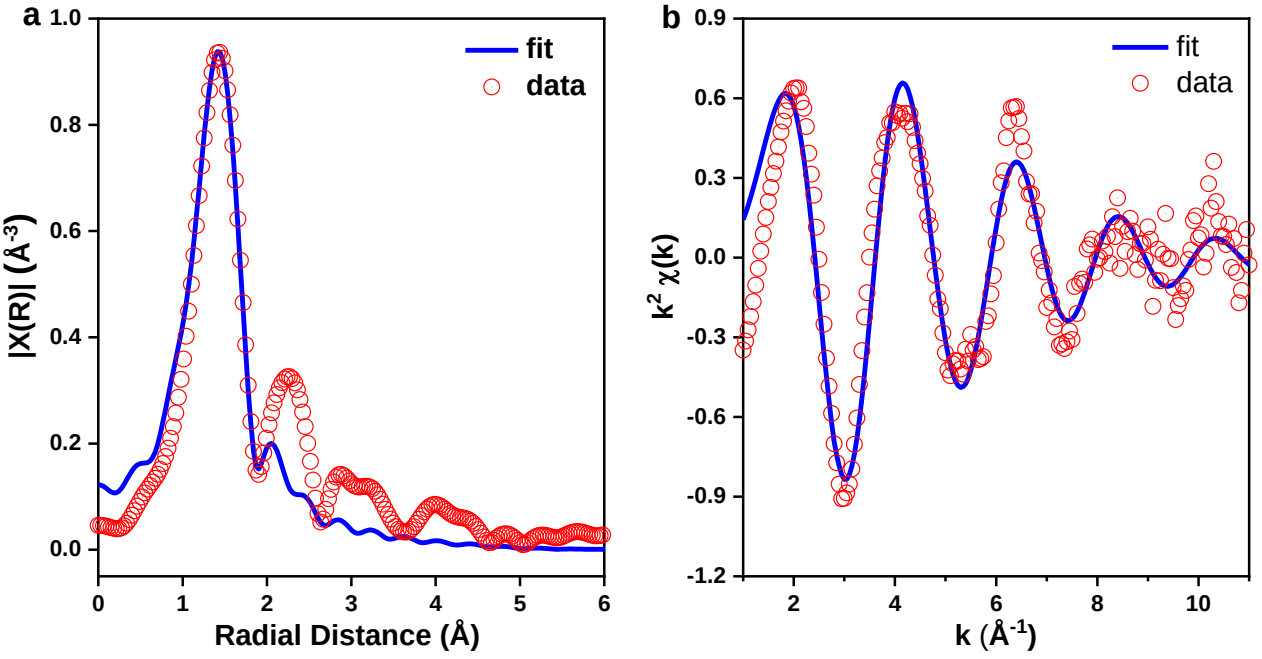


Supplementary Fig. 13. XPS of C 1s (a), O 1s (b), N 1s (c) and Co 2p (d) region of Co@NC-800-PPDA-R (recycled).

XAS analysis



Supplementary Fig. 14. Wavelet transform (WT) of Co foil, CoO, CoPc and Co@NC-800-PPDA.



Supplementary Fig. 15. Co K-edge EXAFS (points) and fit (line) for Co@NC-800-PPDA (a) R space and (b) K space.

Supplementary Table 3. The fitting parameters for Co K-edge EXAFS for the sample.

Sample	Shell	CN[a]	R(Å)[b]	σ^2(Å^2)[c]	ΔE_0 (eV)[d]	R factor
Co foil	Co-Co	12	2.49	0.009	7.1 ± 0.6	0.015
Co@NC-800-PPDA	Co-N	4.2 ± 0.2	1.97	0.009	-2.8 ± 0.4	0.006

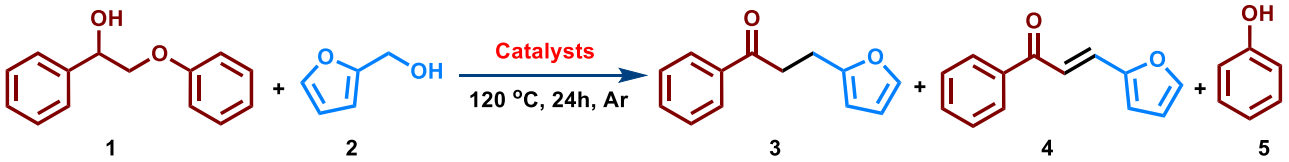
[a]CN, coordination number; [b]R, the distance to the neighboring atom; [c]σ^2, the Mean Square Relative Displacement (MSRD); [d]ΔE0, inner potential correction; R factor indicates the goodness of the fit. S_0^2 was fixed to 0.8951, according to the experimental EXAFS fit of the sample foil by fixing CN as the known crystallographic value. This value was fixed during EXAFS fitting, based on the known structure of Co foil. Data range $2.0 \leqslant k \leqslant 10.0$ Å^{-1}, $1.0 \leqslant R \leqslant 2.0$ Å.

S4. General procedure for the C-alkylation reactions

S4.1 C-Alkylation of lignin models, ketones, and secondary alcohols with primary alcohols

The magnetic stirring bar, 0.3 mmol lignin model compound or 0.5 mmol ketone or 0.5 mmol secondary alcohol and 2.0 equiv. primary alcohol, 40 mg catalyst (Co@NC-800-PPDA, 2.8 mol% Co) and 0.18 mmol potassium phosphate (K_3PO_4) were transferred to 20 mL pressure tube. Then, 2 mL t-BuOH (in case of ketones. Toluene in case secondary alcohols) was added, and the pressure tube was flushed with argon and fitted with screw cap. The pressure tube containing reaction mixture was placed in aluminum block and the reaction was allowed to progress under stirred condition at 120-140 °C for required time. After the completion of the reaction, the pressure tube was cooled to room temperature and the cap was slowly removed. Then, the reaction products were removed from the pressure tube, and the solid catalyst was filtered off and washed thoroughly with ethyl acetate. The reaction products were analyzed by GC-MS. The corresponding products were purified by column chromatography (silica; pentene-ethyl acetate mixture) and characterized by NMR and GC-MS spectral analysis. The following procedure is applied for determining the conversion and yield by GC: After completion of the reaction, n-hexadecane (0.3 mmol) as standard was added to the reaction pressure tube and the reaction products were diluted with ethyl acetate followed by filtration using plug of silica. Then the filtrate containing products were analyzed by GC.

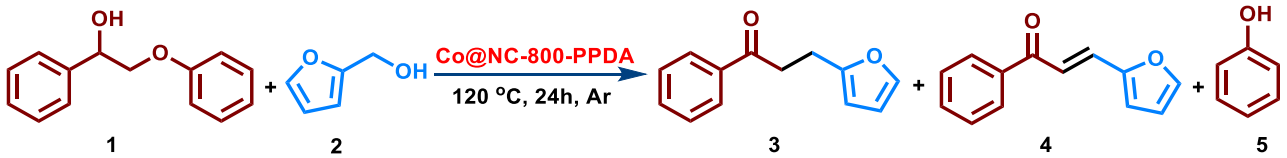
Supplementary Table 4. C-Alkylation of 2-phenoxy-1-phenylethanol with furfuryl alcohol: Testing of different cobalt catalysts.[a]



Entry	Catalysts	Conv.1 (%)	Yield of 3 (%)	Yield of 4 (%)	Yield of 5 (%)
1	Co@NC-SiO_2-800-PPDA (unremoved silica)	24	11	9	20
2	Co-PDA-SiO_2 (un-pyrolyzed material)	<20	<10	<10	11
3	$Co(OAC)_2$ + PDA (homogeneous condition)	13	5	7	10
4	$Co(OAC)_2{\cdot}4H_2O$ homogeneous condition	<10	<5	<5	<10
5	Co@NC-800-PPDA	>99	85	8	94
6[b]	Co@NC-800-PPDA + KSCN	<10	<5	<5	<10

Reaction conditions[a]: 0.3 mmol 2-phenoxy-1-phenylethanol, 0.6 mmol furfuryl alcohol, 40 mg catalyst, 0.18 mmol K_3PO_4 (0.6 equiv. based on **1**), 2 mL t-BuOH, 120 °C, 24 h, Ar. For homogeneous catalysis conditions: 10 mol% of $Co(OAC)_2{\cdot}4H_2O$ and 10 mol% PDA were used. [b]: Poisoning experiment same as "a" with 40 mg Co@NC-800-PPDA and 0.3 mmol KSCN (30 mg). Conversions and yields were determined by GC using n-hexadecane standard based on **1**.

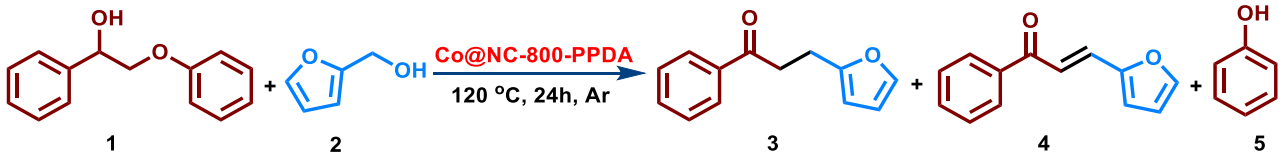
Supplementary Table 5. C-Alkylation of 2-phenoxy-1-phenylethanol with furfuryl alcohol: Testing of different solvents.



Entry	Solvent	Conv.1 (%)	Yield of 3 (%)	Yield of 4 (%)	Yield of 5 (%)
1	THF	70	51	12	66
2	Toluene	97	77	10	91
3	1.4-dioxane	66	59	6	62
4	t-BuOH	>99	85	8	94
5	p-xylene	87	72	8	80
6	o-xylene	86	69	7	80
7	n-Bu_2O	58	40	10	50

Reaction conditions: 0.3 mmol 2-phenoxy-1-phenylethanol, 0.6 mmol furfuryl alcohol, 40 mg Co@NC-800-PPDA (2.8 mol% Co), 0.18 mmol K_3PO_4 (0.6 equiv. based on **1**), 2 mL solvent, 120 °C, 24 h, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1**.

Supplementary Table 6. C-Alkylation of 2-penoxy-1-phenylethanol with furfuryl alcohol: Testing of different bases.

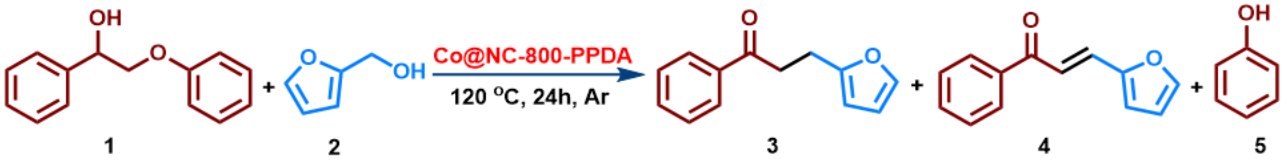


Entry	Base	Conv.1 (%)	Yield of 3 (%)	Yield of 4 (%)	Yield of 5 (%)
1	KOH	90	80	6	87
2	K_3PO_4	>99	85	8	94
3	K_2CO_3	63	55	7	60
4	CS_2CO_3	70	61	8	64
5	NaOH	91	76	9	79

6	KOMe	>99	90	4	95
7[b]	K_3PO_4	89	73	10	82

Reaction conditions: [a]0.3 mmol 2-penoxy-1-phenylethanol, 0.6 mmol furfuryl alcohol, 40 mg Co@NC-800-PPDA (2.8 mol% Co), 0.18 mmol base (0.6 equiv. based on **1**), 2 mL t-BuOH, 120 °C, 24 h, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1**. [b]Same as "a" with 30 mg catalyst.

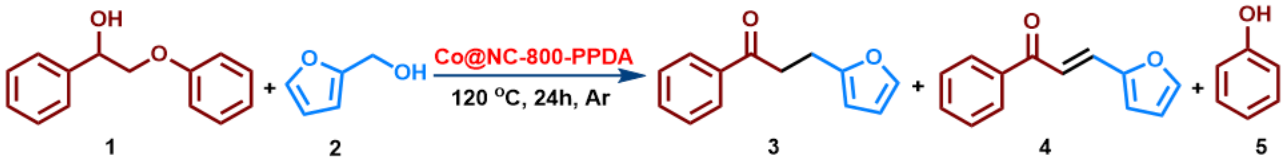
Supplementary Table 7. C-Alkylation of 2-penoxy-1-phenylethanol with furfuryl alcohol: Testing of different amounts of K_3PO_4.



Entry	K_3PO_4 amount	Conv.1 (%)	Yield of 3 (%)	Yield of 4 (%)	Yield of 5 (%)
1	None	61	35	20	54
2	0.06 mol (0.2 equiv)	70	55	10	64
3	0.12 mmol (0.4 equiv)	88	71	9	83
4	0.18 mmol (0.6 equiv)	>99	85	8	94

Reaction conditions: 0.3 mmol 2-penoxy-1-phenylethanol, 0.6 mmol furfuryl alcohol, 40 mg Co@NC-800-PPDA (2.8 mol% Co), 2 mL t-BuOH, 120 °C, 24 h, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1**.

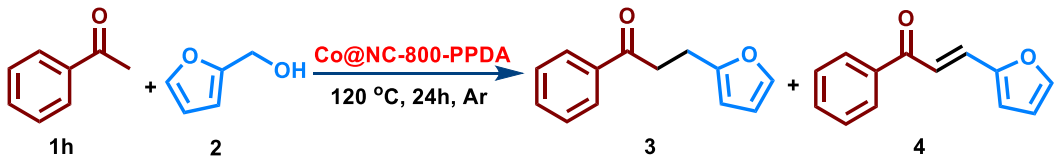
Supplementary Table 8. C-Alkylation of 2-penoxy-1-phenylethanol with furfuryl alcohol: Testing of different furfuryl alcohol amount.



Entry	Alcohol amount	Conv.1 (%)	Yield of 3 (%)	Yield of 4 (%)	Yield of 5 (%)
1	0.5 mmol (1.0 eq)	61	50	6	58
2	0.7 mmol (1.4 eq)	85	71	10	80
3	1 mmol (2.0 eq)	>99	85	8	94
4[b]	1 mmol (2.0 eq)	78	62	8	72

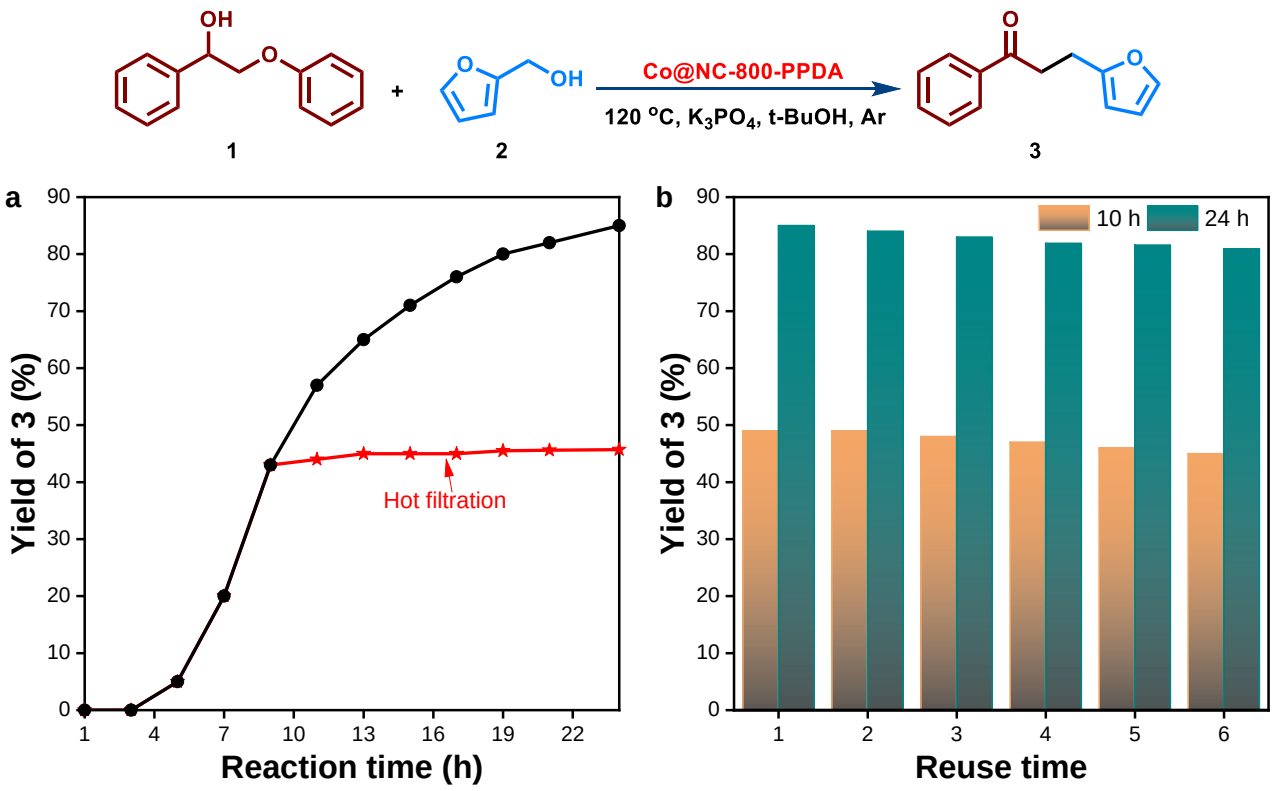
Reaction conditions: [a]0.3 mmol 2-penoxy-1-phenylethanol, 40 mg Co@NC-800-PPDA (2.8 mol% Co), 0.18 mmol K_3PO_4 (0.6 equiv. based on **1**), 2 mL t-BuOH, 120 °C, 24 h, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1**. [b]Same as "a" at 120 °C.

Supplementary Table 9. C-Alkylation of acetophenone with furfuryl alcohol: Testing of different solvent.

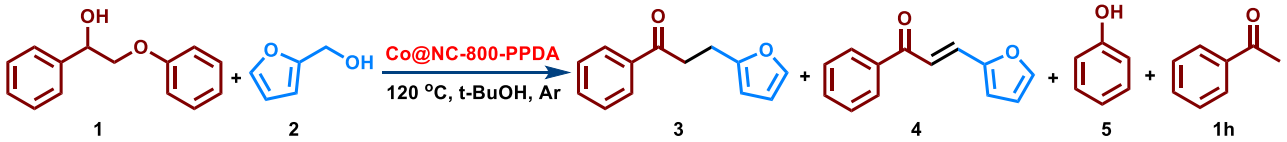


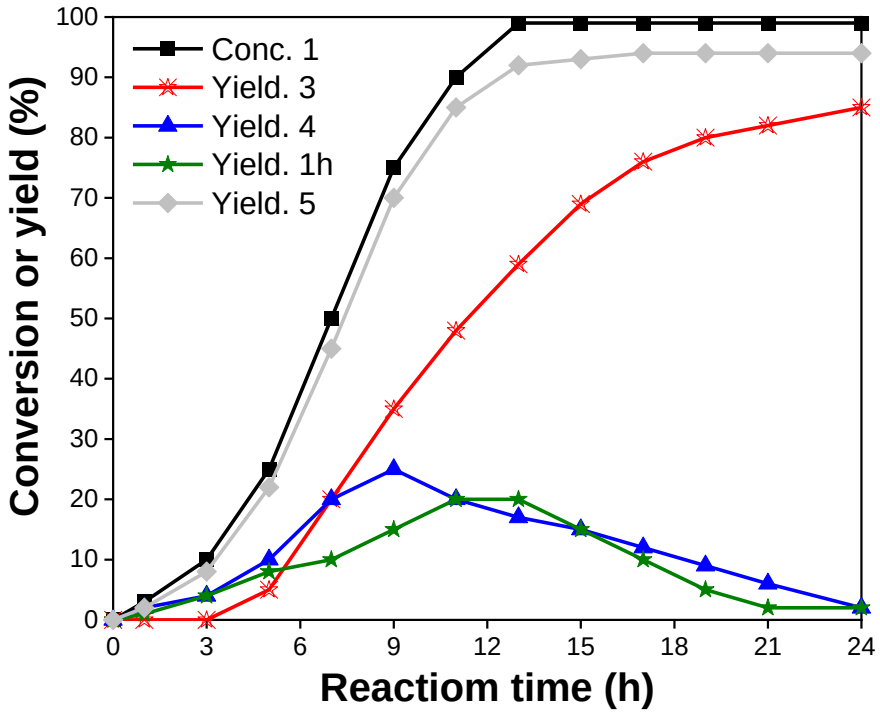
Entry	Solvent	Conv.1 (%)	Yield of 3 (%)	Yield of 4 (%)
1	THF	68	46	11
2	Toluene	99	87	8
3	1.4-dioxane	62	51	9
4	t-BuOH	91	78	11
5	p-xylene	85	69	10

Reaction conditions: 0.5 mmol acetophenone, 1.0 mmol furfuryl alcohol, 40 mg Co@NC-800-PPDA (1.69 mol% Co), 0.15 mmol K_3PO_4 (0.3 equiv. based on **1**), 2 mL solvent, 120 °C, 24 h, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1h**.

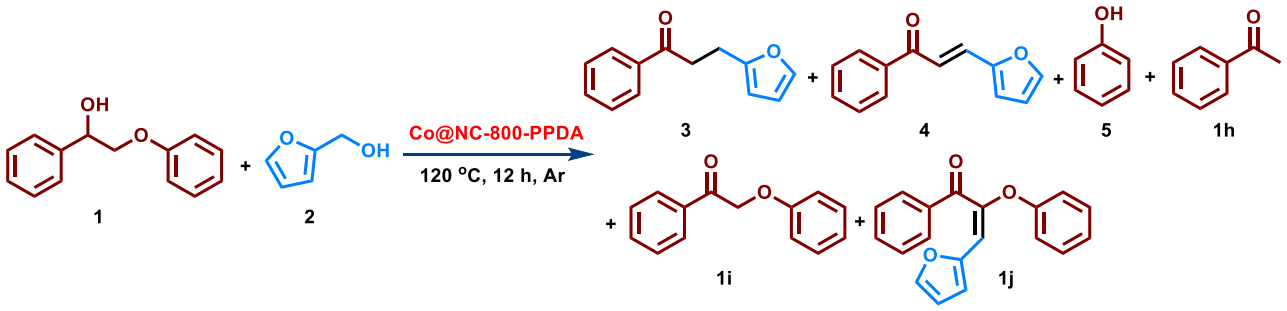


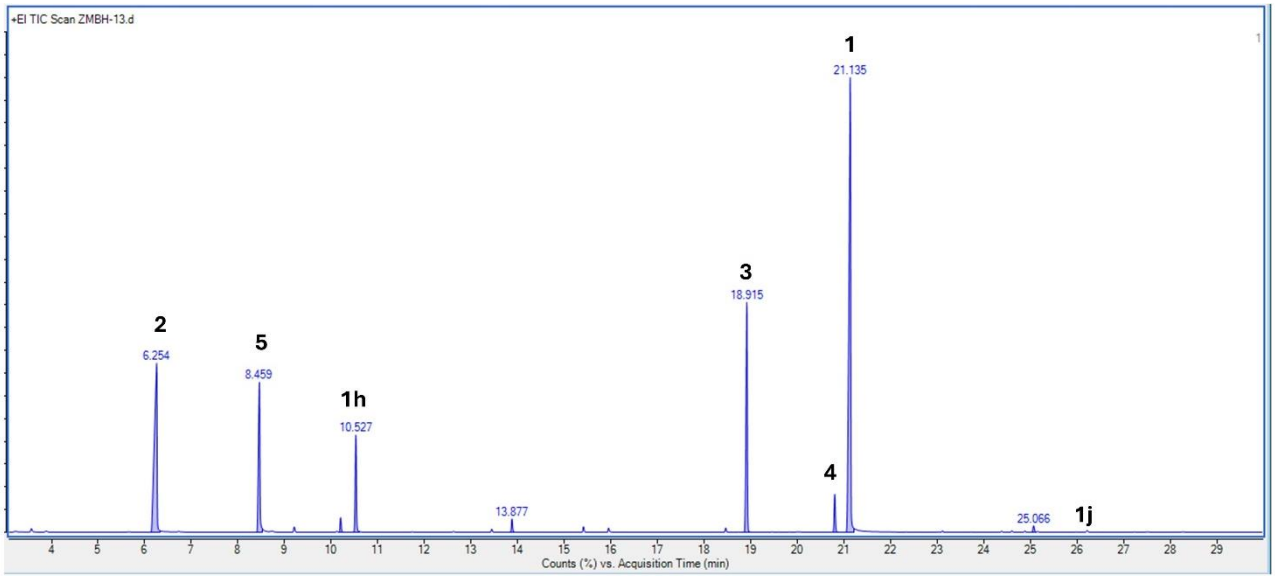
Supplementary Fig. 16. Hot filtration and recycling experiments with Co@NC-800-PPDA. (a) Reaction conditions for hot filtration experiment: 0.3 mmol 2-Phenoxy-1-phenylethanol, 0.6 mmol benzyl alcohol, 40 mg catalyst (2.8 mol% Co), 0.18 mmol K_3PO_4, 2 mL t-BuOH, 120 °C. (b) Reaction conditions for recycling experiment: 0.9 mmol 2-Phenoxy-1-phenylethanol, 1.8 mmol benzyl alcohol, 120 mg catalyst (2.8 mol% Co), 0.54 mmol K_3PO_4, 5 mL t-BuOH, 120 °C, 24 h and 10 h (details in SI). Conversions and yields were determined by GC using n-hexadecane standard based on **1**.



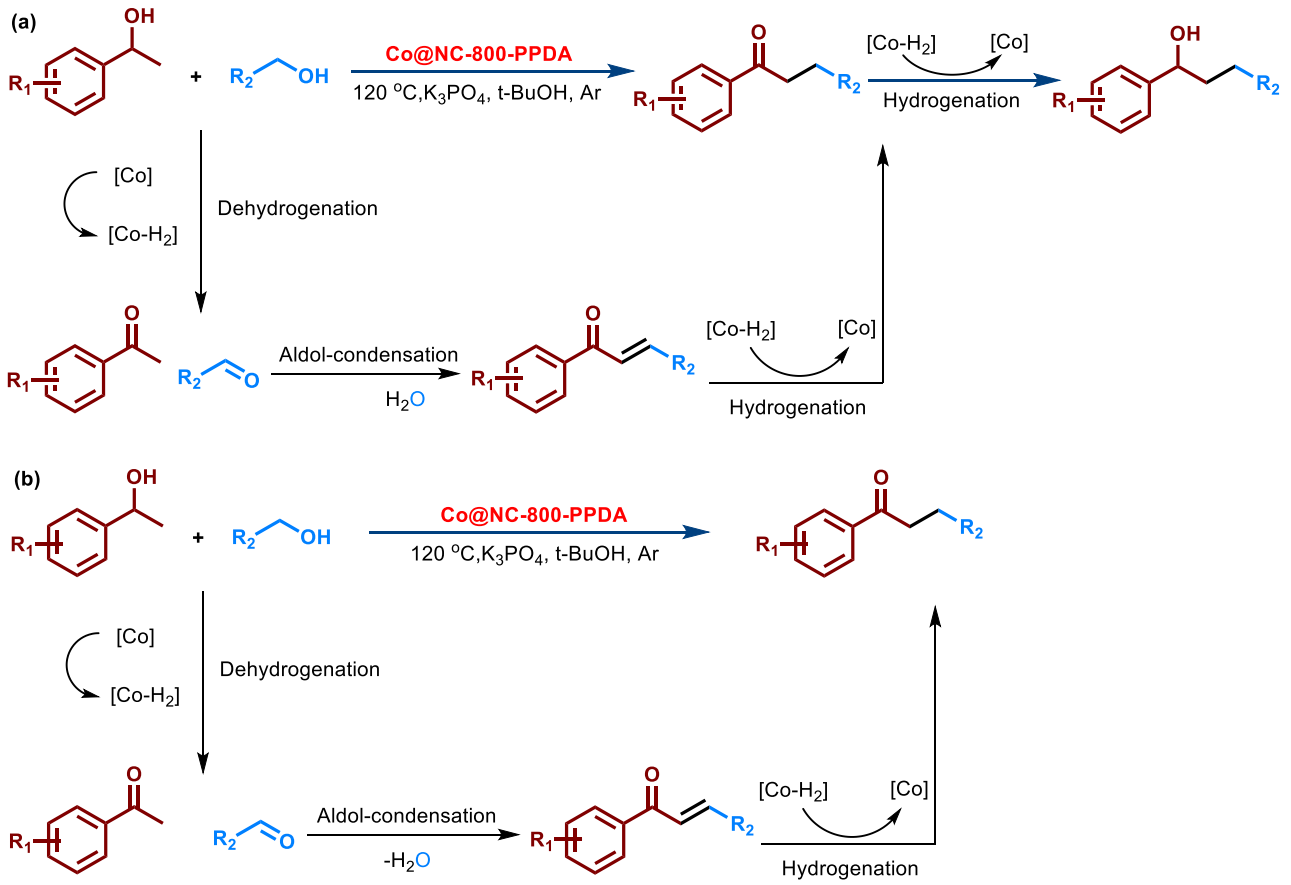


Supplementary Fig. 17. C-alkylation of 2-phenoxy-1-phenylethanol and furfuryl alcohol: Reaction progress with time. Reaction conditions: 0.3 mmol 2-phenoxy-1-phenylethanol, 0.6 mmol furfuryl alcohol, 40 mg Co@NC-800-PPDA (2.8 mol% Co), 0.18 mmol K_3PO_4 (0.6 equiv. based on **1**), 2 mL t-BuOH, 120 °C, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1**.





Supplementary Fig. 18. GC-MS spectra of control experiment. Reaction conditions: 0.3 mmol 2-Phenoxy-1-phenylethanol, 40 mg Co@NC-800-PPDA (2.8 mol% Co), 0.18 mmol K_3PO_4 (0.6 equiv. based on **1**), 2 mL t-BuOH, 120 °C, 8 h, Ar.

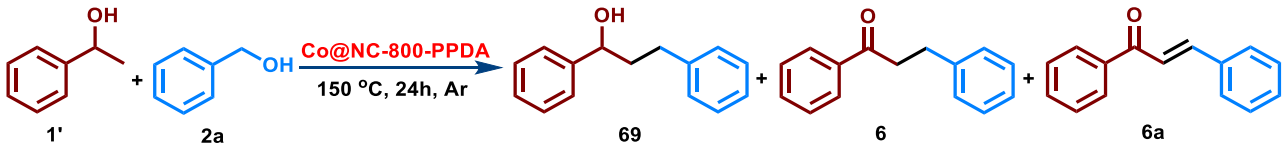


Supplementary Fig. 19. Possible reaction pathway for the C-alkylation of secondary alcohols with primary alcohols (a) to obtain C-alkylated alcohols and (b) to obtain C-alkylated ketones.

S4.2 Alkylation of secondary alcohols with primary alcohols to produce C-alkylated alcohols

The magnetic stirring bar, 0.5 mmol secondary alcohol, 1.5 mmol primary alcohol (3.0 equiv.) and 80 mg Co@NC-800-PPDA (3.37 mol% Co) as well as 0.5 mmol potassium methoxide (KOMe) were transferred to 20 mL pressure tube. Then, 2 mL dry toluene was added, and the pressure tube was flushed with argon and fitted with screw cap. The pressure tube containing reaction mixture was placed into aluminum block and allowed to progress at 150 °C for 24 h. After completion of the reaction, the pressure tube was cooled to room temperature. Then, the samples were removed from the pressure tube, and the solid catalyst was filtered off and washed thoroughly with ethyl acetate. The reaction products were analyzed by GC-MS. The corresponding products were purified by column chromatography (silica; pentene-ethyl acetate mixture) and characterized by NMR, GC-MS, and HR-MS spectral analysis.

Supplementary Table 10. C-Alkylation of 1-phenylethanol with benzyl alcohol to alkylated alcohol: Testing of different bases.



Entry	Base	Conv.1' (%)	Yield. 69 (%)	Yield. 6 (%)	Yield. 6a (%)
1	KOH	>99	50	42	-
2	K_3PO_4	>99	23	68	7
3	NaOH	>99	41	51	4
4	KOMe	>99	85	10	-

Reaction conditions: 0.5 mmol 1-phenylethanol, 1.5 mmol benzyl alcohol, 80 mg Co@NC-800-PPDA (3.37 mol% Co), 0.5 mmol base (1.0 equiv. based on **1'**), 2 mL toluene, 150 °C, 24 h, Ar. Conversions and yields were determined by GC using n-hexadecane standard based on **1'**.

S4.3 Methylation of ketones or secondary alcohols with methanol

The magnetic stirring bar, 0.5 mmol ketone or secondary alcohol, 3 mmol methanol, 100 mg Co@NC-800-PPDA (4.22 mol% Co) and 1 mmol potassium methoxide (KOMe) were transferred to 20 mL pressure tube. Then, 2 mL dry toluene was added, and the pressure tube was flushed with argon and fitted with screw cap. The pressure tube containing reaction mixture was placed into aluminum block and allowed to progress at 140-150 °C for 24 h under stirred conditions. After completion of the reaction, the pressure tube was cooled to room temperature. Then, the samples were removed from the pressure tube, and the solid catalyst was filtered off and washed thoroughly with ethyl acetate. The reaction products were analyzed by GC-MS. The corresponding products were purified by column chromatography (silica; pentene-ethyl acetate mixture) and characterized by NMR, GC-MS, and HR-MS spectral analysis.

S4.4 Hydrogenation of phenol to KA oil and C-alkylation of KA oil with benzyl alcohol

The magnetic stirring bar, filtrate of the reaction mixture obtained after the alkylation reaction, 200 mg Co@NC-800-PPDA (3.3 mol% Co) and 5 mL t-BuOH were transferred to 25 mL parr autoclave. After that, the autoclave was sealed and flushed with 20 bar H_2 three times and then it was pressurized

with 50 bar H_2. Subsequently, the autoclave was placed into an aluminum block preheated at 140 °C and the reactions were stirred for the required time. After the completion of the reactions, the autoclave was cooled to room temperature, the remaining hydrogen was discharged, and the 100uL n-hexadecane was added as internal standard. Then, the sample was filtered off with EtOH and the filtrate containing the product was analyzed by GC. Next, the filtrate was dried via rotary evaporation and redissolved in 5 mL t-BuOH solution, after which the filtrate and desired amount of benzyl alcohol were transferred to a pressure tube for the subsequent hydrogen borrowing reaction, the procedure same as section 4.1.

Supplementary Table 11. State-of-the-art for the C-alkylation via BH-strategy with heterogeneous materials.

Entry	Catalyst	T (°C)/ t (h)	Substrates	Yield	Recycle times	Ref
1	SAC-Co (1.69 mol% Co)	120/6, 0.3 equiv. K_3PO_4	Ketones, alcohols and lignin derivates (>100 examples)	94%	6	This work
2	Pd/C (1.0 mol% Pd)	80/24, 1.5 equiv. K_3PO_4	Ketones (17 examples)	100%	4	4
3	Co-CIA	90/16, 1.0 equiv. $AgNTf_2$ and KF	Ketones, alcohols (32 examples)	93%	5	5
3	Pd/CeO_2-C (0.37 mol% Pd)	130/12, 0.25 equiv. K_3PO_4	Ketones (23 examples)	97%	3	6
4	MnO_2@PDCS (1.4mol% Mn)	120/12, 1.0 equiv. NaOH	Ketones, alcohols (57 examples)	89%	5	7
5	Mn@CeO_2 (3.64 mol%Mn)	130/12, 0.5 equiv. NaOH	Ketones (24 examples)	98%	6	8
6	Mn-MgO/Al_2O_3 (9.1 mol% Mn)	160/6	Ketones (16 examples)	95%	3	9
7	Cu/CuOx-250 (> 60 mol% Cu)	170/6 h, 0.5 equiv. K_3PO_4	Ketones (24 examples)	92%	3	10
8	Cu-HT (3.0 wt% Cu)	180/15	Ketones (9 examples)	80%	-	11
9	LCN@Zn-SAC	110/4,	Ketones	92%	8	12

	(1.5 mol% Zn)	0.3 equiv. KOH	(26 examples)			
10	Nano-Fe_2O_3 (30 mol% Fe)	135/24, 0.3 equiv. tBuOK	Ketones (12 examples)	97%	5	13
11	Ni/SiO_2-Al_2O_3 (20 mol% Ni)	175/24, 0.1 equiv. K_3PO_4	Ketones (26 examples)	93	4	14

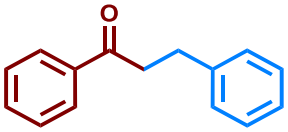
S5. Catalyst recycling

The magnetic stirring bar, 0.9 mmol 2-phenoxy-1-phenylethanol and 1.8 mmol furfuryl alcohol, 120 mg Co@NC-800-PPDA (2.8 mol% Co) and 0.9 mmol K_3PO_4 were transferred to 20 mL pressure tube. Then, 6 mL t-BuOH was added, and the pressure tube was flushed with argon and fitted with screw cap. Then, it was placed into an aluminum block and heated to 120 °C for desired time (10 h and 24 h). After the completion of the reaction, the pressure tube was cooled to room temperature. To the reaction products, 0.9 mmol n-hexadecane as standard was added. The catalyst was separated by high-speed centrifugation and the centrifugate containing reaction products was subjected to GC analysis. The separated catalyst was washed with water, ethanol, and ethyl acetate and then dried under vacuum. The dried catalyst was used for the next run without further purification or reactivation.

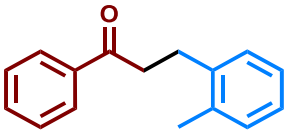
Supplementary Table 12. ICP-OES analysis of both the reaction solution and recovered cobalt catalyst after each recycling experiment.

Recycle time	Co content in recovered material	Co content in reaction solution
fresh	1.24 wt%	-
1	1.22 wt%	-
2	1.21 wt%	-
3	1.20 wt%	-
4	1.18 wt%	-
5	1.16 wt%	-

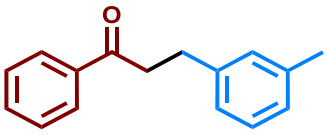
S6. NMR data



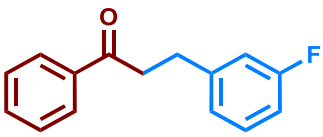
1,3-diphenylpropan-1-one[4]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.03 – 7.91 (m, 2H), 7.61 – 7.53 (m, 1H), 7.51 – 7.42 (m, 2H), 7.36 – 7.16 (m, 5H), 3.37 – 3.26 (m, 2H), 3.09 (dd, *J* = 8.6, 6.8 Hz, 2H).
^{13}C NMR (75 MHz, $CDCl_3$) δ 199.23, 141.32, 136.90, 133.07, 128.63, 128.55, 128.45, 128.06, 126.16, 40.46, 30.16.



1-phenyl-3-(o-tolyl)propan-1-one[4]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.71 (d, *J* = 1.5 Hz, 2H), 7.36 – 7.32 (m, 1H), 7.24 – 7.20 (m, 2H), 7.05 (d, *J* = 2.2 Hz, 1H), 6.95 – 6.82 (m, 3H), 3.26 (dd, *J* = 16.8, 7.0 Hz, 2H), 3.12 (dd, *J* = 16.7, 7.1 Hz, 2H), 2.15 (s, 3H).
^{13}C NMR (75 MHz, $CDCl_3$) δ 198.71, 142.09, 141.34, 136.93, 133.07, 130.70, 128.59, 128.12, 126.34, 126.25, 125.68, 44.69, 32.01, 19.74.



1-phenyl-3-(m-tolyl)propan-1-one[5]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.97 – 7.94 (m, 2H), 7.94 (d, *J* = 1.6 Hz, 1H), 7.55 – 7.52 (m, 2H), 7.49 – 7.36 (m, 4H), 3.48 (dd, *J* = 16.6, 7.0 Hz, 2H), 3.34 (dd, *J* = 16.6, 7.0 Hz, 2H), 2.31 (s, 3H).
^{13}C NMR (75 MHz, $CDCl_3$) δ 198.61, 143.77, 138.11, 136.93, 133.01, 130.88, 128.80, 128.54, 128.12, 127.44, 124.34, 44.92, 37.06, 21.45.



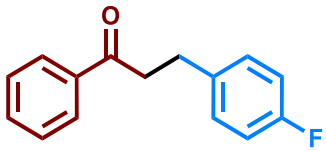
3-(3-fluorophenyl)-1-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.01 – 7.92 (m, 2H),

7.61 – 7.53 (m, 1H), 7.50 – 7.42 (m, 2H), 7.29 – 7.22 (m, 1H), 7.07 – 6.86 (m, 3H), 3.38 – 3.25 (m, 2H), 3.08 (dd, *J* = 8.3, 6.8 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 198.79, 164.58, 161.33, 143.93, 143.84, 136.76, 133.20, 130.01, 129.90, 128.67, 128.04, 124.15, 124.12, 115.48, 115.20, 113.18, 112.90, 39.99, 29.76, 29.74.

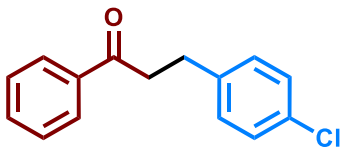
^{19}F NMR (282 MHz, $CDCl_3$) δ -113.4.

HRMS (EI): Calculated for $C_{15}H_{13}FO$ = 228.0950; found = 228.0957.



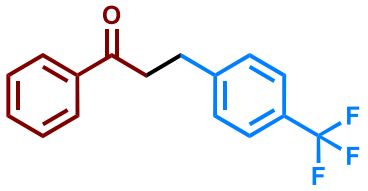
3-(4-fluorophenyl)-1-phenylpropan-1-one[4]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.00 – 7.92 (m, 2H), 7.60 – 7.51 (m, 1H), 7.50 – 7.41 (m, 2H), 7.35 – 7.25 (m, 4H), 3.36 – 3.24 (m, 2H), 3.08 (dd, *J* = 8.7, 6.9 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 216.1, 194.4, 180.7, 174.0, 159.9, 155.6, 149.4, 141.3, 136.9, 133.1, 128.6, 128.5, 128.4, 128.1, 126.2, 107.6, 77.4, 77.0, 76.6, 40.5, 30.1.



3-(4-chlorophenyl)-1-phenylpropan-1-one[6]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.98 – 7.96 (m, 2H), 7.95 (d, *J* = 1.4 Hz, 1H), 7.60 – 7.54 (m, 2H), 7.52 – 7.45 (m, 4H), 3.51 (dd, *J* = 16.8, 6.8 Hz, 2H), 3.35 (dd, *J* = 16.8, 7.3 Hz, 2H).

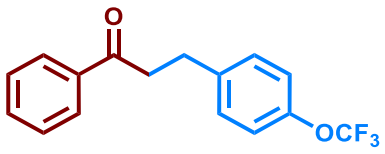
^{13}C NMR (75 MHz, $CDCl_3$) δ 198.24, 142.33, 136.78, 133.23, 132.28, 128.91, 128.75, 128.66, 128.12, 44.74, 36.51.



1-phenyl-3-(4-(trifluoromethyl)phenyl)propan-1-one[4]: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 – 7.91 (m, 2H), 7.62 – 7.52 (m, 3H), 7.50 – 7.43 (m, 2H), 7.40 – 7.35 (m, 2H), 3.36 – 3.29 (m, 2H), 3.14 (t, *J* = 7.5 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 258.2, 128.8, 128.7, 128.0, 125.5, 100.0, 87.0, 77.3, 77.0, 76.7, 39.8, 29.8.

^{19}F NMR (282 MHz, $CDCl_3$) δ -62.4.

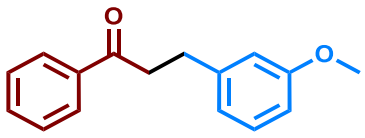


1-phenyl-3-(4-(trifluoromethoxy)phenyl)propan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.00 – 7.89 (m, 2H), 7.60 – 7.53 (m, 1H), 7.51 – 7.42 (m, 2H), 7.31 – 7.24 (m, 2H), 7.14 (ddt, *J* = 7.5, 2.0, 1.0 Hz, 2H), 3.31 (ddd, *J* = 8.0, 7.1, 0.8 Hz, 2H), 3.14 – 3.04 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 198.81, 147.62, 147.59, 140.08, 136.74, 133.21, 129.77, 128.66, 128.02, 121.10, 40.15, 29.32.

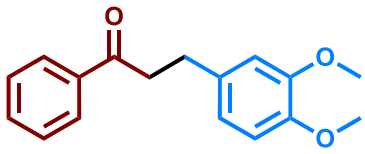
^{19}F NMR (282 MHz, $CDCl_3$) δ -58.0.

HRMS (EI): Calculated for $C_{16}H_{13}F_3O_2$ = 294.0868; found = 294.0871.



3-(3-methoxyphenyl)-1-phenylpropan-1-one[7]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.01 – 7.91 (m, 2H), 7.62 – 7.52 (m, 1H), 7.51 – 7.41 (m, 2H), 7.22 (ddd, *J* = 8.1, 7.5, 0.5 Hz, 1H), 6.89 – 6.72 (m, 3H), 3.80 (s, 3H), 3.35 – 3.26 (m, 2H), 3.05 (dd, *J* = 8.6, 6.8 Hz, 2H).

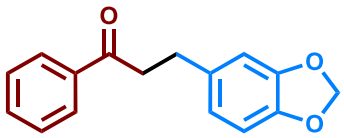
^{13}C NMR (75 MHz, $CDCl_3$) δ 199.22, 159.75, 142.95, 136.85, 133.10, 129.54, 128.63, 128.06, 120.78, 114.25, 111.43, 55.18, 40.39, 30.19.



3-(3,4-dimethoxyphenyl)-1-phenylpropan-1-one[8]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.02 – 7.88 (m, 2H), 7.60 – 7.51 (m, 1H), 7.50 – 7.41 (m, 2H), 6.85 – 6.73 (m, 3H), 3.86 (d, *J* = 3.5 Hz, 6H), 3.33 – 3.25 (m, 2H), 3.02 (dd, *J* = 8.4, 6.9 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 199.42, 148.92, 147.42, 136.92, 133.92, 133.08, 128.62, 128.05,

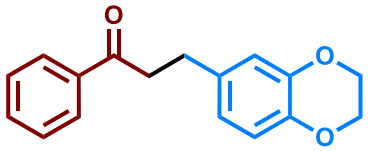
120.19, 111.86, 111.36, 55.95, 55.85, 40.71, 29.83.



3-(benzo[d][1,3]dioxol-5-yl)-1-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.99 – 7.93 (m, 2H), 7.59 – 7.52 (m, 1H), 7.49 – 7.42 (m, 2H), 6.83 – 6.65 (m, 3H), 5.92 (s, 2H), 3.34 – 3.20 (m, 2H), 3.09 – 2.93 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 199.22, 147.66, 145.85, 136.85, 135.09, 133.10, 128.63, 128.05, 121.19, 108.95, 108.30, 100.85, 40.69, 29.89.

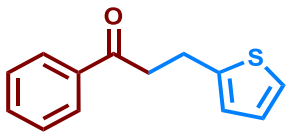
HRMS (EI): Calculated for $C_{16}H_{14}O_3$ = 254.0943; found = 254.0949.



3-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-1-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.98 – 7.93 (m, 2H), 7.59 – 7.52 (m, 1H), 7.49 – 7.42 (m, 2H), 6.86 – 6.70 (m, 3H), 3.86 (s, 3H), 3.30 – 3.23 (m, 2H), 3.02 – 2.94 (m, 2H).

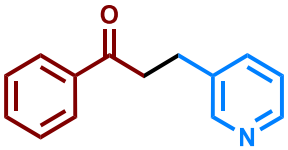
^{13}C NMR (75 MHz, $CDCl_3$) δ 199.39, 145.62, 145.01, 136.91, 134.60, 133.04, 128.61, 128.07, 125.40, 119.80, 114.60, 110.81, 56.04, 40.58, 29.57.

HRMS (EI): Calculated for $C_{17}H_{16}O_3$ = 268.1099; found = 268.1104.



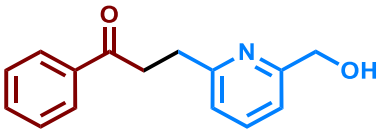
1-phenyl-3-(thiophen-2-yl)propan-1-one[9]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.95 (d, *J* = 1.6 Hz, 2H), 7.60 – 7.50 (m, 3H), 7.11 (dd, *J* = 4.7, 1.6 Hz, 1H), 6.93 – 6.85 (m, 2H), 3.53 (dd, *J* = 16.9, 6.7 Hz, 2H), 3.43 (dd, *J* = 16.9, 6.9 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 198.12, 147.53, 136.82, 133.20, 128.64, 128.16, 126.74, 124.30, 123.35, 45.62, 32.44.



1-phenyl-3-(pyridin-3-yl)propan-1-one[9]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.57 – 8.32 (m, 2H), 7.99 – 7.81 (m, 2H), 7.65 – 7.50 (m, 2H), 7.49 – 7.35 (m, 2H), 7.20 (ddd, *J* = 7.8, 4.8, 0.8 Hz, 1H), 3.34 – 3.26 (m, 2H), 3.06 (t, *J* = 7.4 Hz, 2H).

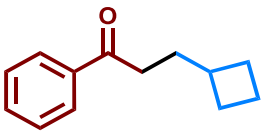
^{13}C NMR (75 MHz, $CDCl_3$) δ 198.46, 149.93, 147.64, 136.67, 136.62, 136.11, 133.28, 128.68, 128.00, 123.42, 39.75, 27.11.



3-(6-(hydroxymethyl)pyridin-2-yl)-1-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.04 – 7.91 (m, 2H), 7.63 – 7.50 (m, 2H), 7.49 – 7.41 (m, 2H), 7.15 (ddt, *J* = 7.7, 1.2, 0.6 Hz, 1H), 7.03 (ddt, *J* = 7.8, 1.1, 0.6 Hz, 1H), 4.68 (t, *J* = 0.7 Hz, 2H), 3.48 (td, *J* = 7.1, 0.7 Hz, 2H), 3.30 – 3.21 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 199.31, 159.49, 158.10, 137.12, 136.85, 133.13, 128.64, 128.07, 121.87, 117.93, 63.77, 37.45, 31.77.

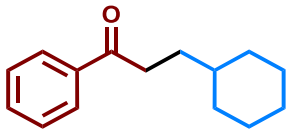
HRMS (EI): Calculated for $C_{15}H_{15}NO_2$ = 241.1103; found = 241.1107.



3-cyclobutyl-1-phenylpropan-1-one: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 – 7.91 (m, 2H), 7.62 – 7.52 (m, 1H), 7.51 – 7.43 (m, 2H), 2.87 (dd, *J* = 8.1, 7.1 Hz, 2H), 2.34 (pent, *J* = 7.9 Hz, 1H), 2.11 – 2.00 (m, 2H), 1.89 – 1.77 (m, 4H), 1.66 – 1.58 (m, 2H).

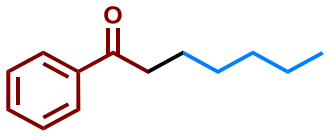
^{13}C NMR (101 MHz, $CDCl_3$) δ 200.67, 137.07, 132.88, 128.56, 128.09, 36.34, 35.64, 31.53, 28.08, 18.31.

HRMS (EI): Calculated for $C_{13}H_{16}O$ = 188.1201; found = 188.1205.

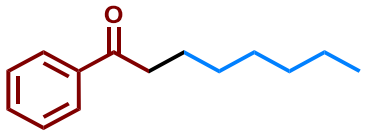


3-cyclohexyl-1-phenylpropan-1-one[9]: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 – 7.96 (m, 2H), 7.57 – 7.52 (m, 1H), 7.47 – 7.43 (m, 2H), 3.11 – 2.98 (m, 2H), 1.86 – 0.78 (m, 10H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 200.19, 137.11, 132.98, 128.59, 128.20, 40.53, 40.33, 36.13, 29.91, 26.63, 26.61.

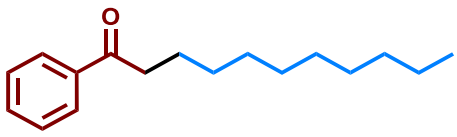


1-phenylheptan-1-one[6]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.98 – 7.90 (m, 2H), 7.58 – 7.50 (m, 1H), 7.49 – 7.40 (m, 2H), 3.02 – 2.90 (m, 2H), 1.73 (tt, J = 8.1, 6.9 Hz, 2H), 1.46 – 1.23 (m, 6H), 0.95 – 0.81 (m, 3H). **^{13}C NMR (75 MHz, $CDCl_3$)** δ 200.56, 137.10, 132.85, 128.54, 128.05, 38.62, 31.69, 29.06, 24.34, 22.55, 14.06.



1-phenyloctan-1-one[10]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.99 – 7.93 (m, 2H), 7.58 – 7.51 (m, 1H), 7.49 – 7.41 (m, 2H), 2.99 – 2.92 (m, 2H), 1.78 – 1.66 (m, 2H), 1.39 – 1.24 (m, 8H), 0.93 – 0.84 (m, 3H).

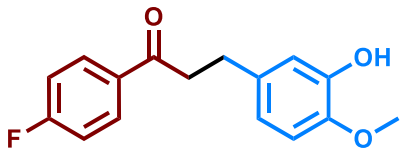
^{13}C NMR (75 MHz, Chloroform-*d*) δ 200.59, 137.11, 132.85, 128.55, 128.06, 38.63, 31.73, 29.36, 29.17, 24.40, 22.64, 14.10.



1-phenylundecan-1-one[10]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.00 – 7.92 (m, 2H), 7.59 – 7.50 (m, 1H), 7.50 – 7.40 (m, 2H), 3.01 – 2.91 (m, 2H), 1.78 – 1.65 (m, 2H), 1.46 – 1.19 (m, 14H), 0.92 – 0.84 (m, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 200.63, 137.12, 132.86, 128.55, 128.07, 38.65, 31.91, 29.60, 29.53,

29.50, 29.40, 29.33, 24.40, 22.69, 14.13.

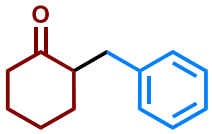


1-(4-fluorophenyl)-3-(3-hydroxy-4-methoxyphenyl)propan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.05 – 7.95 (m, 2H), 7.19 – 7.09 (m, 2H), 6.86 – 6.71 (m, 3H), 3.88 (s, 3H), 3.29 – 3.21 (m, 2H), 3.03 – 2.95 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 197.78, 167.41, 164.03, 145.63, 145.04, 134.42, 133.36, 133.32, 130.74, 130.61, 119.79, 115.82, 115.53, 114.57, 110.80, 56.03, 40.48, 29.53.

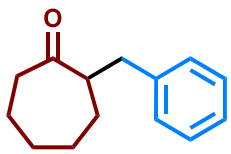
^{19}F NMR (282 MHz, $CDCl_3$) δ -105.4.

HRMS (EI): Calculated for $C_{16}H_{15}FO_3$ = 274.1005; found = 274.1009.



2-benzylcyclohexan-1-one[8]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.35 – 7.11 (m, 5H), 3.24 (dd, *J* = 13.7, 4.6 Hz, 1H), 2.62 – 2.27 (m, 4H), 2.04 (tddd, *J* = 13.0, 5.9, 3.4, 2.6 Hz, 2H), 1.83 (dddd, *J* = 12.9, 6.9, 3.6, 1.4 Hz, 1H), 1.75 – 1.50 (m, 2H), 1.36 (dtd, *J* = 13.2, 11.9, 3.5 Hz, 1H).

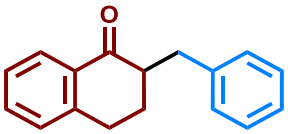
^{13}C NMR (75 MHz, $CDCl_3$) δ 212.59, 140.39, 129.15, 128.31, 125.97, 52.49, 42.18, 35.48, 33.43, 28.07, 25.08.



2-benzylcycloheptan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.33 – 7.15 (m, 5H), 3.16 – 2.78 (m, 2H), 2.58 (dd, *J* = 13.7, 8.4 Hz, 1H), 2.54 – 2.39 (m, 2H), 1.89 – 1.33 (m, 8H).

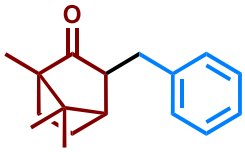
^{13}C NMR (75 MHz, $CDCl_3$) δ 215.59, 140.02, 129.16, 128.34, 126.09, 53.63, 43.23, 37.90, 30.38, 29.32, 28.66, 24.27.

HRMS (EI): Calculated for $C_{14}H_{18}O$ = 202.1358; found = 202.1360.



2-benzyl-3,4-dihydronaphthalen-1(2H)-one[6]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.08 (ddd, *J* = 7.8, 1.5, 0.5 Hz, 1H), 7.50 – 7.43 (m, 1H), 7.35 – 7.21 (m, 7H), 3.51 (dd, *J* = 13.4, 3.7 Hz, 1H), 3.00 – 2.88 (m, 2H), 2.81 – 2.60 (m, 2H), 2.12 (dq, *J* = 13.4, 4.4 Hz, 1H), 1.93 – 1.68 (m, 1H).

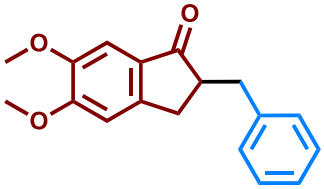
^{13}C NMR (75 MHz, $CDCl_3$) δ 199.40, 144.05, 140.08, 133.29, 132.51, 129.29, 128.73, 128.43, 127.58, 126.65, 126.16, 49.48, 35.70, 28.66, 27.69.



3-benzyl-1,7,7-trimethylbicyclo[2.2.1]heptan-2-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.23 – 6.97 (m, 5H), 3.10 (ddd, *J* = 22.6, 14.2, 4.0 Hz, 1H), 2.70 – 2.53 (m, 1H), 2.46 – 2.34 (m, 1H), 1.91 – 1.78 (m, 1H), 1.65 (dddd, *J* = 5.6, 4.3, 2.6, 1.3 Hz, 2H), 1.32 – 1.09 (m, 3H), 0.87 – 0.74 (m, 9H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 220.48, 140.35, 128.66, 128.55, 128.50, 126.09, 126.05, 58.80, 51.89, 45.75, 32.74, 31.00, 20.32, 19.58, 19.32, 9.63.

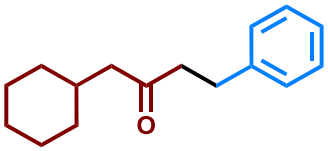
HRMS (EI): Calculated for $C_{17}H_{22}O$ = 242.1671; found = 242.1675.



2-benzyl-5,6-dimethoxy-2,3-dihydro-1H-inden-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.33 – 7.19 (m, 6H), 6.80 (d, *J* = 0.8 Hz, 1H), 3.93 (s, 3H), 3.91 (s, 3H), 3.45 – 3.32 (m, 1H), 3.11 – 2.94 (m, 2H), 2.81 – 2.58 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 206.54, 155.61, 149.49, 148.99, 139.82, 129.25, 128.93, 128.50, 126.31, 107.42, 104.42, 56.21, 56.12, 49.15, 37.32, 31.90.

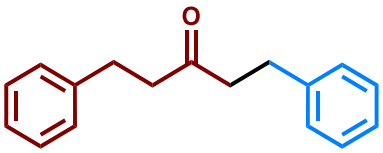
HRMS (EI): Calculated for $C_{18}H_{18}O_3$ = 282.1256; found = 282.1261.



1-cyclohexyl-4-phenylbutan-2-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.21 – 7.04 (m, 5H), 2.78 (dd, *J* = 8.1, 6.6 Hz, 2H), 2.64 – 2.55 (m, 2H), 2.15 (d, *J* = 6.8 Hz, 2H), 1.59 – 1.48 (m, 5H), 1.29 – 1.00 (m, 4H), 0.85 – 0.73 (m, 2H).

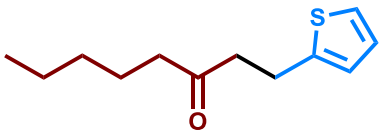
^{13}C NMR (75 MHz, $CDCl_3$) δ 209.99, 141.22, 128.47, 28.36, 126.06, 50.82, 44.94, 33.95, 33.25, 29.74, 26.21, 26.11.

HRMS (EI): Calculated for $C_{16}H_{22}O$ = 230.1671; found = 230.1676.



1,5-diphenylpentan-3-one[4]: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.23 (m, 10H), 3.00 (t, *J* = 7.6 Hz, 4H), 2.88 – 2.77 (m, 4H).

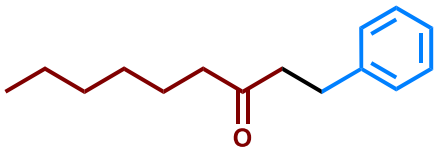
^{13}C NMR (101 MHz, $CDCl_3$) δ 29.77, 44.54, 126.16, 128.36, 128.55, 141.06, 209.14.



1-(thiophen-2-yl)octan-3-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.11 (dd, *J* = 5.1, 1.2 Hz, 1H), 6.90 (dd, *J* = 5.1, 3.5 Hz, 1H), 6.79 (dq, *J* = 3.3, 1.0 Hz, 1H), 3.11 (tt, *J* = 6.8, 0.7 Hz, 2H), 2.82 – 2.75 (m, 2H), 2.39 (t, *J* = 7.4 Hz, 2H), 1.62 – 1.54 (m, 2H), 1.31 – 1.24 (m, 4H), 0.90 – 0.86 (m, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 209.75, 143.84, 134.74, 126.81, 124.56, 123.31, 44.33, 43.03, 31.38, 23.91, 23.48, 22.45, 13.92.

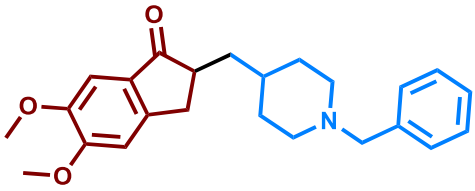
HRMS (EI): Calculated for $C_{12}H_{18}OS$ = 210.1078; found = 210.1080.



1-phenylnonan-3-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.34 – 7.18 (m, 5H), 2.97 – 2.61 (m, 4H), 2.48 – 2.29 (m, 2H), 1.56 (d, *J* = 6.6 Hz, 2H), 1.32 – 1.26 (m, 6H), 0.93 – 0.89 (m, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 210.42, 141.21, 128.48, 128.33, 126.07, 44.26, 43.09, 31.59, 29.81, 28.89, 23.78, 22.49, 14.03.

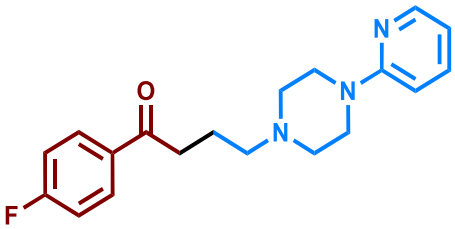
HRMS (EI): Calculated for $C_{15}H_{22}O$ = 218.1671; found = 218.1675.



Donepezil: ^{1}H NMR (300 MHz, DMSO-d_6) δ 7.35 – 7.22 (m, 5H), 7.07 (d, *J* = 7.9 Hz, 2H), 3.87 (s, 3H), 3.79 (s, 3H), 3.32 (s, 2H), 3.22 (dd, *J* = 17.7, 8.1 Hz, 1H), 2.86 – 2.58 (m, 4H), 1.91 (td, *J* = 11.6, 2.5 Hz, 2H), 1.78 – 1.37 (m, 4H), 1.20 (dddd, *J* = 20.0, 15.5, 11.0, 4.4 Hz, 3H).

^{13}C NMR (75 MHz, DMSO-d_6) δ 207.05, 155.69, 149.57, 149.16, 139.16, 129.21, 128.90, 128.56, 127.23, 108.64, 104.42, 62.98, 56.39, 56.06, 53.76, 45.25, 38.72, 34.37, 33.15, 31.91.

HRMS (EI): Calculated for $C_{24}H_{29}NO_3$ = 379.2174; found = 379.2177.

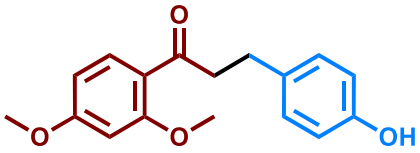


Azaperone: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.17 (ddd, *J* = 4.9, 2.0, 0.9 Hz, 1H), 8.05 – 7.95 (m, 2H), 7.46 (ddd, *J* = 8.6, 7.1, 2.0 Hz, 1H), 7.18 – 7.06 (m, 2H), 6.67 – 6.55 (m, 2H), 3.56 – 3.44 (m, 4H), 3.01 (t, *J* = 7.1 Hz, 2H), 2.62 – 2.42 (m, 6H), 1.98 (q, *J* = 7.1 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 198.42, 159.51, 147.96, 137.44, 133.59, 130.74, 130.61, 115.78, 115.49, 113.29, 107.06, 57.71, 52.91, 45.08, 36.14, 21.46.

^{19}F NMR (376 MHz, $CDCl_3$) δ -105.6.

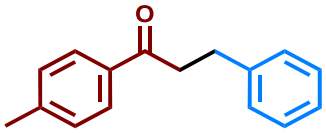
HRMS (EI): Calculated for $C_{19}H_{22}FN_3O$ = 327.1747; found = 327.1749.



Loureirin A: ^{1}H NMR (500 MHz, DMSO-d$_6$) δ 10.30 (s, 1H), 7.89 – 7.81 (m, 2H), 7.07 (d, *J* = 8.2 Hz, 1H), 6.87 – 6.81 (m, 2H), 6.52 (d, *J* = 2.4 Hz, 1H), 6.43 (dd, *J* = 8.2, 2.4 Hz, 1H), 3.78 (s, 3H), 3.73 (s, 3H), 3.10 (dd, *J* = 8.4, 6.8 Hz, 2H), 2.79 (dd, *J* = 8.4, 6.9 Hz, 2H).

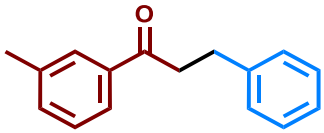
^{13}C NMR (126 MHz, DMSO-d$_6$) δ 198.1, 162.4, 159.5, 158.4, 130.9, 130.4, 128.7, 121.6, 115.7, 104.8, 98.8, 55.8, 55.6, 38.4, 24.9.

HRMS (EI): Calculated for $C_{17}H_{18}O_4$ = 286.1205; found = 286.1209.



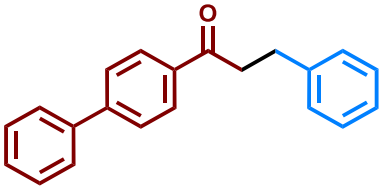
3-phenyl-1-(p-tolyl)propan-1-one[4]: ^{1}H NMR (300 MHz, CDCl$_3$) δ 7.92 – 7.82 (m, 2H), 7.29 – 7.23 (m, 5H), 7.21 – 7.12 (m, 2H), 3.33 – 3.24 (m, 2H), 3.07 (dd, *J* = 8.9, 6.9 Hz, 2H), 2.41 (d, *J* = 0.8 Hz, 3H).

^{13}C NMR (75 MHz, CDCl$_3$) δ 198.94, 143.86, 141.42, 139.64, 134.40, 129.30, 129.17, 129.03, 128.53, 128.44, 128.39, 128.29, 128.19, 126.23, 126.11, 40.37, 30.23, 21.65.



3-phenyl-1-(m-tolyl)propan-1-one[9]: ^{1}H NMR (300 MHz, CDCl$_3$) δ 7.69 – 7.61 (m, 2H), 7.29 – 7.09 (m, 7H), 3.21 – 3.14 (m, 2H), 2.95 (dd, *J* = 8.8, 6.9 Hz, 2H), 2.28 (d, *J* = 0.6 Hz, 3H).

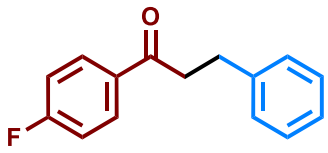
^{13}C NMR (75 MHz, CDCl$_3$) δ 199.48, 141.39, 138.41, 136.91, 133.84, 128.61, 128.54, 128.49, 128.45, 126.14, 125.27, 40.55, 30.19, 21.38.



1-([1,1'-biphenyl]-4-yl)-3-phenylpropan-1-one[8]: ^{1}H NMR (300 MHz, DMSO-*d*$_6$) δ 8.10 – 8.03 (m,

2H), 7.84 – 7.77 (m, 2H), 7.77 – 7.70 (m, 2H), 7.54 – 7.47 (m, 2H), 7.46 – 7.41 (m, 1H), 7.34 – 7.25 (m, 4H), 7.21 – 7.19 (m, 1H), 3.40 (dd, *J* = 8.0, 7.0 Hz, 2H), 2.97 (dd, *J* = 7.9, 7.0 Hz, 2H).

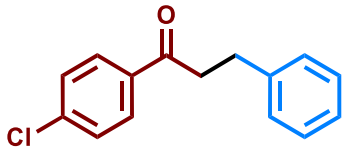
^{13}C NMR (75 MHz, DMSO-d_6) δ 199.15, 144.94, 141.72, 139.38, 135.88, 129.55, 129.14, 128.86, 128.83, 128.74, 127.44, 127.35, 126.33, 39.97, 29.99.



1-(4-fluorophenyl)-3-phenylpropan-1-one[4]: ^{1}H NMR (300 MHz, CDCl$_3$) δ 7.97 – 7.88 (m, 2H), 7.28 – 7.13 (m, 5H), 7.10 – 7.02 (m, 2H), 3.26 – 3.18 (m, 2H), 3.05 – 2.97 (m, 2H).

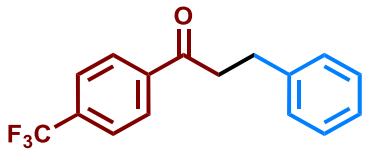
^{13}C NMR (75 MHz, CDCl$_3$) δ 197.61, 167.43, 164.05, 141.16, 133.34, 133.30, 130.74, 130.61, 128.58, 128.44, 126.22, 115.85, 115.56, 40.38, 30.12.

^{19}F NMR (282 MHz, CDCl$_3$) δ -105.3.



1-(4-chlorophenyl)-3-phenylpropan-1-one[6]: ^{1}H NMR (300 MHz, CDCl$_3$) δ 7.95 – 7.85 (m, 2H), 7.45 – 7.42 (m, 2H), 7.32 – 7.19 (m, 5H), 3.37 – 3.22 (m, 2H), 3.15 – 3.00 (m, 2H).

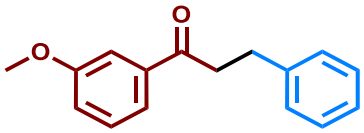
^{13}C NMR (75 MHz, CDCl$_3$) δ 197.99, 145.38, 141.08, 135.17, 133.09, 130.78, 129.95, 129.48, 128.94, 128.59, 128.55, 128.43, 128.06, 126.25, 121.52, 40.44, 30.06.



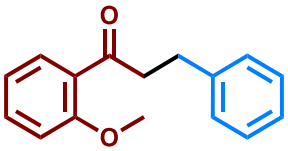
3-phenyl-1-(4-(trifluoromethyl)phenyl)propan-1-one[6]: ^{1}H NMR (300 MHz, CDCl$_3$) δ 8.06 – 7.91 (m, 2H), 7.70 – 7.59 (m, 2H), 7.26 – 7.12 (m, 5H), 3.30 – 3.15 (m, 2H), 3.00 (dd, *J* = 8.3, 6.8 Hz, 2H).

^{13}C NMR (75 MHz, CDCl$_3$) δ 198.22, 140.88, 139.50, 134.61, 134.17, 128.63, 128.43, 128.38, 126.32, 125.79, 125.74, 125.69, 125.64, 121.81, 40.76, 29.94.

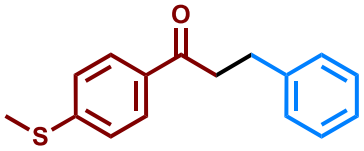
^{19}F NMR (282 MHz, CDCl$_3$) δ -63.2.



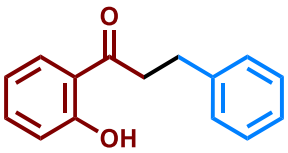
1-(3-methoxyphenyl)-3-phenylpropan-1-one[10]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.58 – 7.47 (m, 2H), 7.37 – 7.33 (m, 1H), 7.30 – 7.09 (m, 6H), 3.85 (s, 3H), 3.34 – 3.26 (m, 2H), 3.12 – 3.04 (m, 2H).
^{13}C NMR (75 MHz, $CDCl_3$) δ 199.06, 159.87, 141.30, 138.25, 129.61, 128.56, 128.46, 126.17, 120.69, 120.67, 119.60, 112.38, 112.27, 55.46, 40.58, 30.21.



1-(2-methoxyphenyl)-3-phenylpropan-1-one[8]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.61 (ddd, *J* = 7.7, 1.8, 0.4 Hz, 1H), 7.37 (ddd, *J* = 8.3, 7.3, 1.9 Hz, 1H), 7.22 – 7.01 (m, 11H), 6.81 – 6.72 (m, 1H), 3.79 (s, 3H), 3.26 – 3.19 (m, 2H), 2.94 (dd, *J* = 8.7, 6.9 Hz, 2H).
^{13}C NMR (75 MHz, $CDCl_3$) δ 201.75, 158.56, 141.75, 140.06, 133.44, 130.39, 129.13, 128.49, 128.42, 128.23, 126.00, 125.92, 120.70, 120.62, 111.51, 111.32, 55.51, 45.46, 37.66, 30.51.



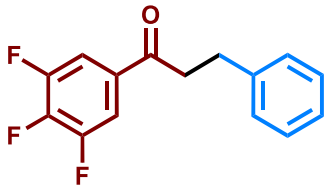
1-(4-(methylthio)phenyl)-3-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.85 – 7.78 (m, 2H), 7.28 – 7.11 (m, 7H), 3.28 – 3.16 (m, 2H), 3.00 (dd, *J* = 8.5, 6.6 Hz, 2H), 2.45 (s, 3H).
^{13}C NMR (75 MHz, $CDCl_3$) δ 198.26, 145.84, 141.34, 133.17, 128.55, 128.48, 128.44, 126.15, 125.02, 40.26, 30.23, 14.79.
HRMS (EI): Calculated for $C_{16}H_{16}OS$ = 256.0922; found = 256.0927.



1-(2-hydroxyphenyl)-3-phenylpropan-1-one: ^{1}H NMR (300 MHz, DMSO-d_6) δ 11.89 (q, *J* = 0.9 Hz, 1H), 7.92 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.51 (ddd, *J* = 8.6, 7.1, 1.7 Hz, 1H), 7.28 (d, *J* = 4.4 Hz, 4H), 7.23 – 7.15 (m, 1H), 7.00 – 6.90 (m, 2H), 3.42 (dd, *J* = 8.1, 7.0 Hz, 2H), 2.96 (dd, *J* = 8.1, 7.0 Hz,

2H).

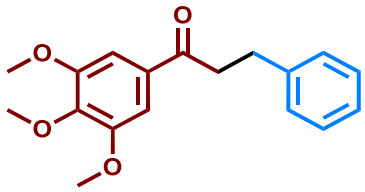
^{13}C NMR (75 MHz, DMSO-d_6) δ 205.64, 161.07, 141.45, 136.45, 131.18, 128.85, 128.76, 126.39, 120.78, 119.65, 118.10, 40.77, 29.87.



3-phenyl-1-(3,4,5-trifluorophenyl)propan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.86 (dd, *J* = 15.6, 2.2 Hz, 1H), 7.72 – 7.55 (m, 4H), 7.46 – 7.43 (m, 2H), 7.25 – 7.23 (m, 1H), 3.23 (ddd, *J* = 7.9, 6.9, 1.0 Hz, 2H), 3.06 (dd, *J* = 8.0, 6.4 Hz, 2H).

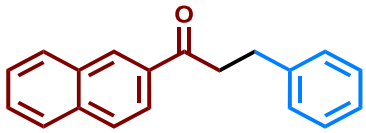
^{13}C NMR (75 MHz, $CDCl_3$) δ 146.62, 131.19, 129.12, 128.69, 128.66, 128.39, 126.41, 112.72, 112.43, 40.26, 29.88.

HRMS (EI): Calculated for $C_{15}H_{11}F_3O$ = 264.0762; found = 264.0766.



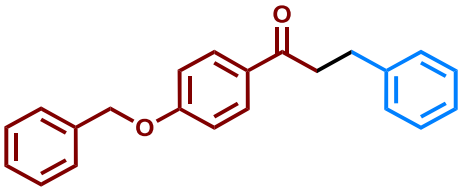
3-phenyl-1-(3,4,5-trimethoxyphenyl)propan-1-one[8]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.37 – 7.27 (m, 5H), 7.20 (s, 2H), 3.91 (s, 3H), 3.89 (s, 6H), 3.30 – 3.24 (m, 2H), 3.07 (dd, *J* = 8.4, 6.6 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 198.05, 153.08, 142.55, 141.35, 132.16, 128.59, 128.57, 128.50, 127.66, 126.99, 126.22, 105.51, 60.96, 56.31, 40.39, 30.39.



1-(naphthalen-2-yl)-3-phenylpropan-1-one[6]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.47 (dt, *J* = 1.7, 0.7 Hz, 1H), 8.05 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.96 – 7.86 (m, 3H), 7.62 – 7.52 (m, 2H), 7.35 – 7.28 (m, 4H), 7.25 – 7.19 (m, 1H), 3.52 – 3.41 (m, 2H), 3.14 (dd, *J* = 8.6, 6.9 Hz, 2H).

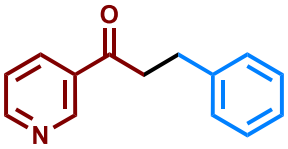
^{13}C NMR (75 MHz, $CDCl_3$) δ 199.20, 141.38, 135.60, 134.20, 132.54, 129.72, 129.57, 128.59, 128.49, 128.46, 127.80, 126.81, 126.80, 126.80, 126.19, 123.87, 40.60, 30.30.



1-(4-(benzyloxy)phenyl)-3-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.97 – 7.91 (m, 2H), 7.45 – 7.15 (m, 10H), 7.02 – 6.95 (m, 2H), 5.11 (s, 2H), 3.27 – 3.20 (m, 2H), 3.08 – 3.01 (m, 2H).

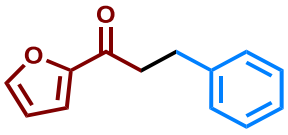
^{13}C NMR (75 MHz, $CDCl_3$) δ 197.84, 162.63, 141.50, 136.22, 130.36, 130.19, 128.74, 128.55, 128.47, 128.29, 127.52, 126.13, 114.62, 70.16, 40.16, 30.35.

HRMS (EI): Calculated for $C_{22}H_{20}O_2$ = 316.1463; found = 316.1468.



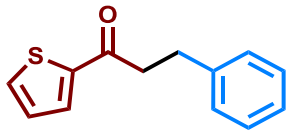
3-phenyl-1-(pyridin-3-yl)propan-1-one[9]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 9.09 (dd, *J* = 2.2, 0.9 Hz, 1H), 8.70 (dd, *J* = 4.9, 1.7 Hz, 1H), 8.15 (ddd, *J* = 8.0, 2.3, 1.7 Hz, 1H), 7.34 (ddd, *J* = 8.0, 4.8, 0.9 Hz, 1H), 7.29 – 7.08 (m, 5H), 3.33 – 3.17 (m, 2H), 3.02 (dd, *J* = 8.3, 6.9 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 198.05, 153.50, 149.60, 140.77, 135.36, 132.07, 128.63, 128.43, 126.33, 123.67, 40.70, 29.81.



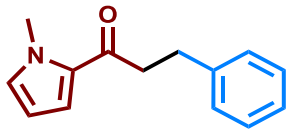
1-(furan-2-yl)-3-phenylpropan-1-one[9]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.59 (dd, *J* = 1.7, 0.8 Hz, 1H), 7.33 – 7.19 (m, 6H), 6.54 (dd, *J* = 3.6, 1.7 Hz, 1H), 3.18 (ddd, *J* = 8.5, 6.8, 1.8 Hz, 2H), 3.07 (ddd, *J* = 8.7, 6.7, 1.8 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ = 188.59, 128.53, 128.42, 126.19, 117.01, 112.21, 40.19, 29.97.



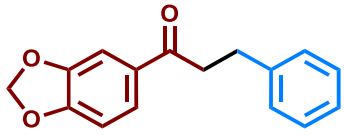
3-phenyl-1-(thiophen-2-yl)propan-1-one[9]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.69 (dd, *J* = 3.8, 1.1 Hz, 1H), 7.62 (dd, *J* = 5.0, 1.1 Hz, 1H), 7.32 – 7.19 (m, 5H), 7.12 (dd, *J* = 5.0, 3.8 Hz, 1H), 3.28 – 3.20 (m, 2H), 3.12 – 3.03 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 192.18, 144.20, 141.02, 133.58, 131.83, 128.58, 128.45, 128.11, 126.24, 41.17, 30.41.



1-(1-methyl-1H-pyrrol-2-yl)-3-phenylpropan-1-one[9]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.33 – 7.02 (m, 5H), 6.85 (dd, *J* = 4.1, 1.7 Hz, 1H), 6.69 (ddd, *J* = 2.4, 1.7, 0.5 Hz, 1H), 6.01 (dd, *J* = 4.1, 2.5 Hz, 1H), 3.85 (d, *J* = 0.5 Hz, 3H), 3.05 – 2.98 (m, 2H), 2.93 (ddd, *J* = 9.0, 6.2, 2.1 Hz, 2H).

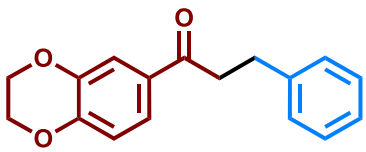
^{13}C NMR (75 MHz, $CDCl_3$) δ 190.20, 141.56, 131.01, 130.61, 128.51, 128.44, 126.07, 119.05, 107.95, 40.76, 37.73, 30.89.



1-(benzo[d][1,3]dioxol-5-yl)-3-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.51 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.40 (dd, *J* = 1.8, 0.4 Hz, 1H), 7.29 – 7.12 (m, 5H), 6.79 (dd, *J* = 8.2, 0.4 Hz, 1H), 5.99 (s, 2H), 3.22 – 3.13 (m, 2H), 3.04 – 2.95 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 197.31, 151.73, 148.21, 141.35, 131.77, 128.53, 128.43, 126.14, 124.26, 107.90, 107.88, 101.84, 40.23, 30.36.

HRMS (EI): Calculated for $C_{16}H_{14}O_3$ = 254.0943; found = 254.0946.

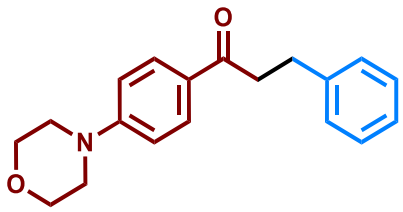


1-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-3-phenylpropan-1-one: ^{1}H NMR (300 MHz, DMSO-d_6)

δ 7.54 – 7.45 (m, 2H), 7.31 – 7.23 (m, 4H), 7.20 – 7.14 (m, 1H), 6.95 (d, *J* = 8.4 Hz, 1H), 4.35 – 4.24 (m, 4H), 3.32 – 3.22 (m, 2H), 2.91 (dd, *J* = 8.0, 7.0 Hz, 2H).

^{13}C NMR (75 MHz, DMSO-d_6) δ 197.85, 148.25, 143.63, 141.76, 130.73, 128.83, 128.69, 126.28, 122.38, 117.51, 117.38, 64.97, 64.38, 39.48, 30.09.

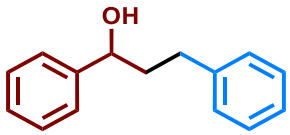
HRMS (EI): Calculated for $C_{17}H_{16}O_3$ = 268.1099; found = 268.1102.



1-(4-morpholinophenyl)-3-phenylpropan-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.96 – 7.86 (m, 2H), 7.33 – 7.17 (m, 5H), 6.91 – 6.81 (m, 2H), 3.88 – 3.83 (m, 4H), 3.35 – 3.27 (m, 4H), 3.06 (dd, *J* = 9.1, 6.9 Hz, 2H).

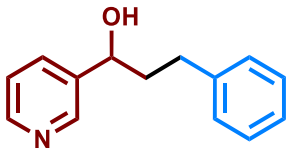
^{13}C NMR (75 MHz, $CDCl_3$) δ 197.59, 154.23, 141.66, 130.10, 128.51, 128.45, 127.74, 126.06, 113.35, 66.59, 47.54, 39.95, 30.50.

HRMS (EI): Calculated for $C_{19}H_{21}NO_2$ = 295.1572; found = 295.1576.



1,3-diphenylpropan-1-ol[11]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.32 – 7.08 (m, 10H), 4.58 (dd, *J* = 7.7, 5.5 Hz, 1H), 2.63 (qdd, *J* = 13.9, 9.4, 6.4 Hz, 2H), 2.20 – 1.87 (m, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 144.66, 141.88, 128.57, 128.52, 128.46, 127.68, 126.02, 125.92, 73.90, 40.52, 32.12.

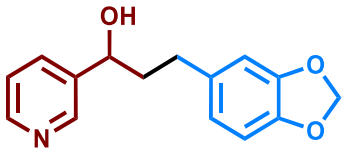


3-phenyl-1-(pyridin-3-yl)propan-1-ol: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.52 (dd, *J* = 11.3, 5.2 Hz, 2H), 7.44 – 7.27 (m, 7H), 5.19 (s, 1H), 4.85 – 4.77 (m, 1H), 2.99 – 2.69 (m, 2H), 2.27 – 2.00 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.01, 149.02, 141.38, 129.10, 129.07, 128.51, 128.49, 128.45,

128.39, 126.06, 126.03, 121.19, 71.74, 40.42, 31.77.

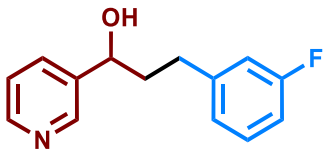
HRMS (EI): Calculated for $C_{14}H_{15}NO$ = 213.1154; found = 213.1159.



Product 79: 3-(benzo[d][1,3]dioxol-5-yl)-1-(pyridin-3-yl)propan-1-ol: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 – 8.28 (m, 2H), 7.26 – 7.21 (m, 2H), 6.70 – 6.56 (m, 3H), 5.86 (s, 2H), 4.64 (dd, *J* = 8.0, 4.8 Hz, 1H), 2.72 – 2.55 (m, 2H), 2.04 – 1.80 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.09, 149.06, 147.61, 145.70, 135.25, 121.16, 108.87, 108.21, 100.78, 71.40, 40.69, 31.49.

HRMS (EI): Calculated for $C_{15}H_{15}NO_3$ = 257.1052; found = 257.1056.

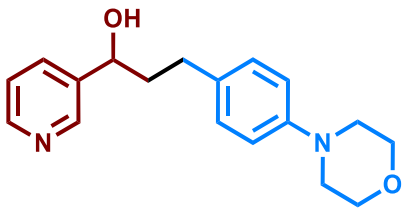


3-(3-fluorophenyl)-1-(pyridin-3-yl)propan-1-ol: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.41 (d, *J* = 5.2 Hz, 2H), 7.36 – 7.20 (m, 3H), 7.08 – 6.76 (m, 3H), 4.73 (dd, *J* = 7.6, 5.1 Hz, 2H), 2.91 – 2.69 (m, 2H), 2.16 – 1.93 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 164.54, 161.29, 154.86, 149.13, 144.09, 143.99, 129.94, 129.83, 124.11, 124.07, 121.14, 115.42, 115.14, 113.02, 112.75, 71.42, 40.10, 31.50, 31.47.

^{19}F NMR (282 MHz, $CDCl_3$) δ -113.5.

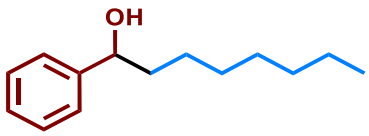
HRMS (EI): Calculated for $C_{14}H_{14}FNO$ = 231.1059; found = 231.1062.



3-(4-morpholinophenyl)-1-(pyridin-3-yl)propan-1-ol: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.39 (d, *J* = 5.1 Hz, 2H), 7.24 (d, *J* = 4.7 Hz, 2H), 7.15 – 7.04 (m, 2H), 6.88 – 6.77 (m, 2H), 4.79 – 4.53 (m, 1H), 4.18 (s, 1H), 3.88 – 3.76 (m, 4H), 3.16 – 3.01 (m, 4H), 2.75 – 2.57 (m, 2H), 2.09 – 1.86 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 154.86, 149.54, 149.21, 133.00, 129.13, 121.12, 116.01, 71.73, 66.91, 49.66, 40.56, 30.81.

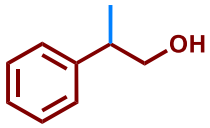
HRMS (EI): Calculated for $C_{18}H_{22}N_2O_2$ = 298.1681; found = 298.1685.



1-phenyloctan-1-ol: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.31 – 7.16 (m, 5H), 4.55 (dd, *J* = 7.4, 5.9 Hz, 1H), 2.28 – 2.13 (m, 1H), 1.81 – 1.57 (m, 2H), 1.35 – 1.10 (m, 10H), 0.89 – 0.80 (m, 3H).

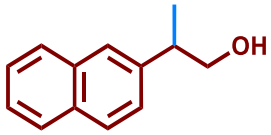
^{13}C NMR (75 MHz, $CDCl_3$) δ 145.05, 128.41, 127.43, 125.96, 74.67, 39.15, 31.87, 29.56, 29.28, 25.88, 22.69, 14.13.

HRMS (EI): Calculated for $C_{14}H_{22}O$ = 206.1671; found = 206.1676.



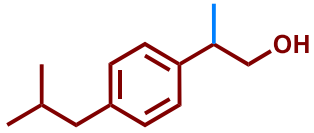
2-phenylpropan-1-ol[11]: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.32 (m, 2H), 7.28 (s, 3H), 3.71 (d, J = 6.8 Hz, 2H), 2.97 (h, J = 6.9 Hz, 1H), 1.30 (d, J = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.7, 128.6, 127.5, 126.7, 77.4, 77.1, 76.8, 68.7, 42.5, 17.6.



2-(naphthalen-2-yl)propan-1-ol[11]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.86 – 7.77 (m, 4H), 7.52 – 7.45 (m, 3H), 4.78 (t, *J* = 6.6 Hz, 1H), 1.96 – 1.84 (m, 2H), 1.84 – 1.78 (m, 1H), 0.95 (t, *J* = 7.4 Hz, 3H).

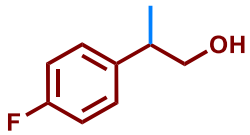
^{13}C NMR (75 MHz, $CDCl_3$) δ 141.94, 133.28, 133.00, 128.26, 127.94, 127.70, 126.13, 125.80, 124.74, 124.15, 76.16, 31.80, 10.17.



2-(4-isobutylphenyl)propan-1-ol[11]: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.13 (q, J = 7.9 Hz, 4H), 3.68 (t,

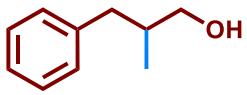
J = 6.0 Hz, 2H), 2.92 (h, J = 7.0 Hz, 1H), 2.46 (d, J = 7.2 Hz, 2H), 1.86 (dp, J = 13.6, 6.8 Hz, 1H), 1.52 (d, J = 5.8 Hz, 1H), 1.27 (d, J = 7.0 Hz, 3H), 0.91 (d, J = 6.7 Hz, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 140.76, 140.07, 129.39, 127.19, 68.79, 45.06, 42.04, 30.24, 22.44, 17.64.



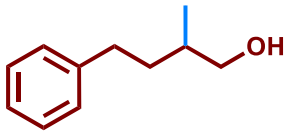
2-(4-fluorophenyl)propan-1-ol[11]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.23 – 7.16 (m, 2H), 7.06 – 6.97 (m, 2H), 3.73 – 3.62 (m, 2H), 2.93 (h, *J* = 6.9 Hz, 1H), 1.26 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 163.29, 160.05, 139.40, 139.35, 128.91, 128.80, 115.51, 115.23, 68.67, 41.71, 17.72.



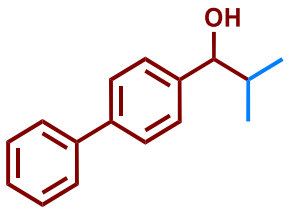
2-methyl-3-phenylpropan-1-ol[12]: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 (t, J = 7.3 Hz, 2H), 7.21 – 7.12 (m, 3H), 3.47 (qd, J = 10.6, 5.9 Hz, 2H), 2.73 (dd, J = 13.5, 6.3 Hz, 1H), 2.39 (dd, J = 13.5, 8.1 Hz, 1H), 1.92 (tq, J = 12.6, 6.6 Hz, 1H), 0.89 (dd, J = 6.7, 1.5 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 140.67, 129.18, 128.29, 125.90, 67.66, 39.73, 37.82, 16.49.



2-methyl-4-phenylbutan-1-ol[11]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.34 – 7.27 (m, 2H), 7.24 – 7.14 (m, 3H), 3.68 – 3.37 (m, 2H), 2.64 (ddd, *J* = 11.1, 6.3, 2.9 Hz, 2H), 1.82 – 1.47 (m, 4H), 1.38 – 1.10 (m, 2H), 0.95 (d, *J* = 6.7 Hz, 3H).

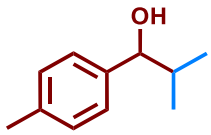
^{13}C NMR (75 MHz, $CDCl_3$) δ 142.63, 128.40, 128.30, 125.70, 68.30, 36.24, 35.70, 32.80, 28.93, 16.54.



1-([1,1'-biphenyl]-4-yl)-2-methylpropan-1-ol: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.65 – 7.56 (m, 4H), 7.49 – 7.33 (m, 5H), 4.42 (d, *J* = 6.8 Hz, 1H), 2.08 – 1.97 (m, 1H), 1.05 (d, *J* = 6.6 Hz, 3H), 0.86 (d, *J* = 6.8 Hz, 3H).

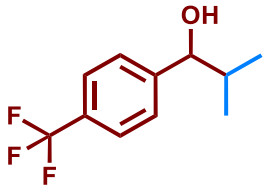
^{13}C NMR (75 MHz, $CDCl_3$) δ 142.73, 140.91, 140.32, 128.80, 127.27, 127.09, 127.05, 126.95, 79.81, 35.30, 19.08, 18.30.

HRMS (EI): Calculated for $C_{16}H_{18}O$ = 226.1358; found = 226.1361.



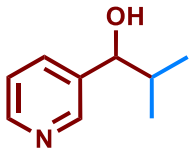
2-methyl-1-(p-tolyl)propan-1-ol[11]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.84 – 7.76 (m, 2H), 7.23 – 7.15 (m, 2H), 3.47 (dt, *J* = 13.7, 6.9 Hz, 1H), 2.34 (s, 3H), 2.30 – 2.22 (m, 1H), 1.14 (d, *J* = 6.9 Hz, 6H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 143.52, 133.69, 129.30, 128.47, 35.21, 21.61, 19.23.



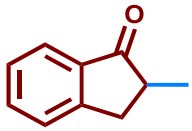
2-methyl-1-(4-(trifluoromethyl)phenyl)propan-1-ol[12]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.90 – 7.82 (m, 2H), 7.29 – 7.23 (m, 2H), 3.61 – 3.46 (m, 1H), 2.41 – 2.41 (m, 2H), 1.21 (d, *J* = 6.8 Hz, 6H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 204.18, 143.52, 133.69, 129.30, 128.46, 35.21, 21.60, 19.23.



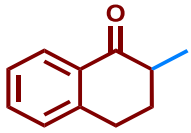
2-methyl-1-(pyridin-3-yl)propan-1-ol[12]: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.33 (d, *J* = 6.4 Hz, 2H), 7.65 (dddd, *J* = 7.9, 2.2, 1.6, 0.6 Hz, 1H), 7.21 (ddd, *J* = 7.9, 4.8, 0.8 Hz, 1H), 4.36 (d, *J* = 6.6 Hz, 1H), 3.98 (s, 1H), 2.10 – 1.77 (m, *J* = 6.7 Hz, 1H), 0.94 (d, *J* = 6.7 Hz, 3H), 0.77 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 148.01, 147.99, 139.57, 134.61, 123.33, 77.05, 35.25, 18.72, 18.01.



2-methyl-2,3-dihydro-1H-inden-1-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.76 – 7.68 (m, 1H), 7.56 (td, *J* = 7.4, 1.2 Hz, 1H), 7.42 (dp, *J* = 7.7, 0.9 Hz, 1H), 7.37 – 7.28 (m, 1H), 3.44 – 3.31 (m, 1H), 2.77 – 2.62 (m, 2H), 1.29 (dd, *J* = 7.3, 0.8 Hz, 3H).

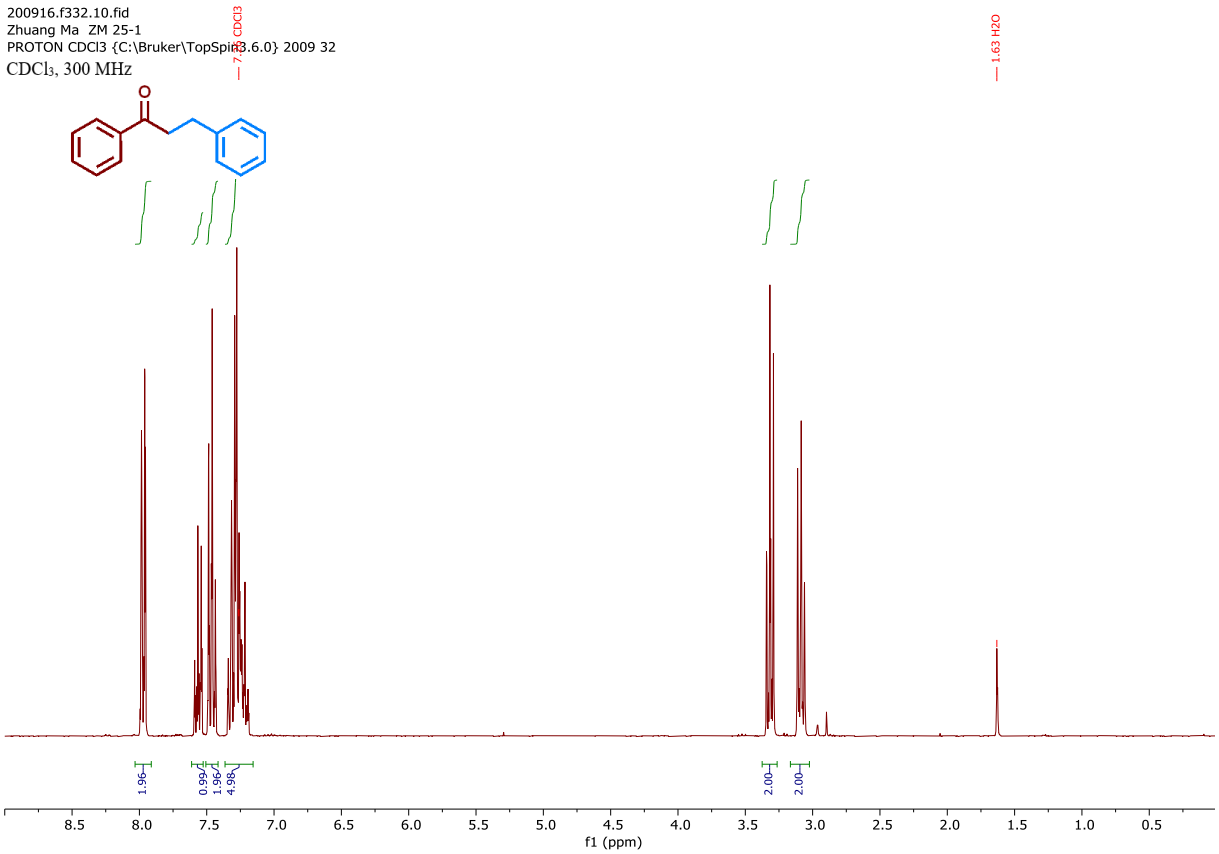
^{13}C NMR (75 MHz, $CDCl_3$) δ 209.53, 153.51, 136.34, 134.71, 127.36, 126.56, 123.96, 41.99, 34.96, 16.29.

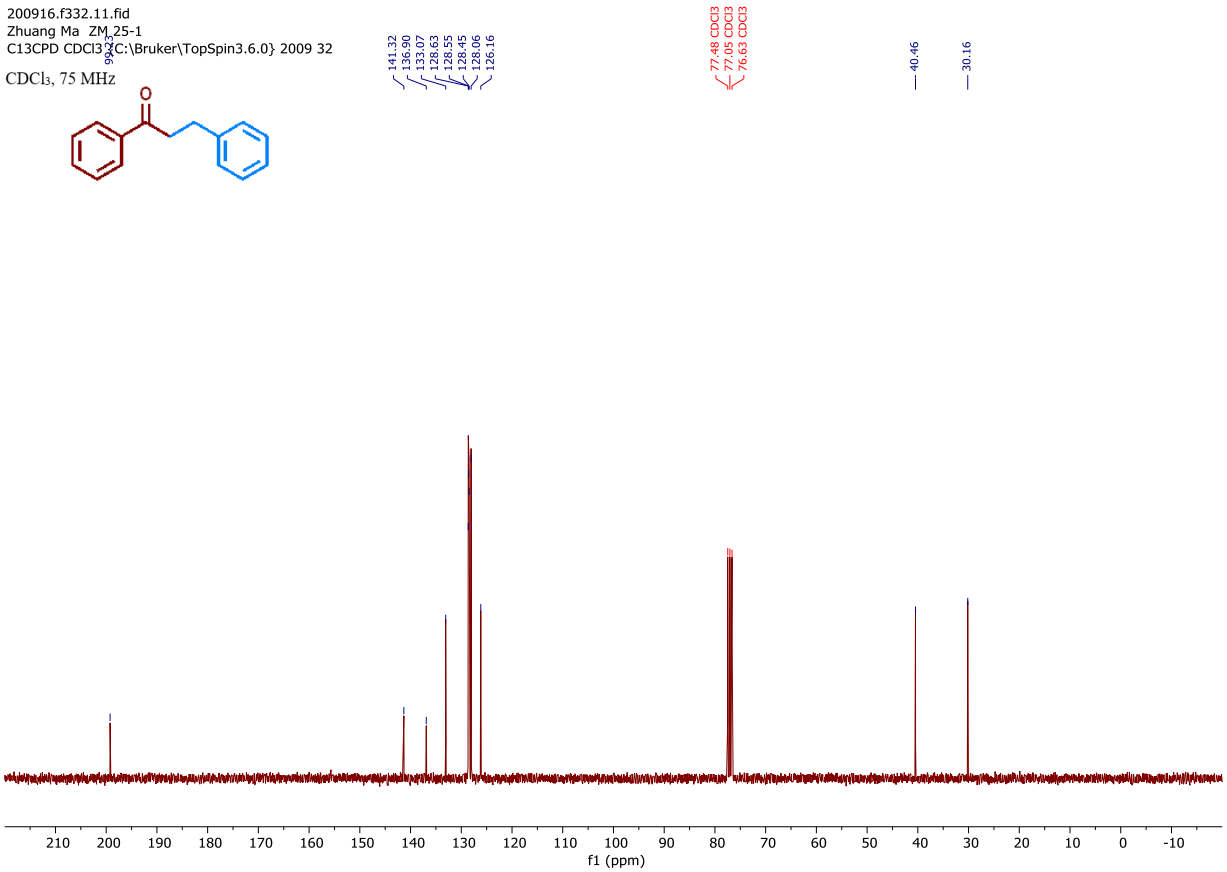


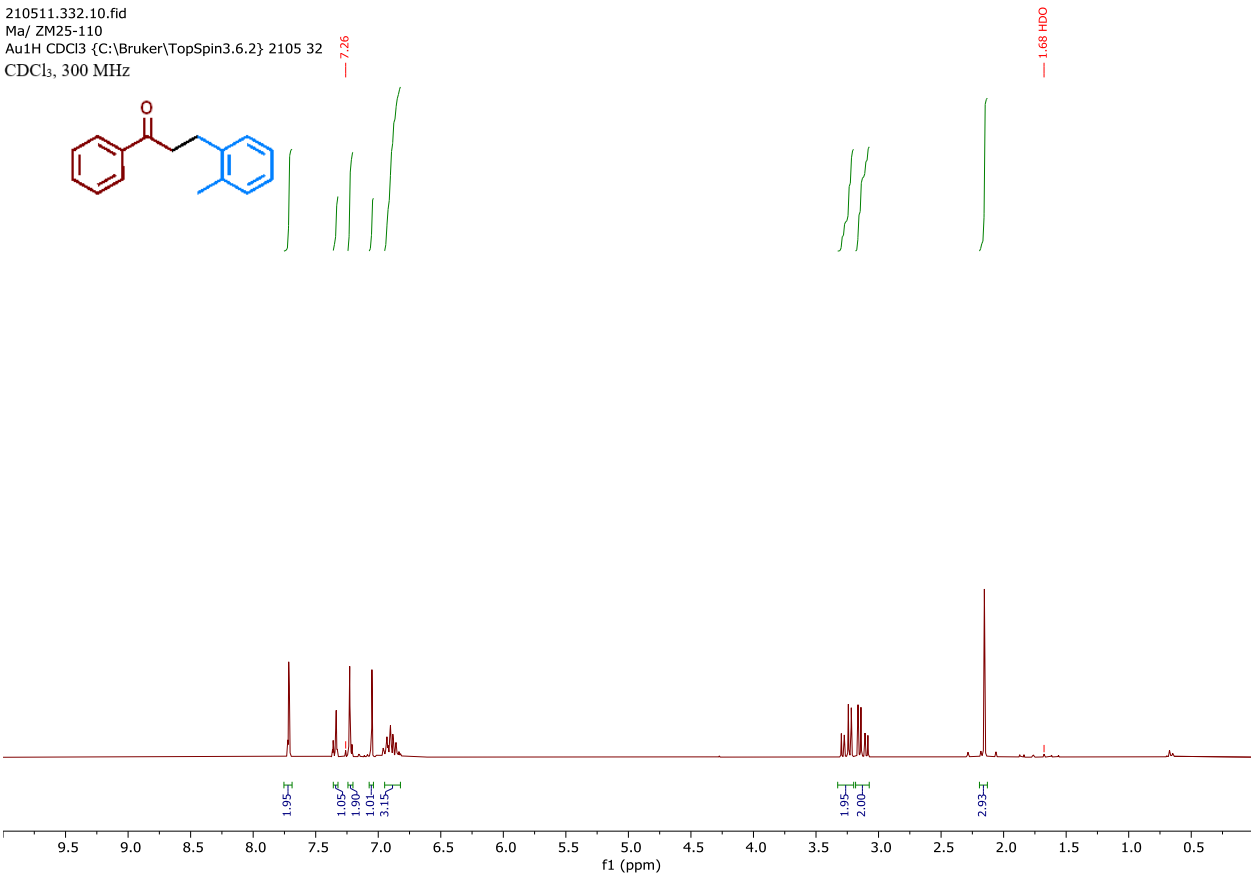
2-methyl-3,4-dihydronaphthalen-1(2H)-one: ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.10 – 8.00 (m, 1H), 7.47 (td, *J* = 7.5, 1.5 Hz, 1H), 7.36 – 7.22 (m, 2H), 3.14 – 2.92 (m, 2H), 2.61 (dqd, *J* = 12.0, 6.8, 4.5 Hz, 1H), 2.22 (dq, *J* = 13.3, 4.5 Hz, 1H), 1.90 (dddd, *J* = 13.2, 12.0, 10.7, 5.2 Hz, 1H), 1.29 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 200.82, 144.22, 133.09, 132.39, 128.73, 127.39, 126.55, 42.65, 31.38, 28.85, 15.46.

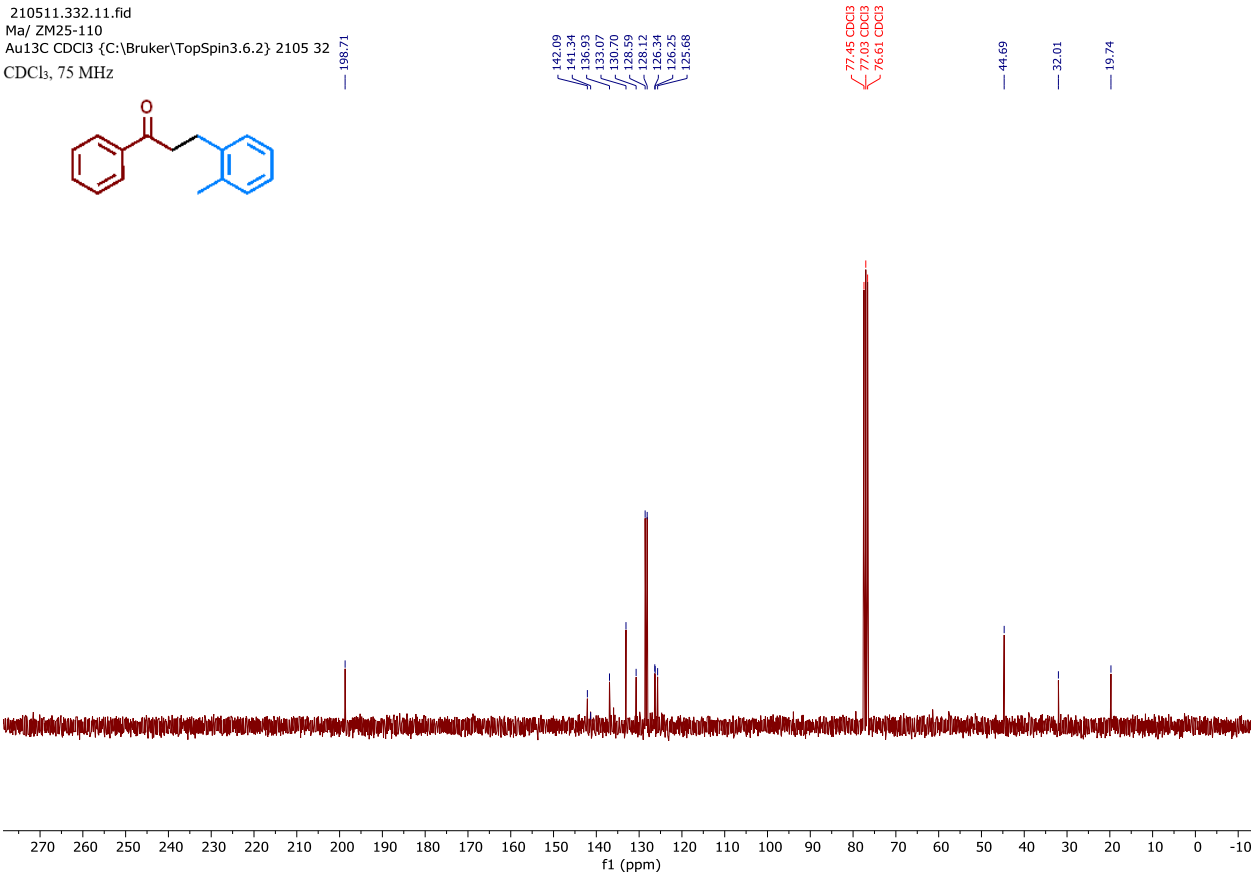
S7. NMR spectra






210511.332.10.fid
Ma/ ZM25-110
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 32
CDCl3, 300 MHz
7.26
1.68 HDO
1.95
1.05
1.90
1.01
3.15
1.95
2.00
2.93
f1 (ppm)

949
950


210511.332.11.fid
Ma/ ZM25-110
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 32
CDCl3, 75 MHz
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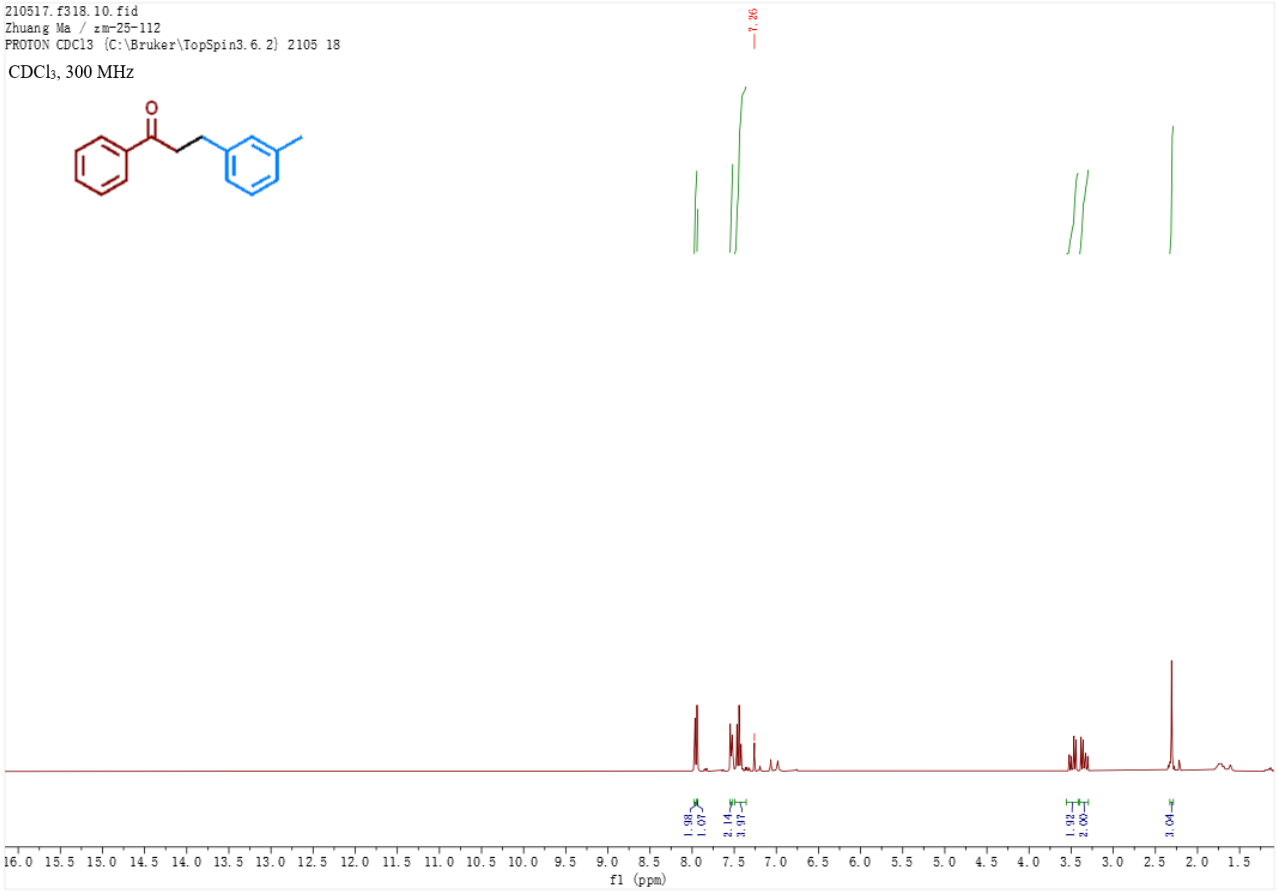
142.09
141.34
136.93
133.07
130.70
128.59
128.12
126.34
126.25
125.68
77.45 CDCl3
77.03 CDCl3
76.61 CDCl3
44.69
32.01
19.74
f1 (ppm)

951


210517.f318.10.fid
Zhuang Ma / zm-25-112
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 18
CDCl3, 300 MHz
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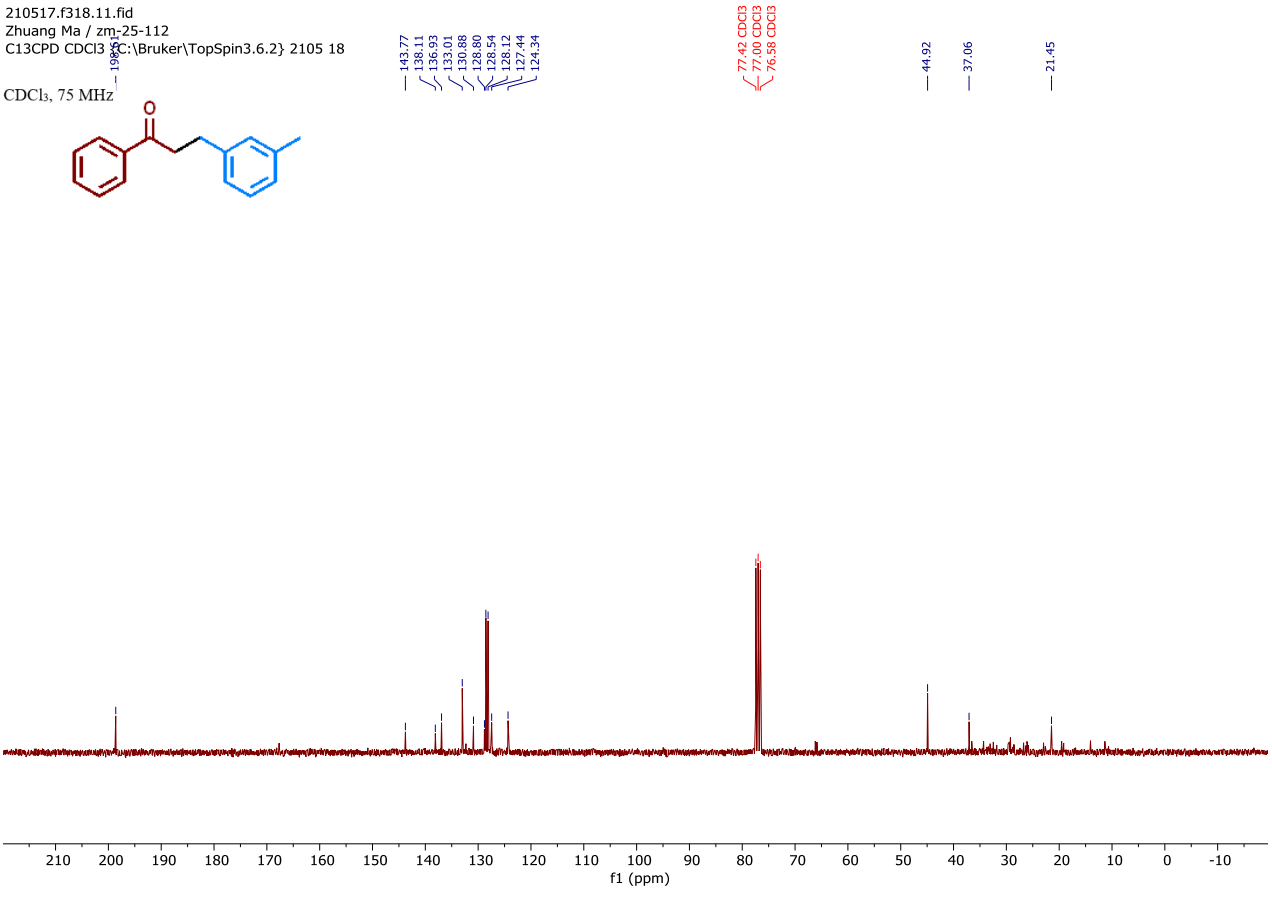
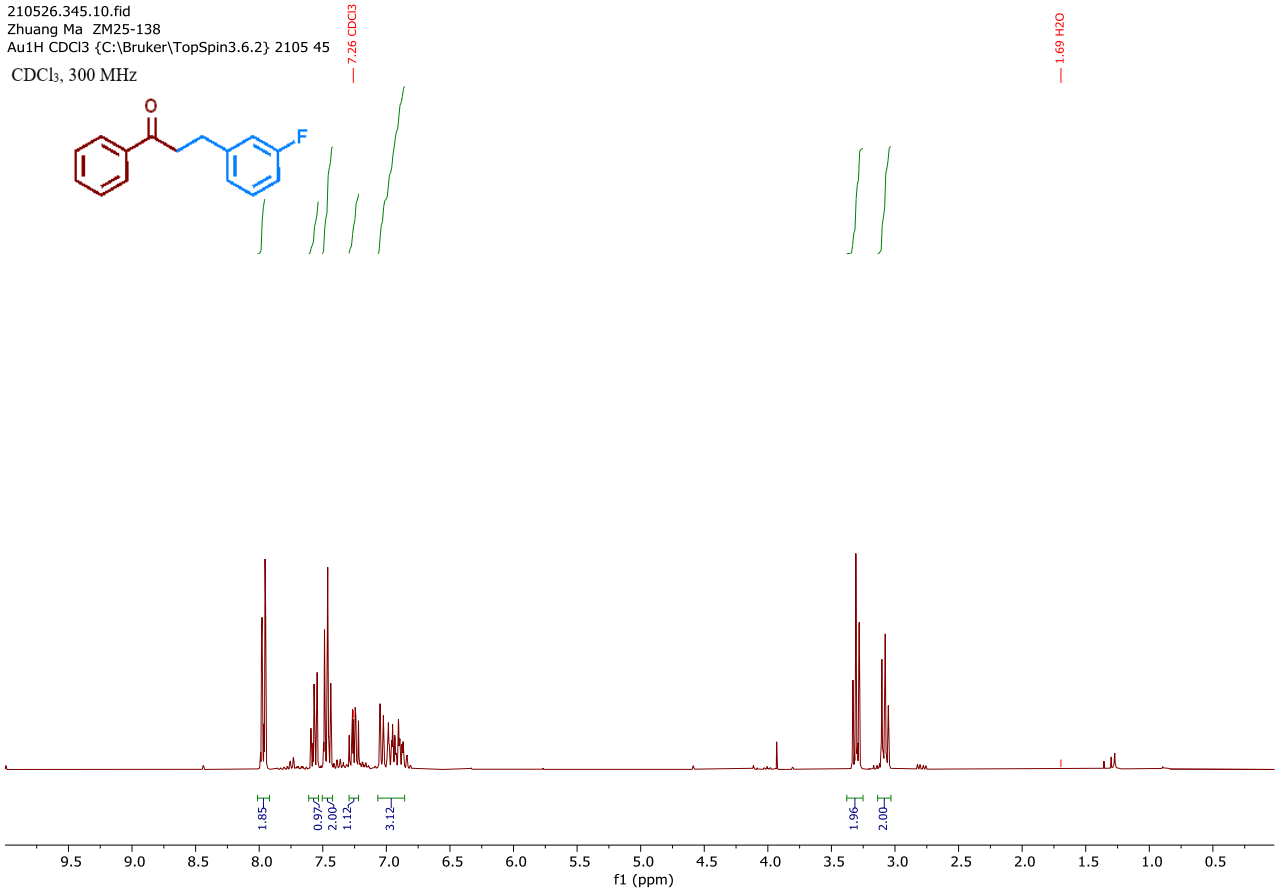
1.98
1.07
2.14
3.97
1.93
2.00
3.04
f1 (ppm)

952

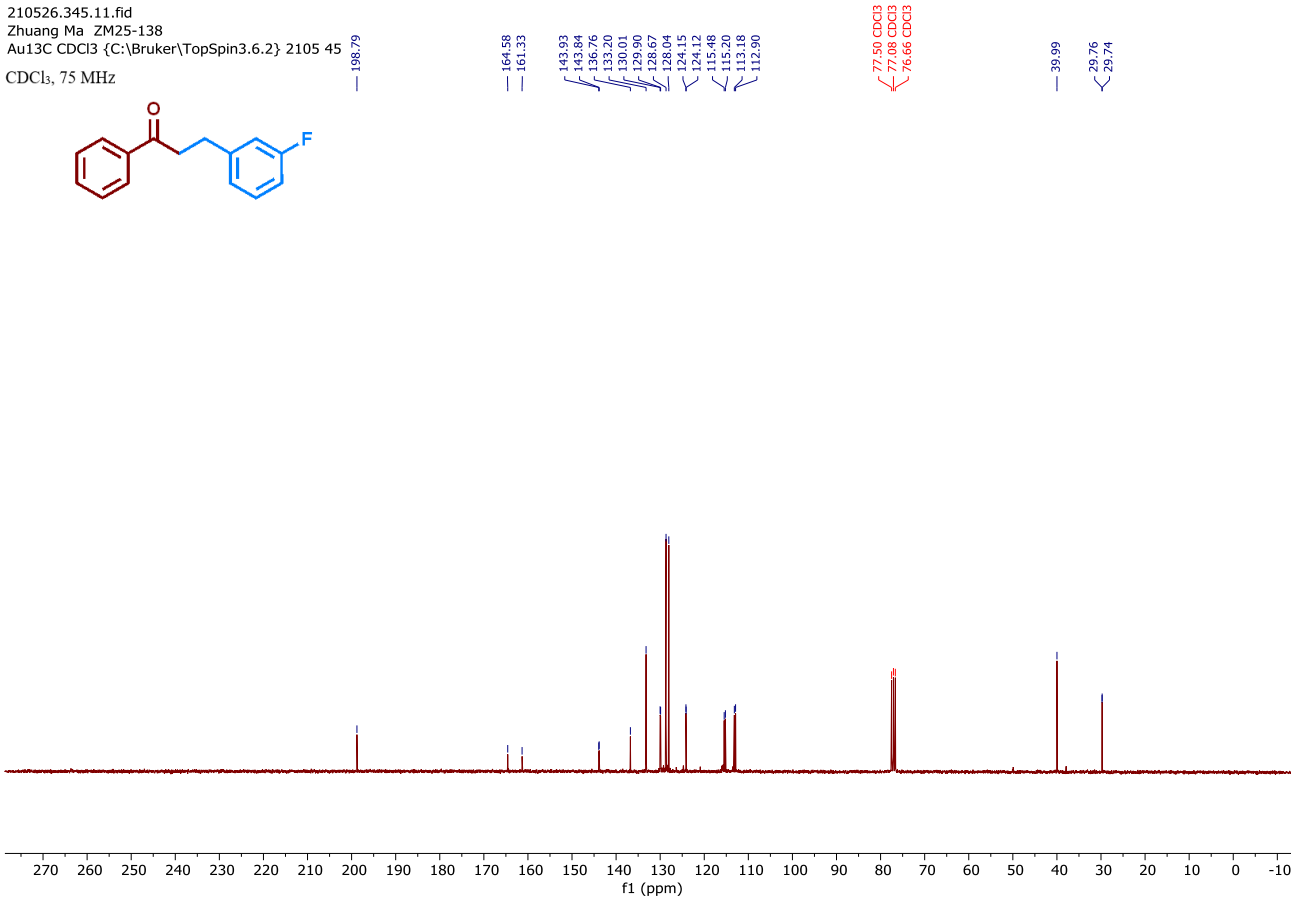
953


210517.f318.11.fid
Zhuang Ma / zm-25-112
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 18
CDCl3, 75 MHz
143.77
138.11
136.93
133.01
130.88
128.80
128.54
128.12
127.44
124.34
77.42 CDCl3
77.00 CDCl3
76.58 CDCl3
44.92
37.06
21.45
f1 (ppm)

954


210526.345.10.fid
Zhuang Ma ZM25-138
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 45
CDCl3, 300 MHz
7.26 CDCl3
1.69 H2O
O
F
1.85
0.97
2.00
1.12
3.12
1.96
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

955


210526.345.11.fid
Zhuang Ma ZM25-138
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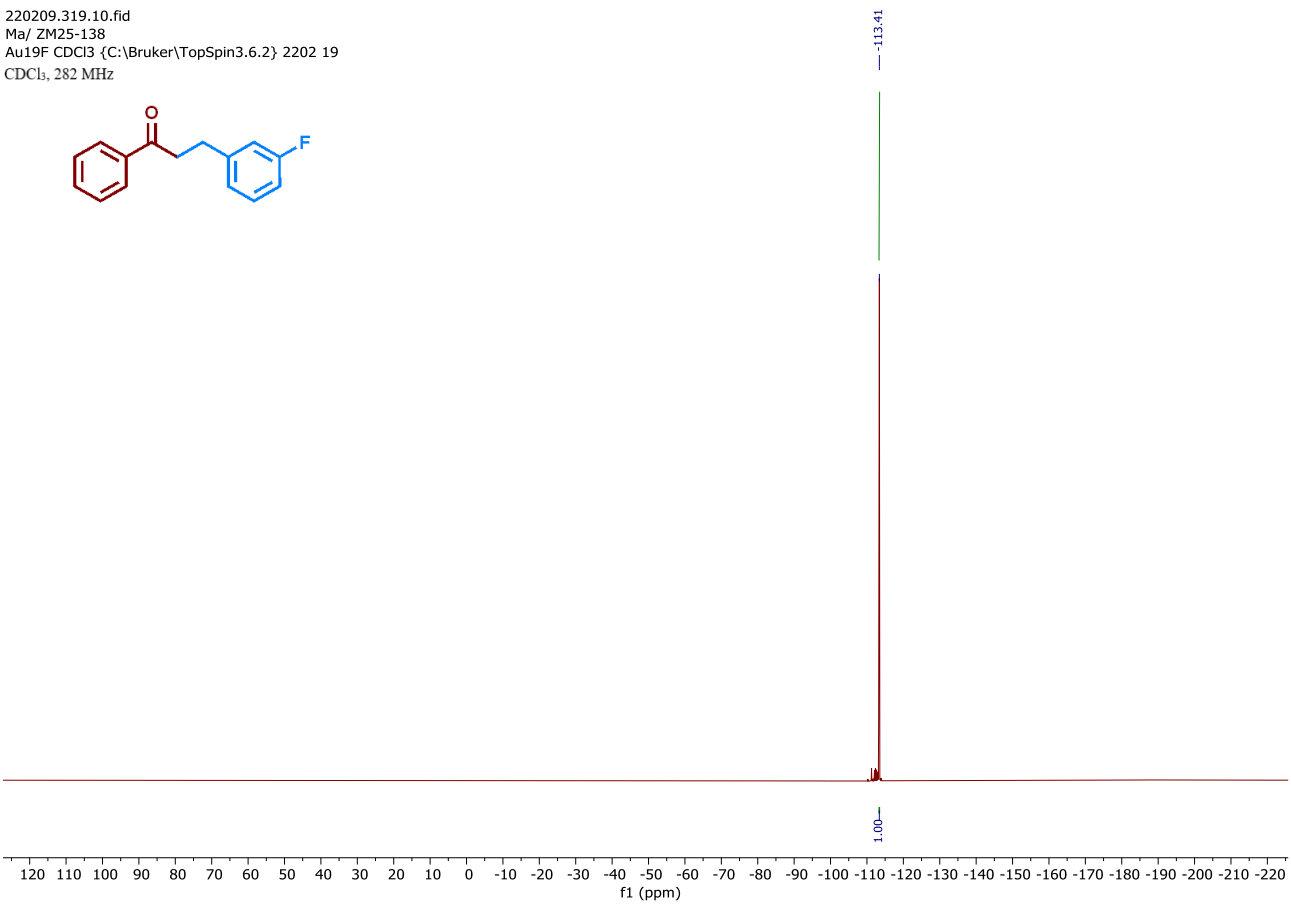
CDCl3, 75 MHz
198.79
164.58
161.33
143.93
143.84
136.76
133.20
130.01
129.90
128.67
128.04
124.15
124.12
115.48
115.20
113.18
112.90
77.50 CDCl3
77.08 CDCl3
76.66 CDCl3
39.99
29.76
29.74
O
F
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

956


220209.319.10.fid
Ma/ ZM25-138
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CDCl3, 282 MHz
O
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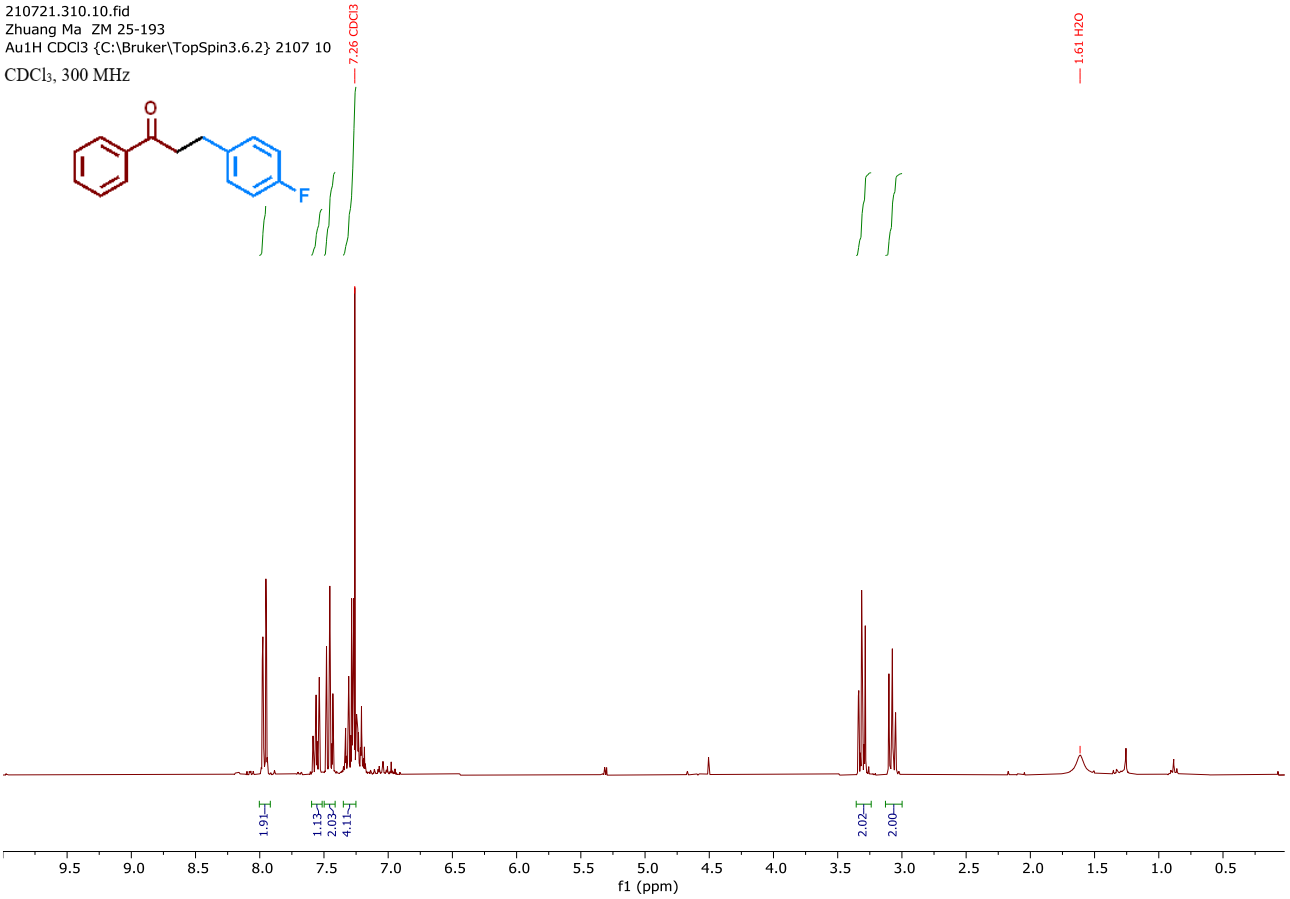
1.00
120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)

957

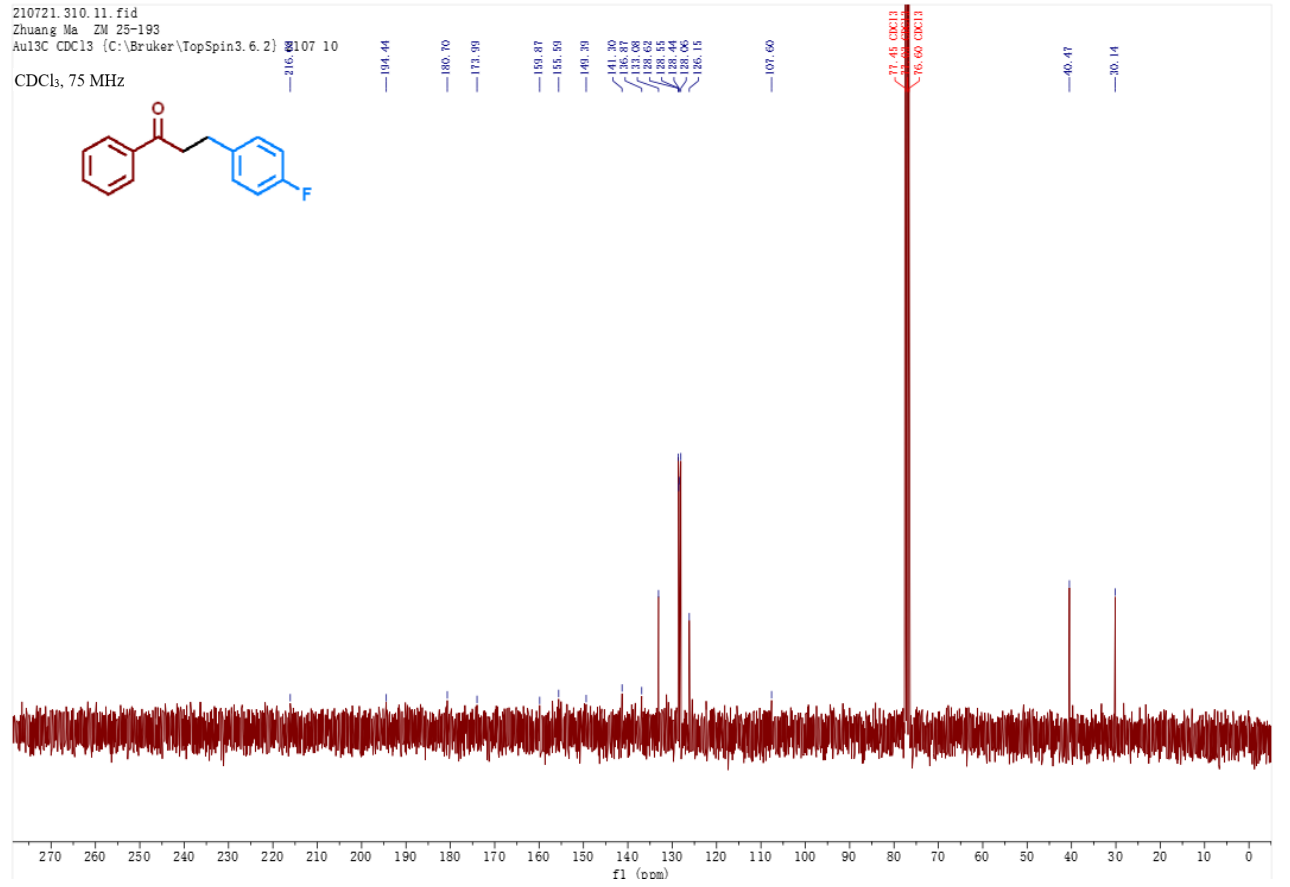
958

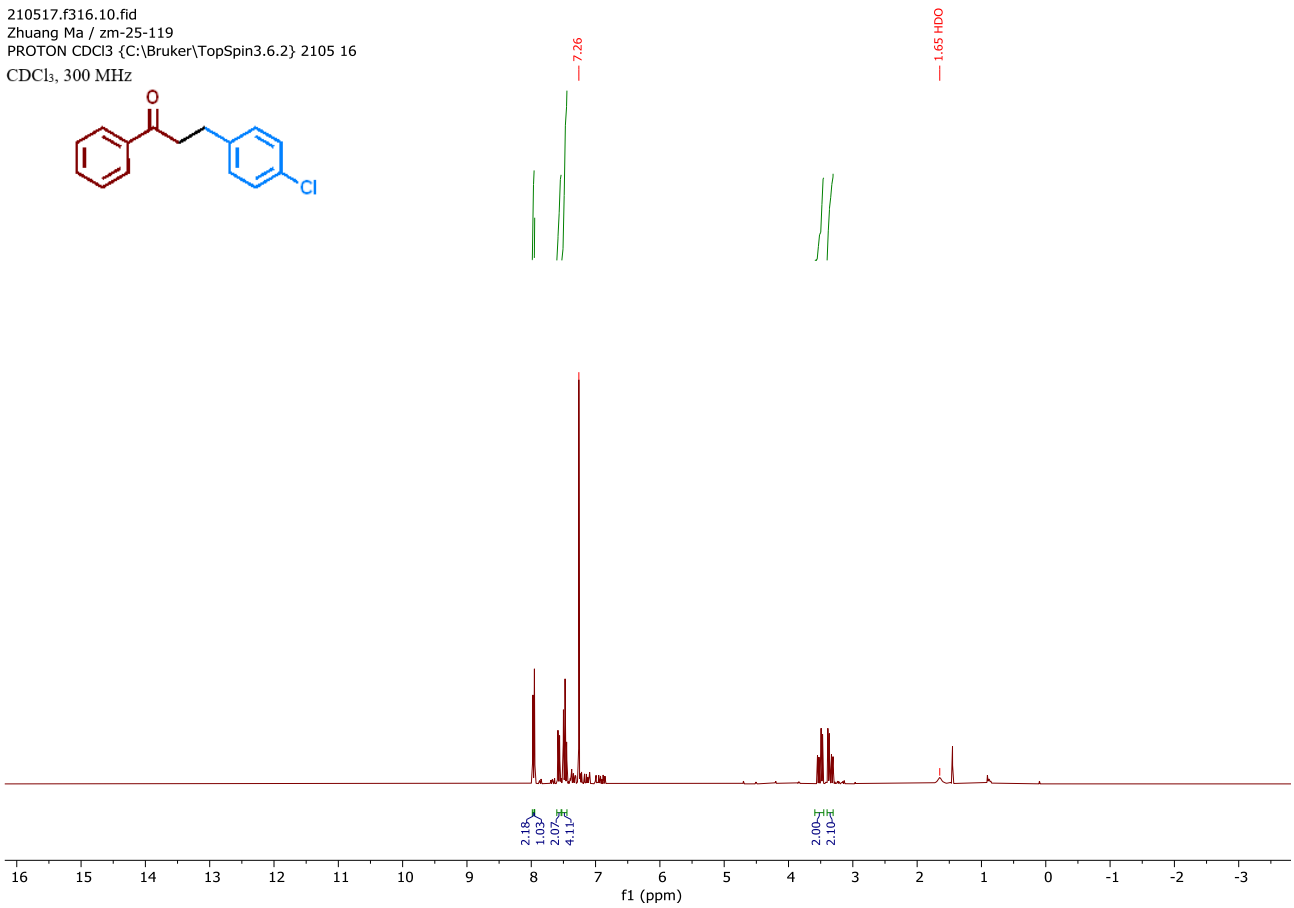
959

960


210721.310.10.fid
Zhuang Ma ZM 25-193
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 10
CDCl3, 300 MHz
7.26 CDCl3
1.61 H2O
1.91
1.13
2.03
4.11
2.02
2.00
f1 (ppm)

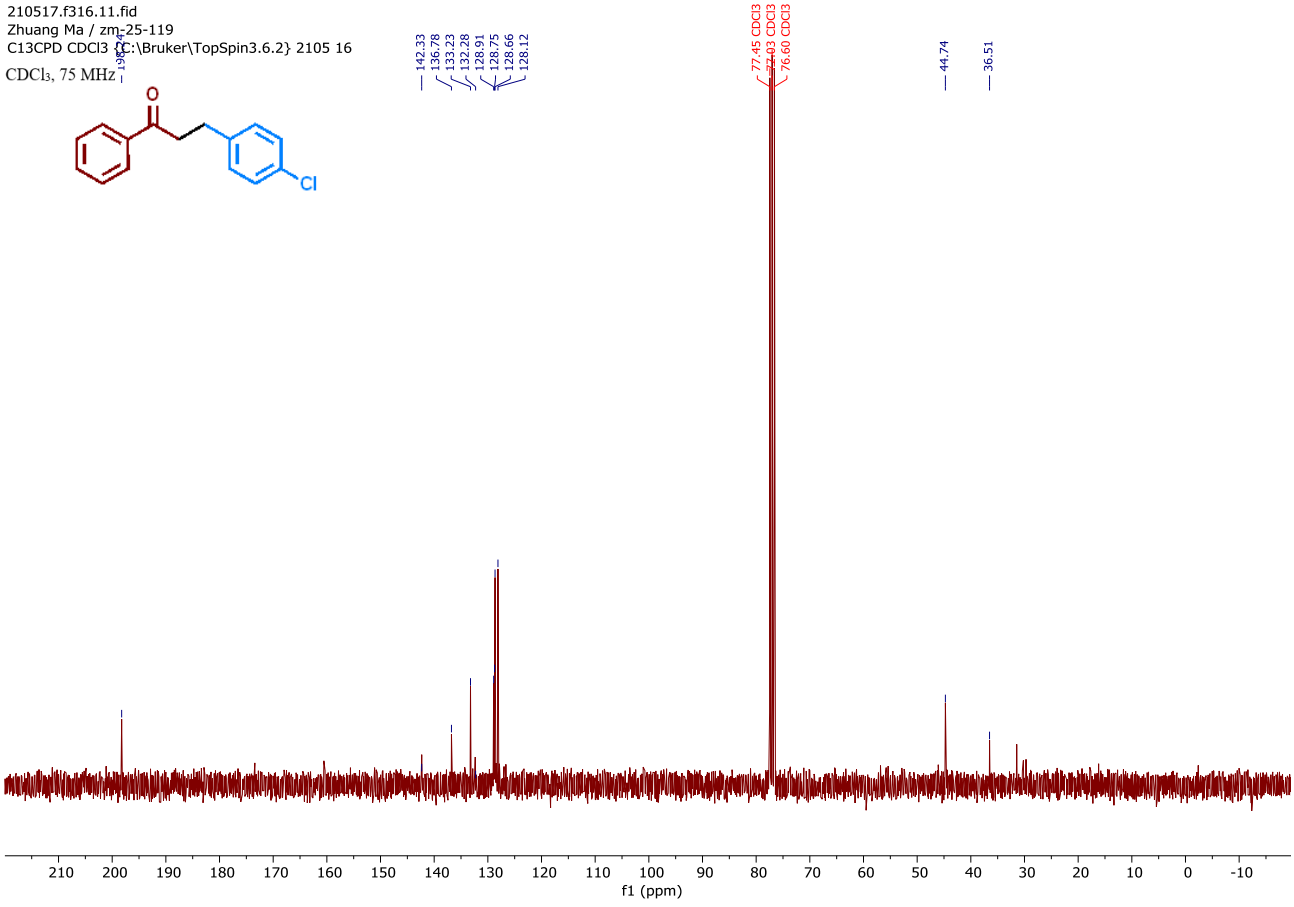
961


210721.310.11.fid
Zhuang Ma ZM 25-193
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 10
CDCl3, 75 MHz
194.44
180.70
173.99
159.87
155.59
149.39
141.30
136.87
133.08
130.62
128.55
128.44
128.06
126.15
107.60
77.45 CDCl3
76.60 CDCl3
40.47
30.14
f1 (ppm)

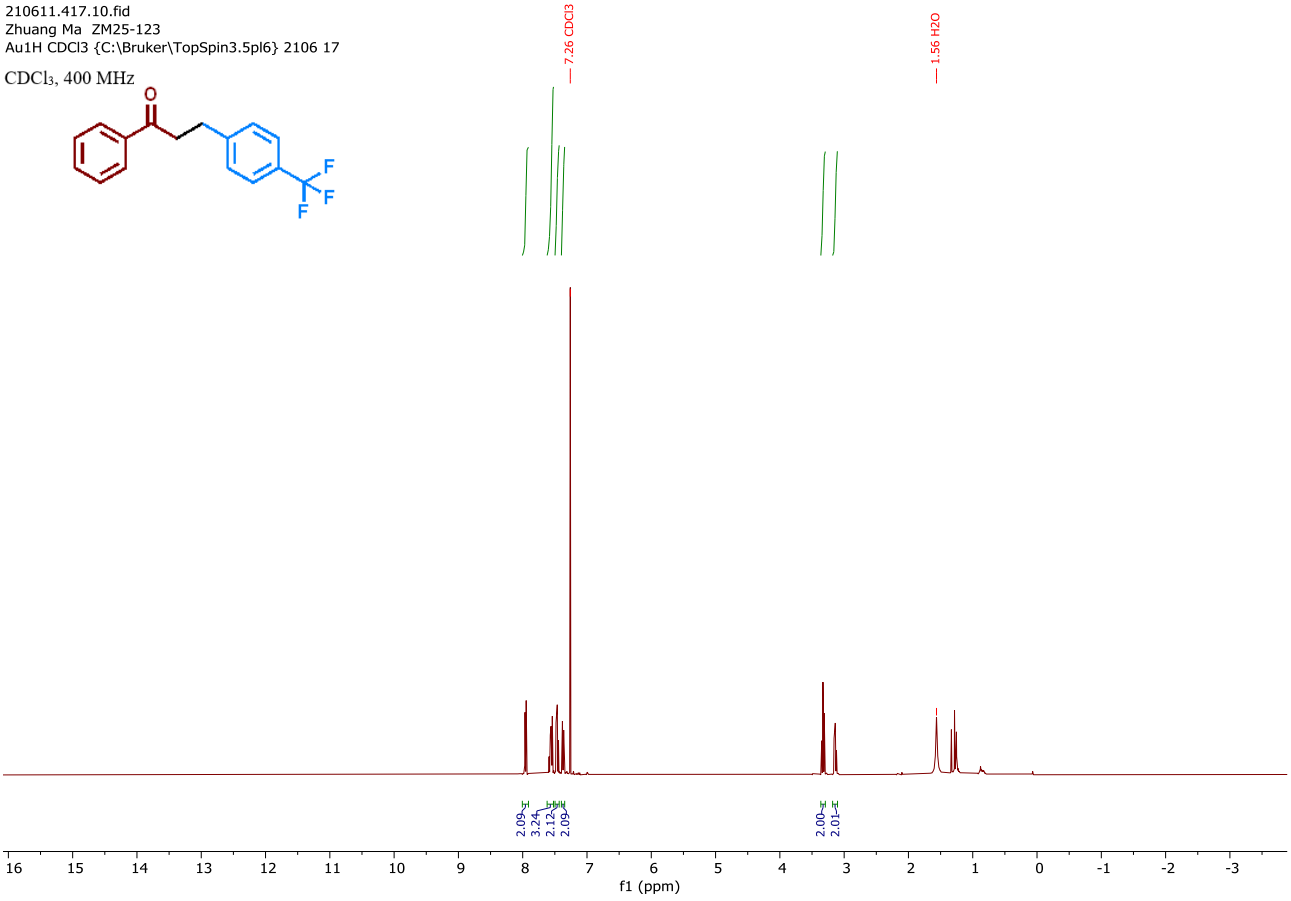

210517.f316.10.fid
Zhuang Ma / zm-25-119
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 16
CDCl3, 300 MHz
7.26
1.65 HDO
2.18
1.03
2.07
4.11
2.00
2.10
f1 (ppm)

962

963

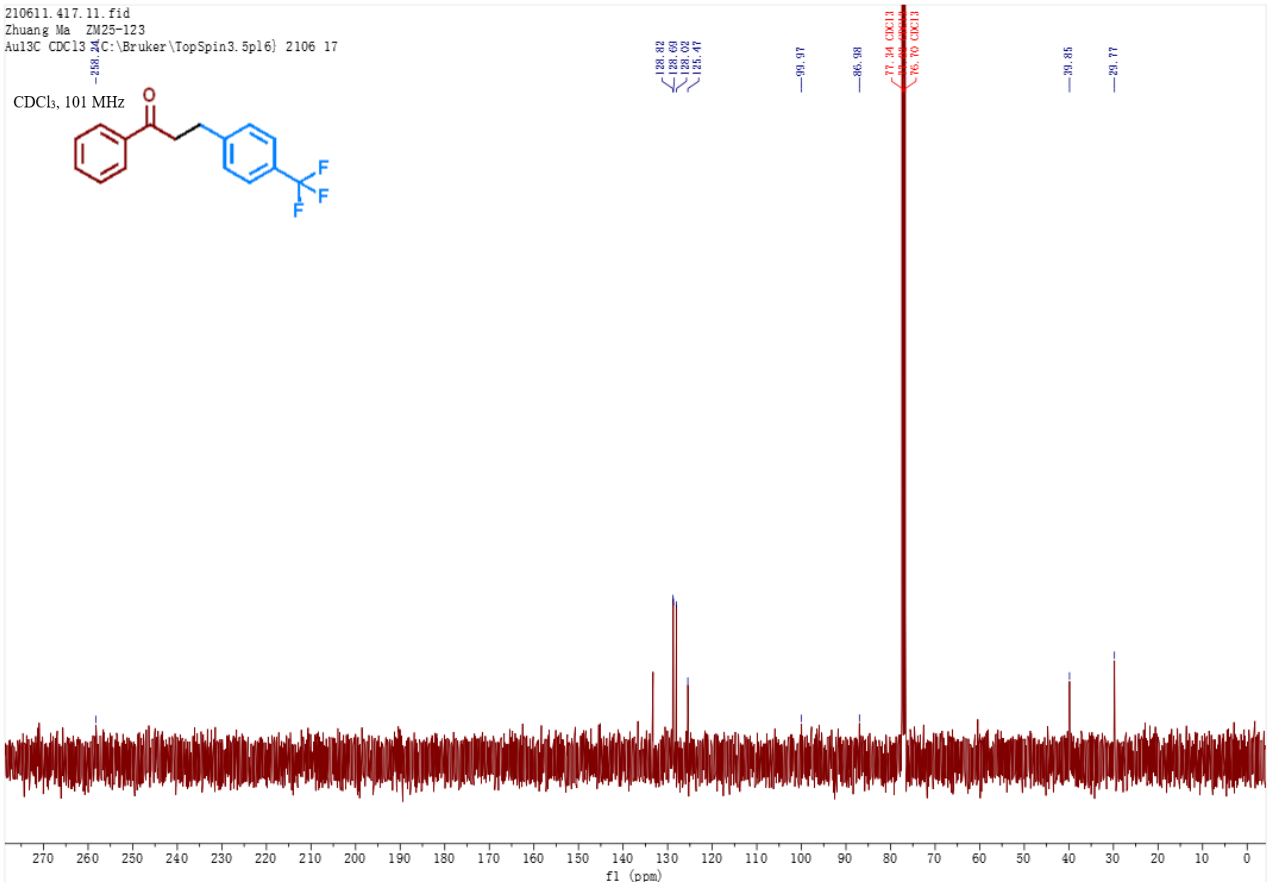

210517.f316.11.fid
Zhuang Ma / zm-25-119
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 16
CDCl3, 75 MHz
142.33
136.78
133.23
132.28
128.91
128.75
128.66
128.12
77.45 CDCl3
77.03 CDCl3
76.60 CDCl3
44.74
36.51
f1 (ppm)

964

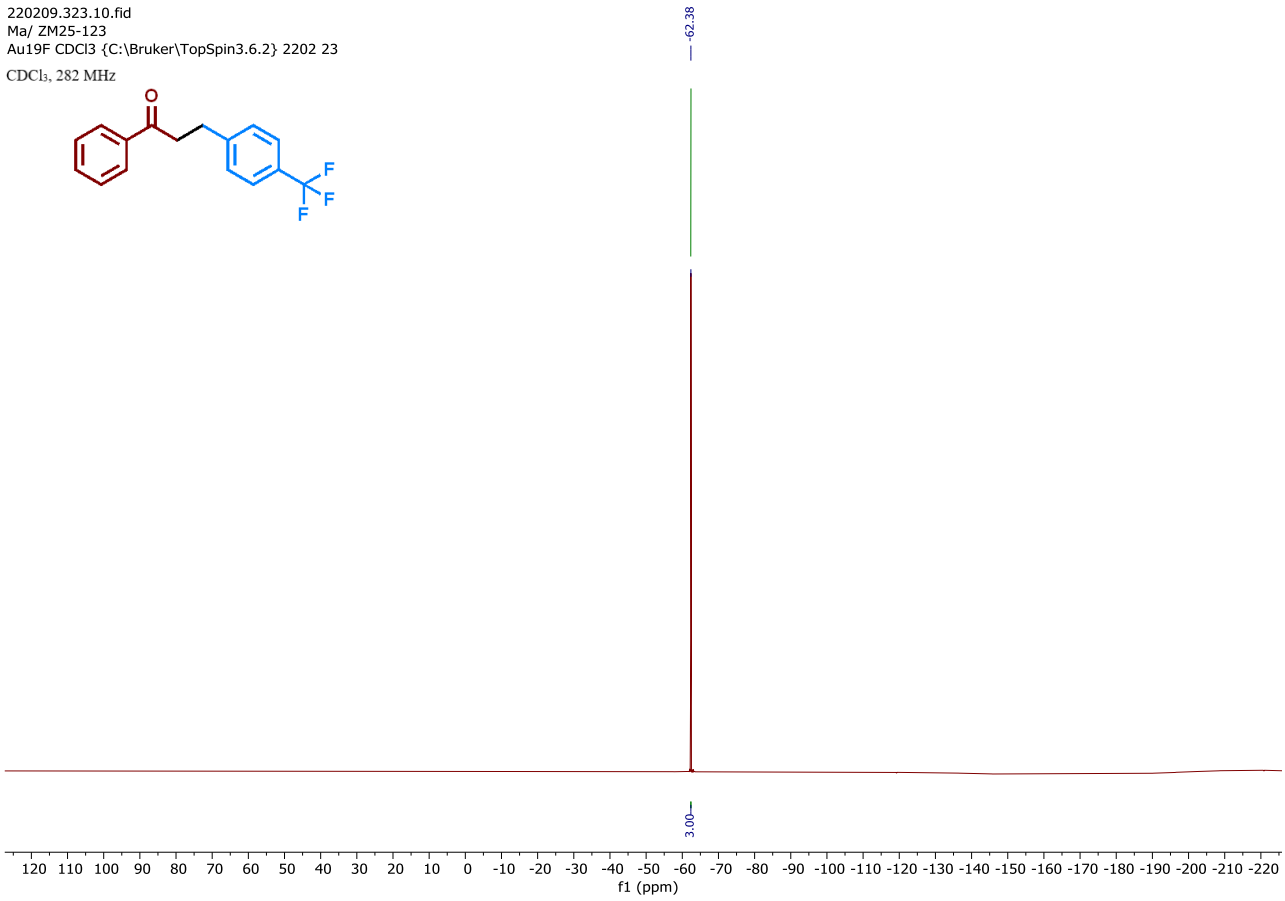

210611.417.10.fid
Zhuang Ma ZM25-123
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2106 17
CDCl3, 400 MHz
7.26 CDCl3
1.56 H2O
2.09
3.24
2.12
2.09
2.00
2.01
f1 (ppm)

965

966


210611.417.11.fid
Zhuang Ma ZM25-123
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2106 17
CDCl3, 101 MHz
128.82
128.60
126.02
125.47
99.97
86.98
77.34 CDCl3
76.70 CDCl3
39.85
29.77
f1 (ppm)

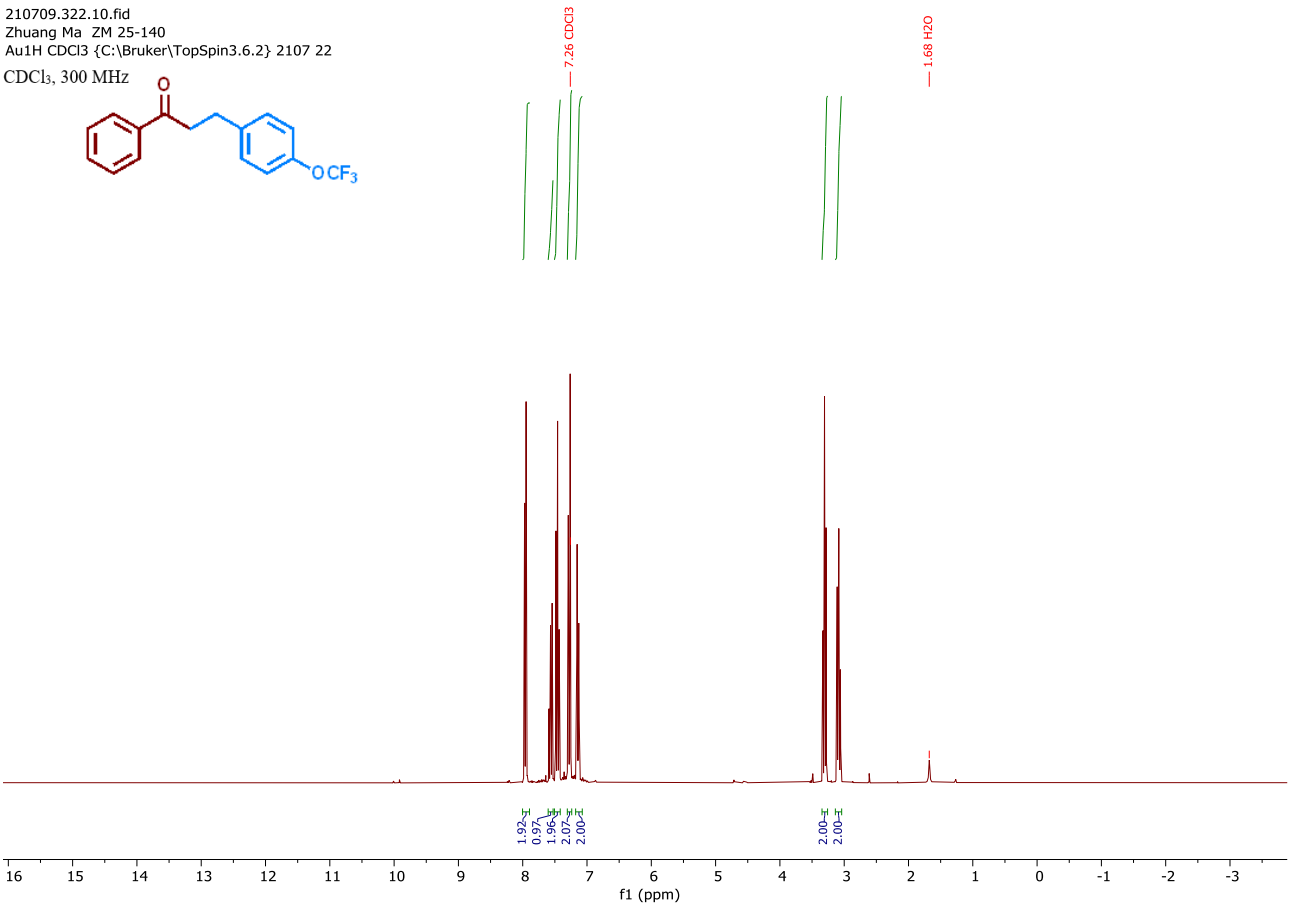
967


220209.323.10.fid
Ma/ ZM25-123
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2202 23
CDCl3, 282 MHz
O
F
F
F
-62.38
3.00
120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)

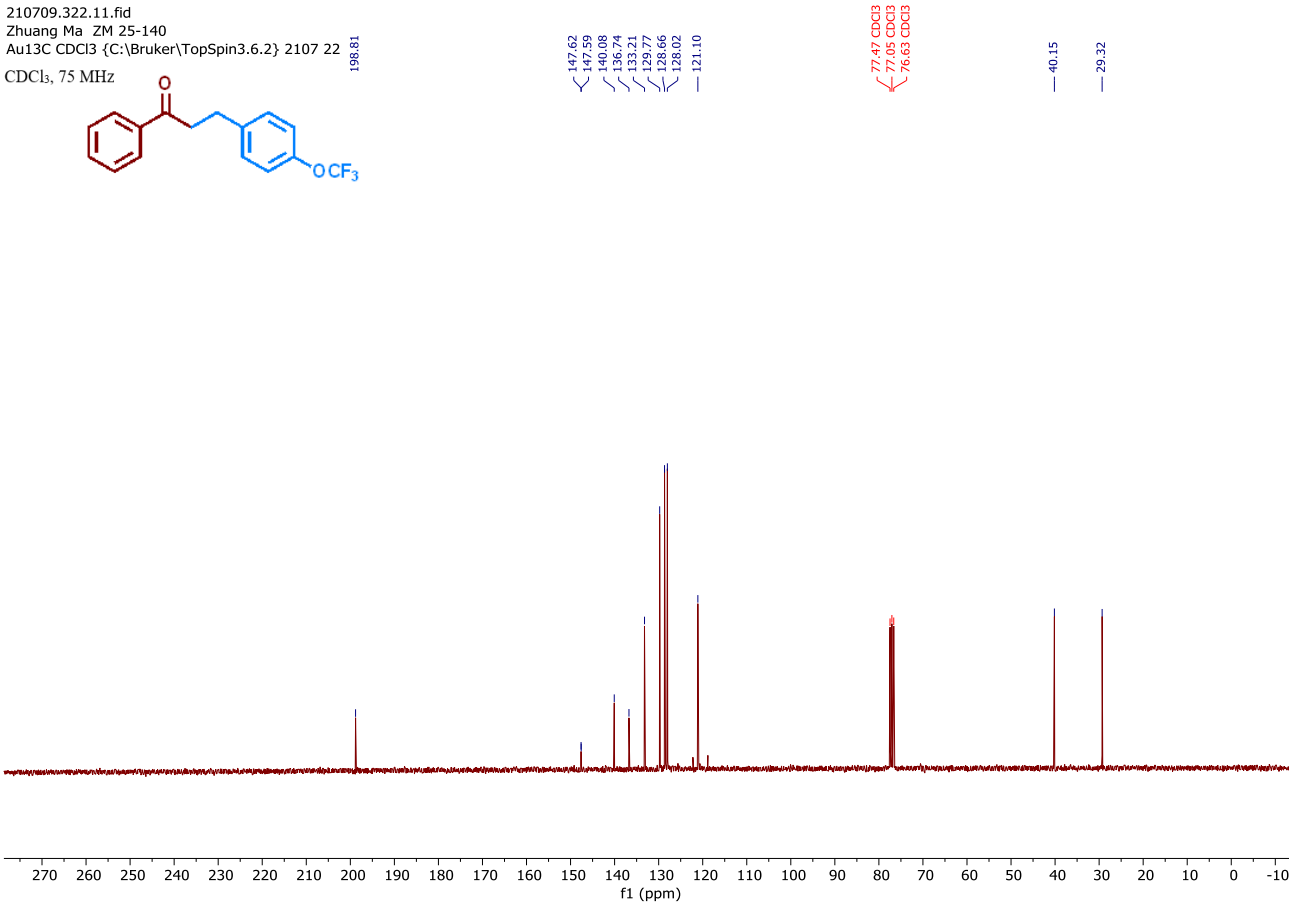
968

969

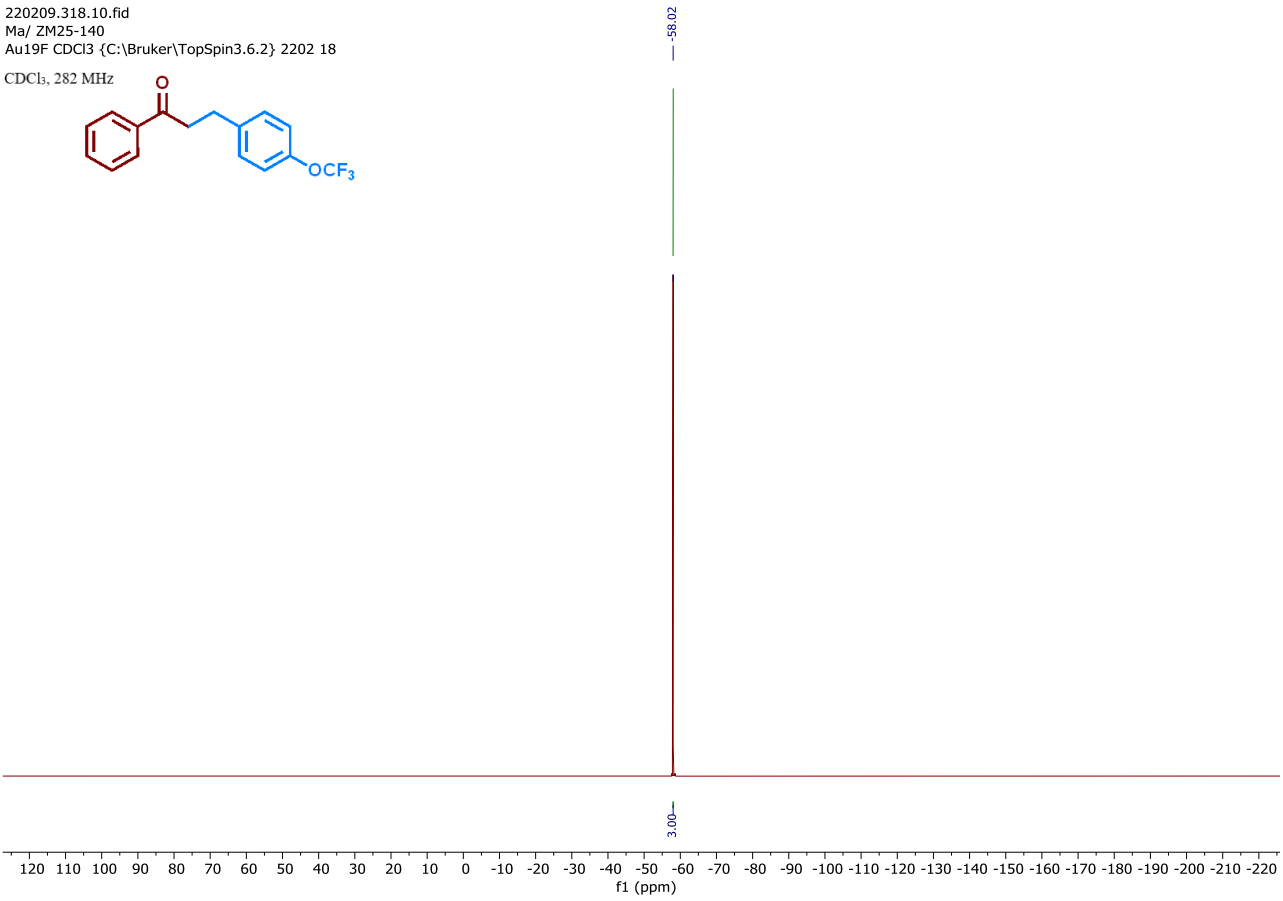
970


210709.322.10.fid
Zhuang Ma ZM 25-140
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 22
CDCl3, 300 MHz
O
OCF3
7.26 CDCl3
1.68 H2O
1.92
0.97
1.96
2.07
2.00
2.00
2.00
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3
f1 (ppm)

971


210709.322.11.fid
Zhuang Ma ZM 25-140
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 22
CDCl3, 75 MHz
O
OCF3
198.81
147.62
147.59
140.08
136.74
133.21
129.77
128.66
128.02
121.10
77.47 CDCl3
77.05 CDCl3
76.63 CDCl3
40.15
29.32
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

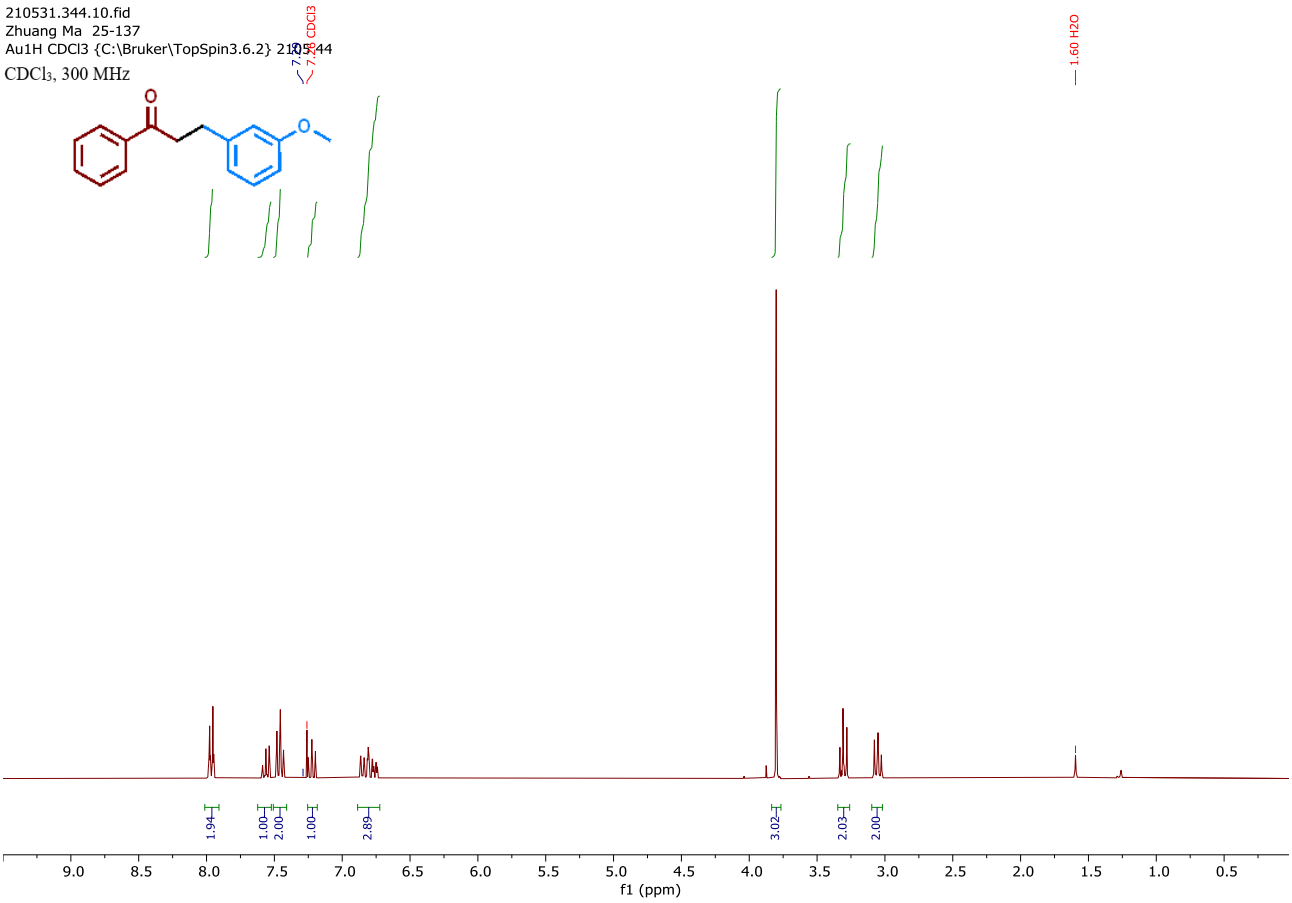
972


220209.318.10.fid
Ma/ ZM25-140
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2202 18
CDCl3, 282 MHz
O
OCF3
-58.02
3.00
120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)

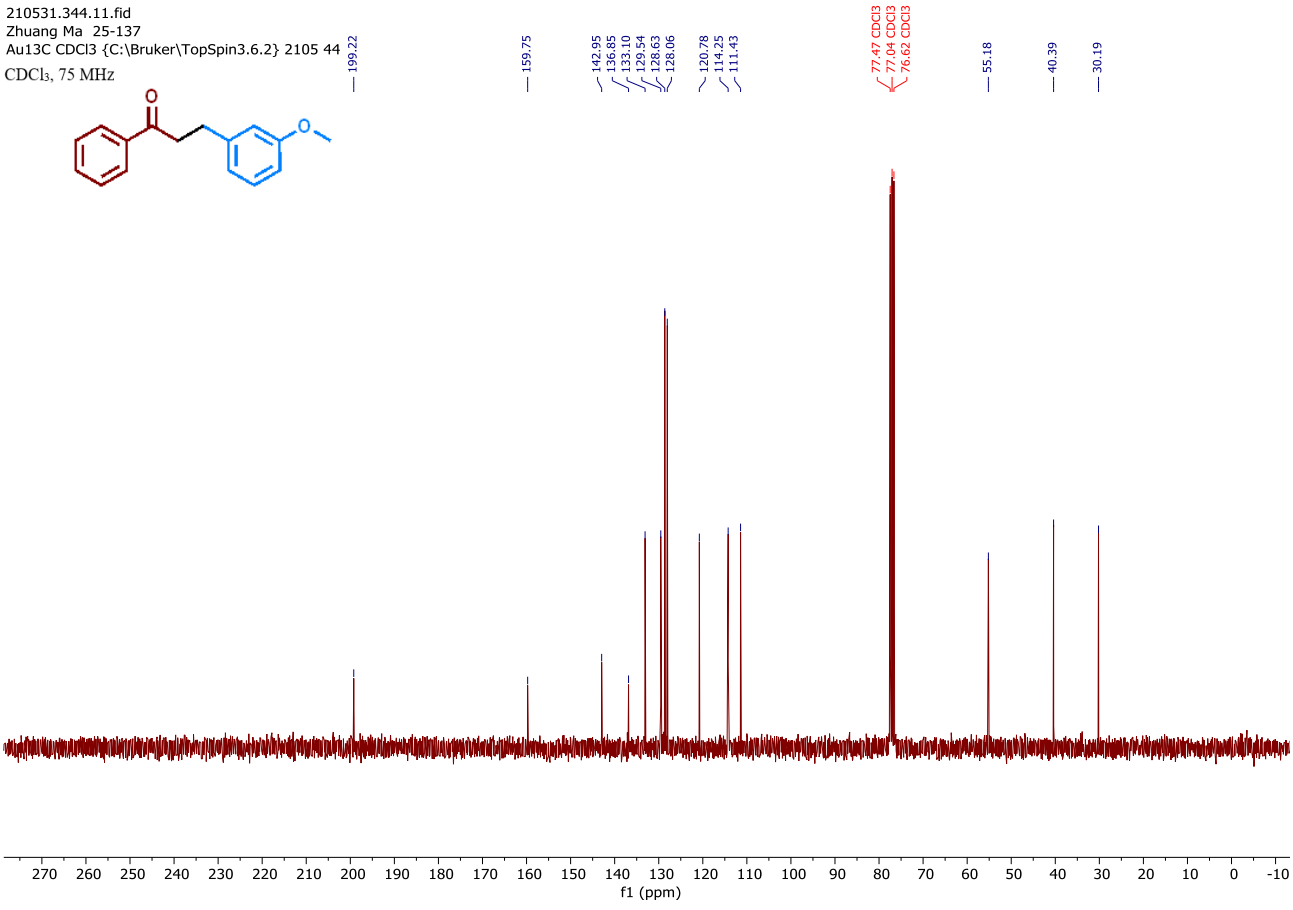
973

974

975

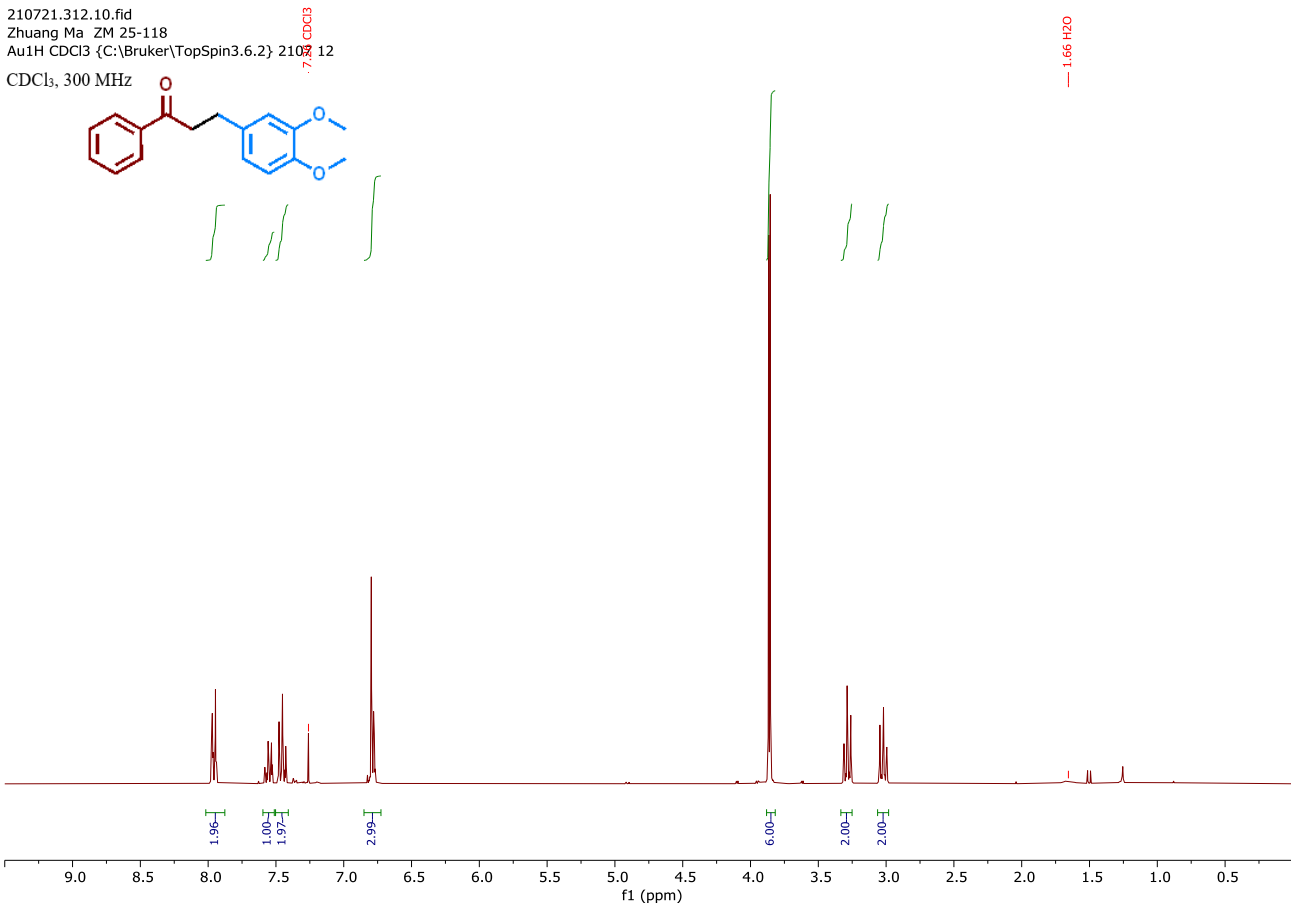

210531.344.10.fid
Zhuang Ma 25-137
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 44
CDCl3, 300 MHz
7.26 CDCl3
7.24
1.60 H2O
1.94
1.00
2.00
1.00
2.89
3.02
2.03
2.00
f1 (ppm)

976


210531.344.11.fid
Zhuang Ma 25-137
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 44
CDCl3, 75 MHz
199.22
159.75
142.95
136.85
133.10
129.54
128.63
128.06
120.78
114.25
111.43
77.47 CDCl3
77.04 CDCl3
76.62 CDCl3
55.18
40.39
30.19
f1 (ppm)

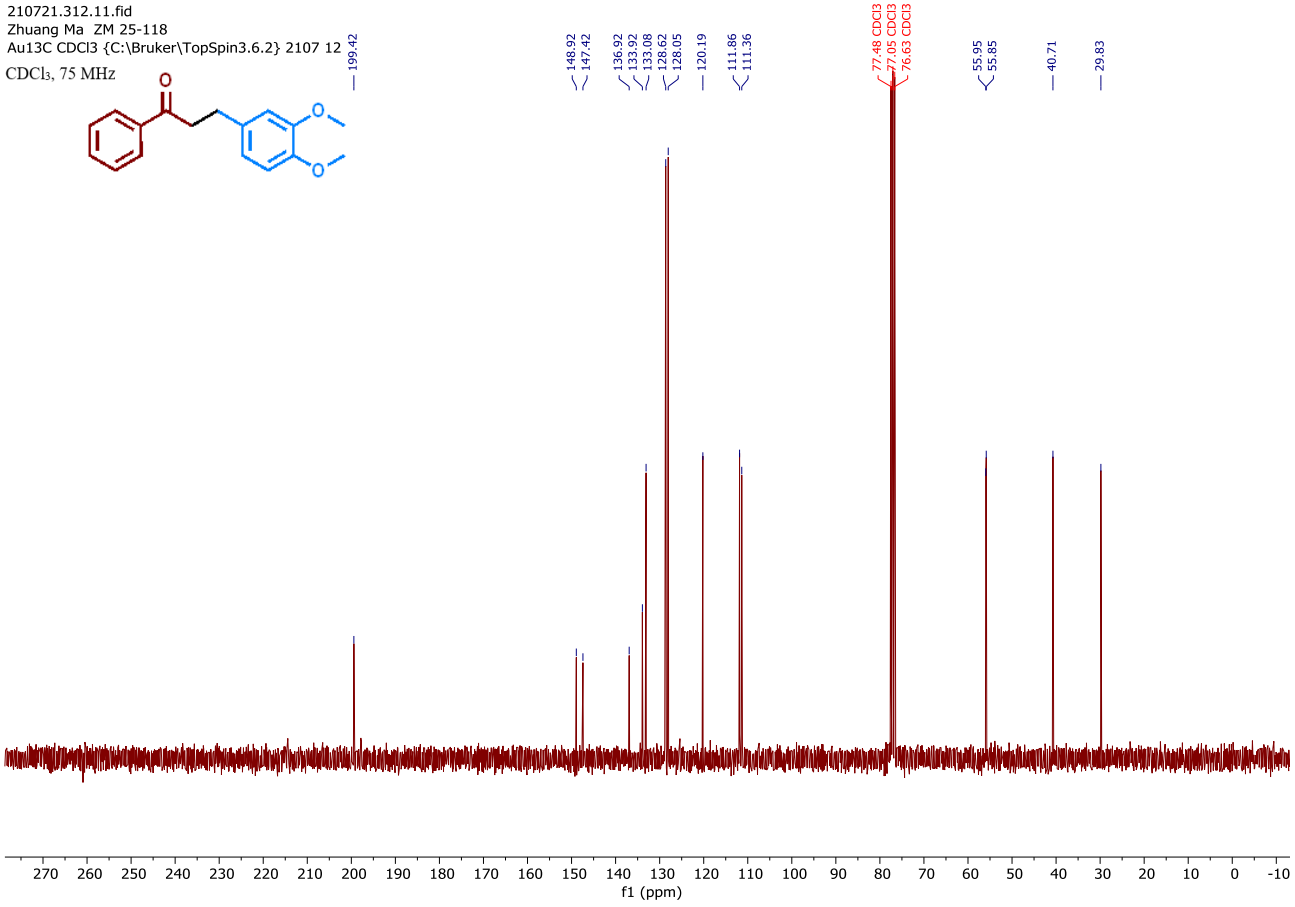
977

978

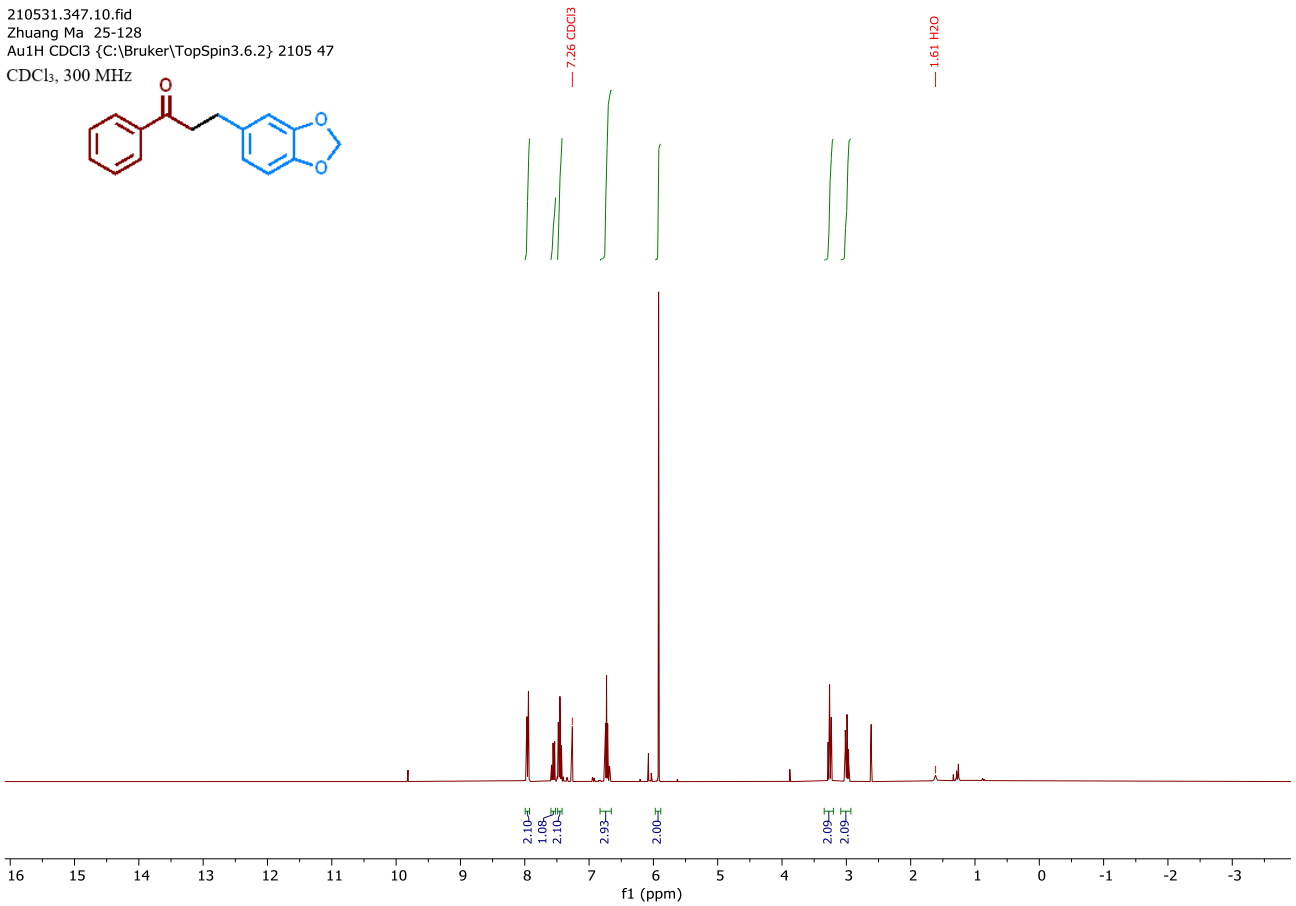

210721.312.10.fid
Zhuang Ma ZM 25-118
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 12
CDCl3, 300 MHz
7.26 CDCl3
1.66 H2O
1.96
1.00
1.97
2.99
6.00
2.00
2.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

979

980

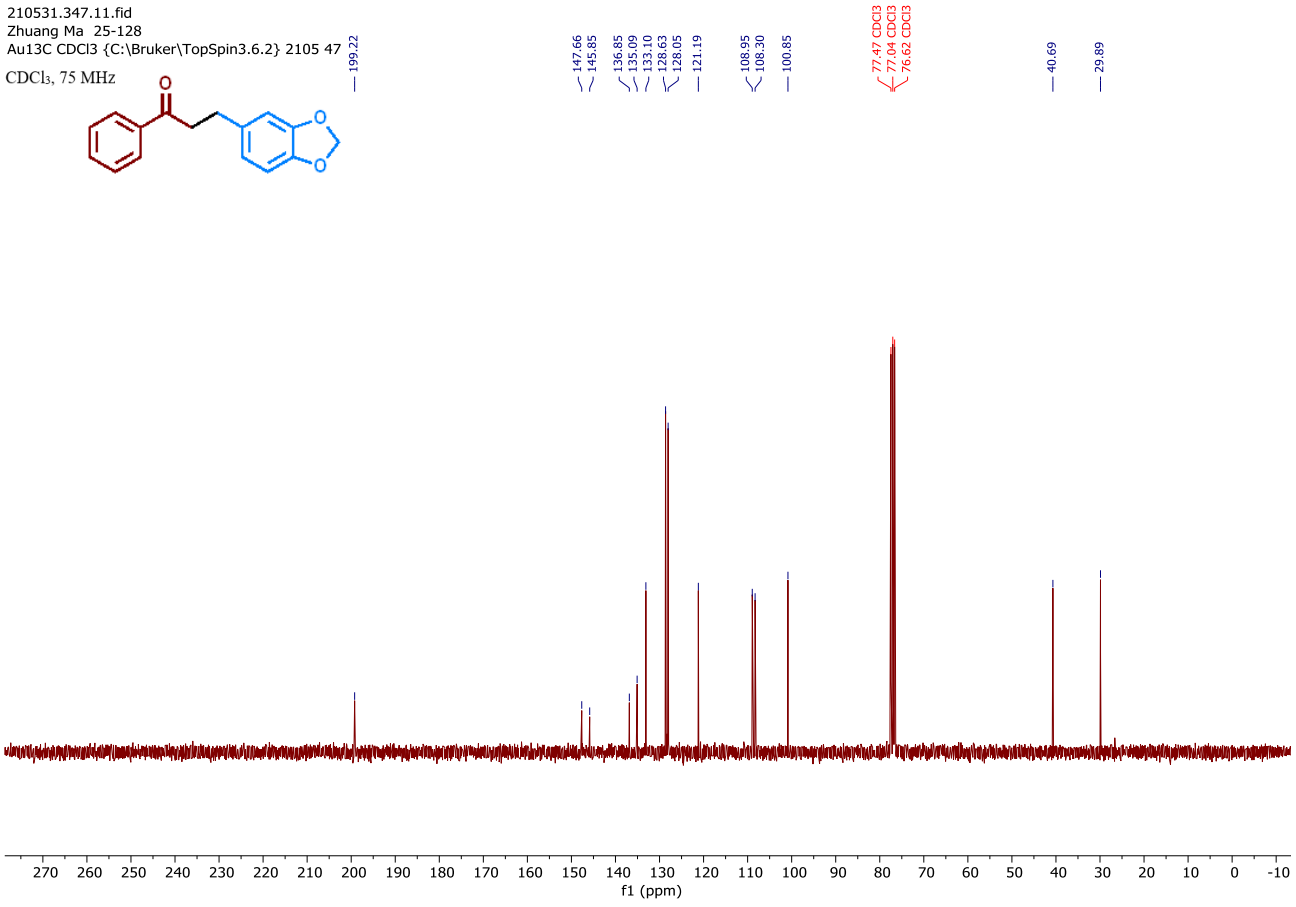

210721.312.11.fid
Zhuang Ma ZM 25-118
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 12
CDCl3, 75 MHz
199.42
148.92
147.42
136.92
133.92
133.08
128.62
128.05
120.19
111.86
111.36
77.48 CDCl3
77.05 CDCl3
76.63 CDCl3
55.95
55.85
40.71
29.83
270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

981

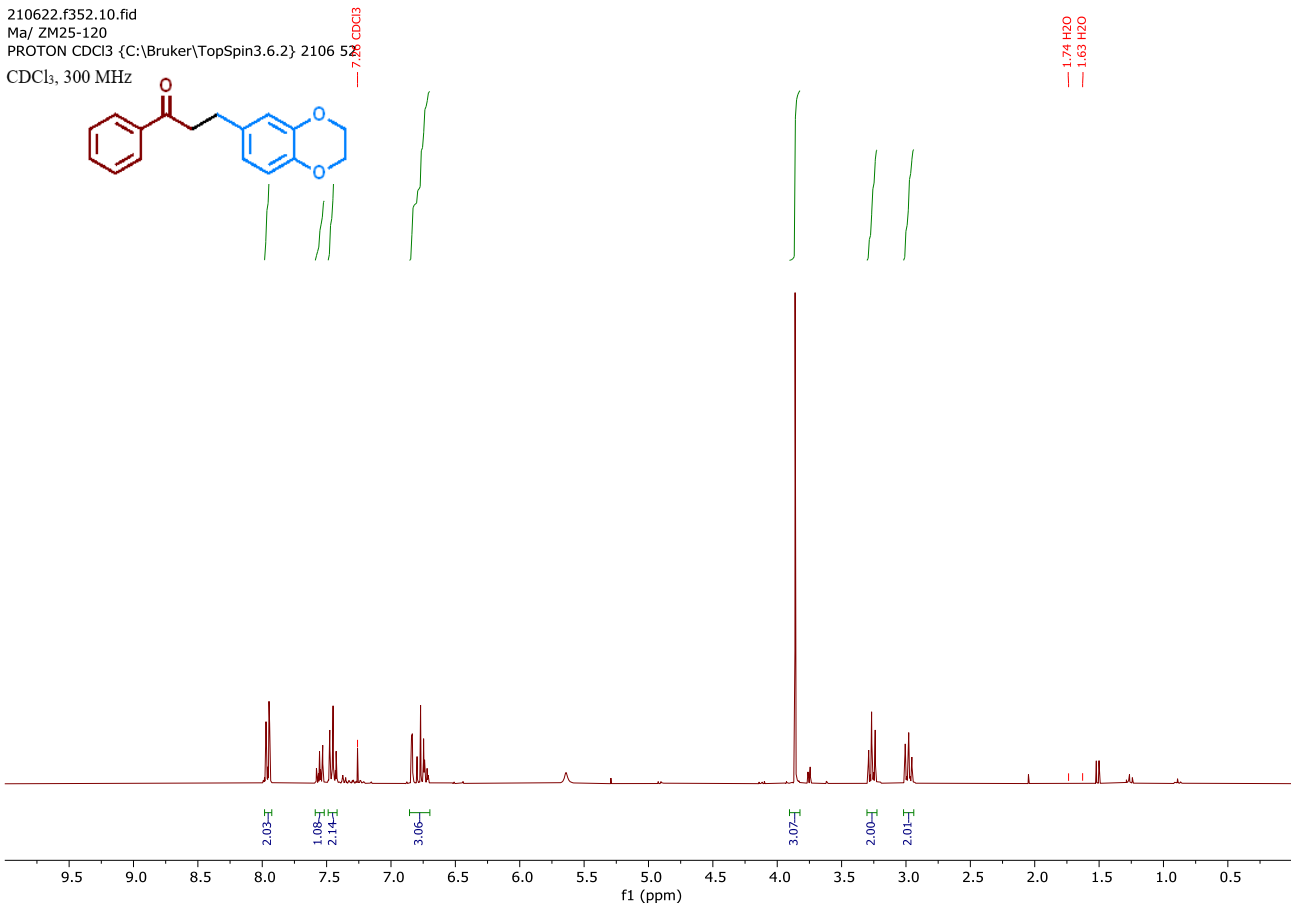

210531.347.10.fid
Zhuang Ma 25-128
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 47
CDCl3, 300 MHz
7.26 CDCl3
1.61 H2O
2.10
1.08
2.10
2.93
2.00
2.09
2.09
f1 (ppm)

982

983

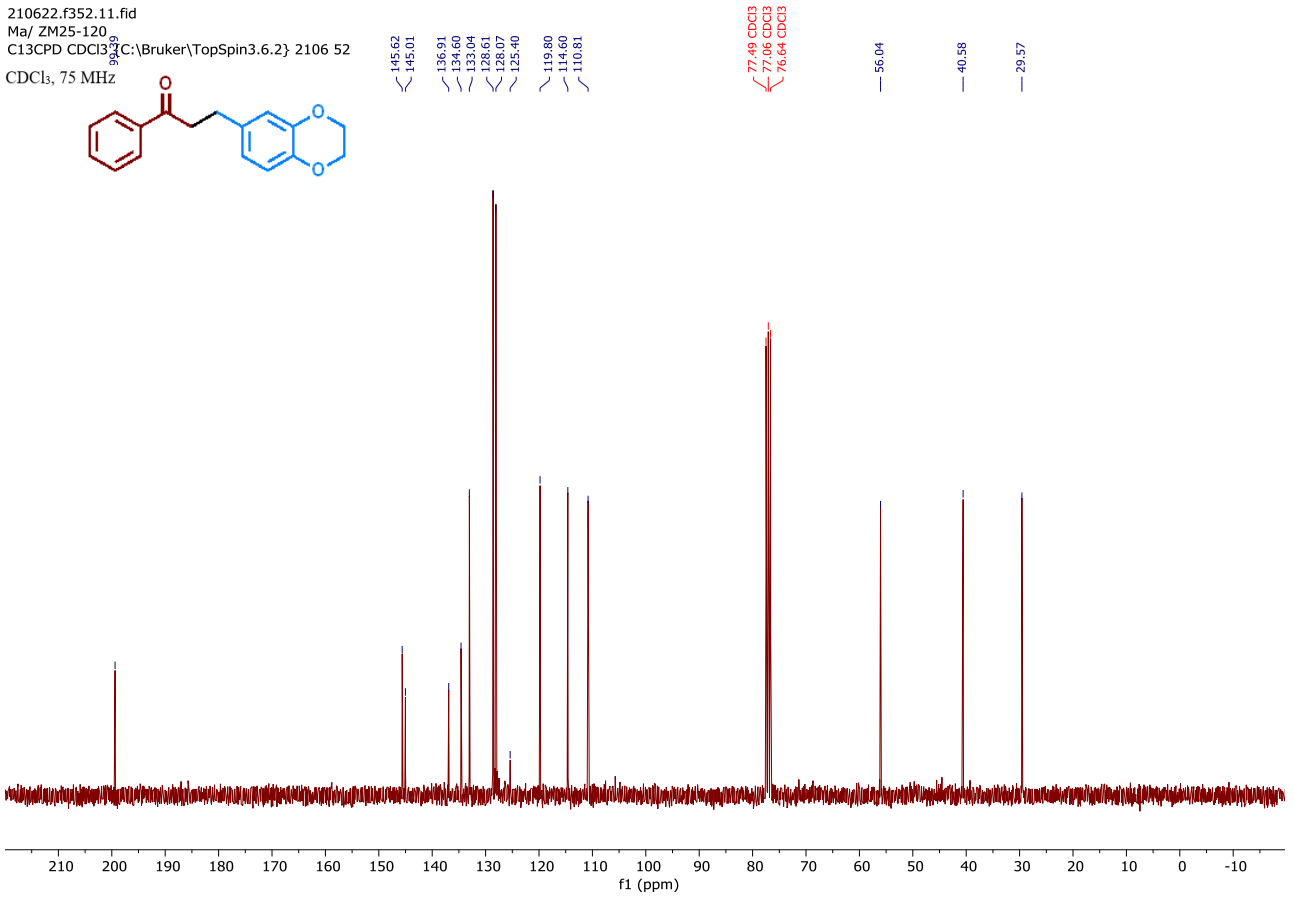

210531.347.11.fid
Zhuang Ma 25-128
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 47
CDCl3, 75 MHz
199.22
147.66
145.85
136.85
135.09
133.10
128.63
128.05
121.19
108.95
108.30
100.85
77.47 CDCl3
77.04 CDCl3
76.62 CDCl3
40.69
29.89
f1 (ppm)

984

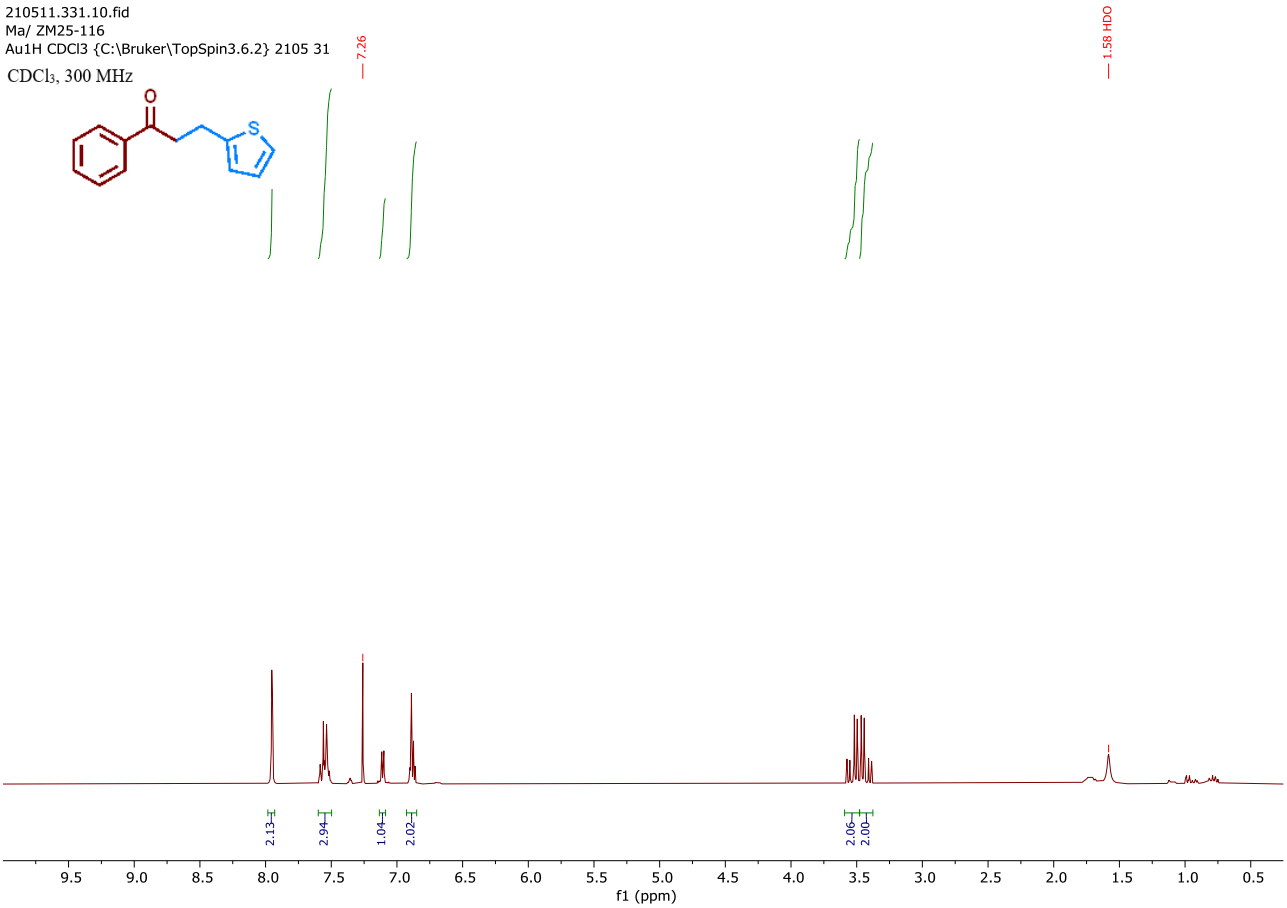

210622.f352.10.fid
Ma/ ZM25-120
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 52
CDCl3, 300 MHz
7.26 CDCl3
1.74 H2O
1.63 H2O
2.03
1.08
2.14
3.06
3.07
2.00
2.01
f1 (ppm)

985

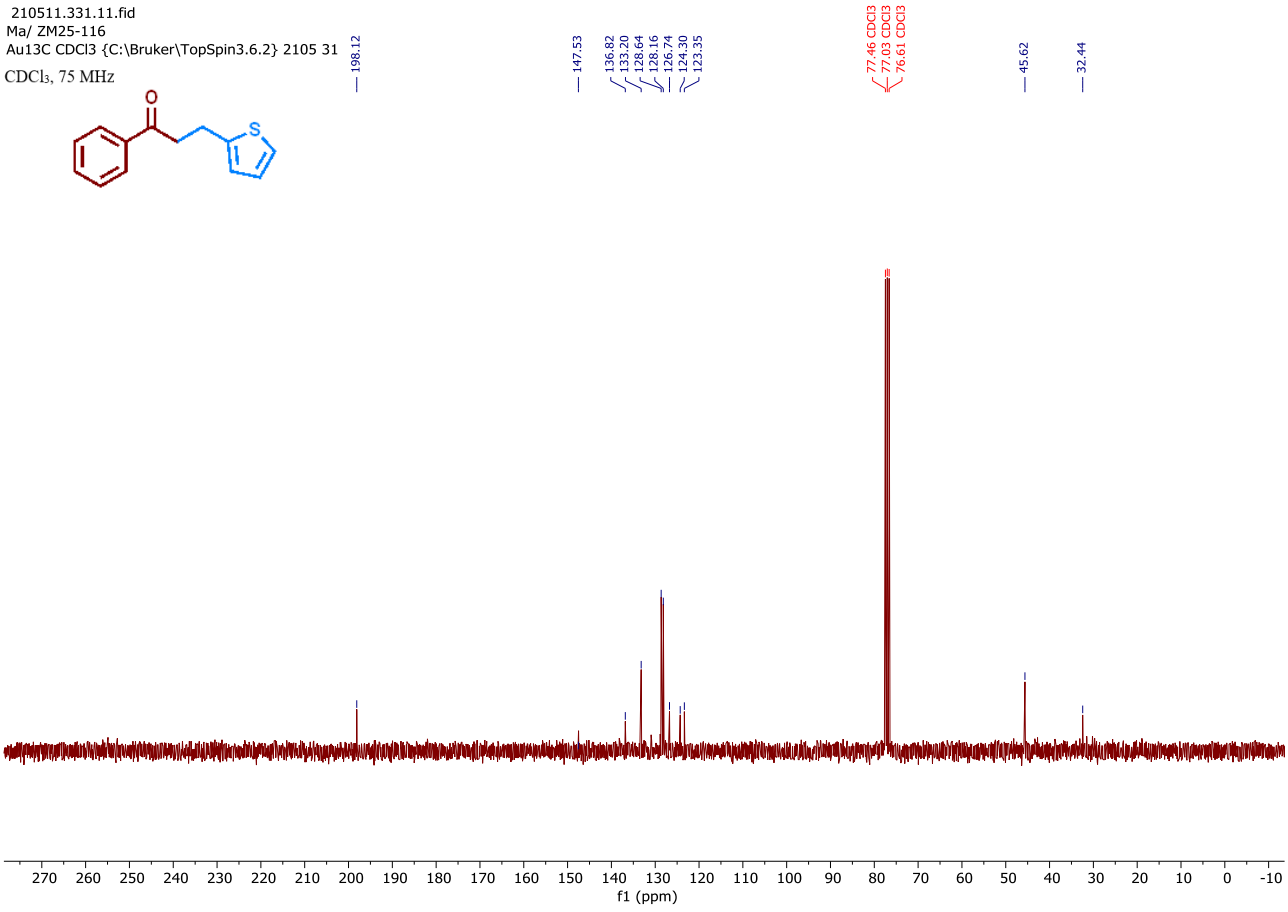
986


210622.f352.11.fid
Ma/ ZM25-120
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 52
CDCl3, 75 MHz
145.62
145.01
136.91
134.60
133.04
128.61
128.07
125.40
119.80
114.60
110.81
77.49 CDCl3
77.06 CDCl3
76.64 CDCl3
56.04
40.58
29.57
f1 (ppm)

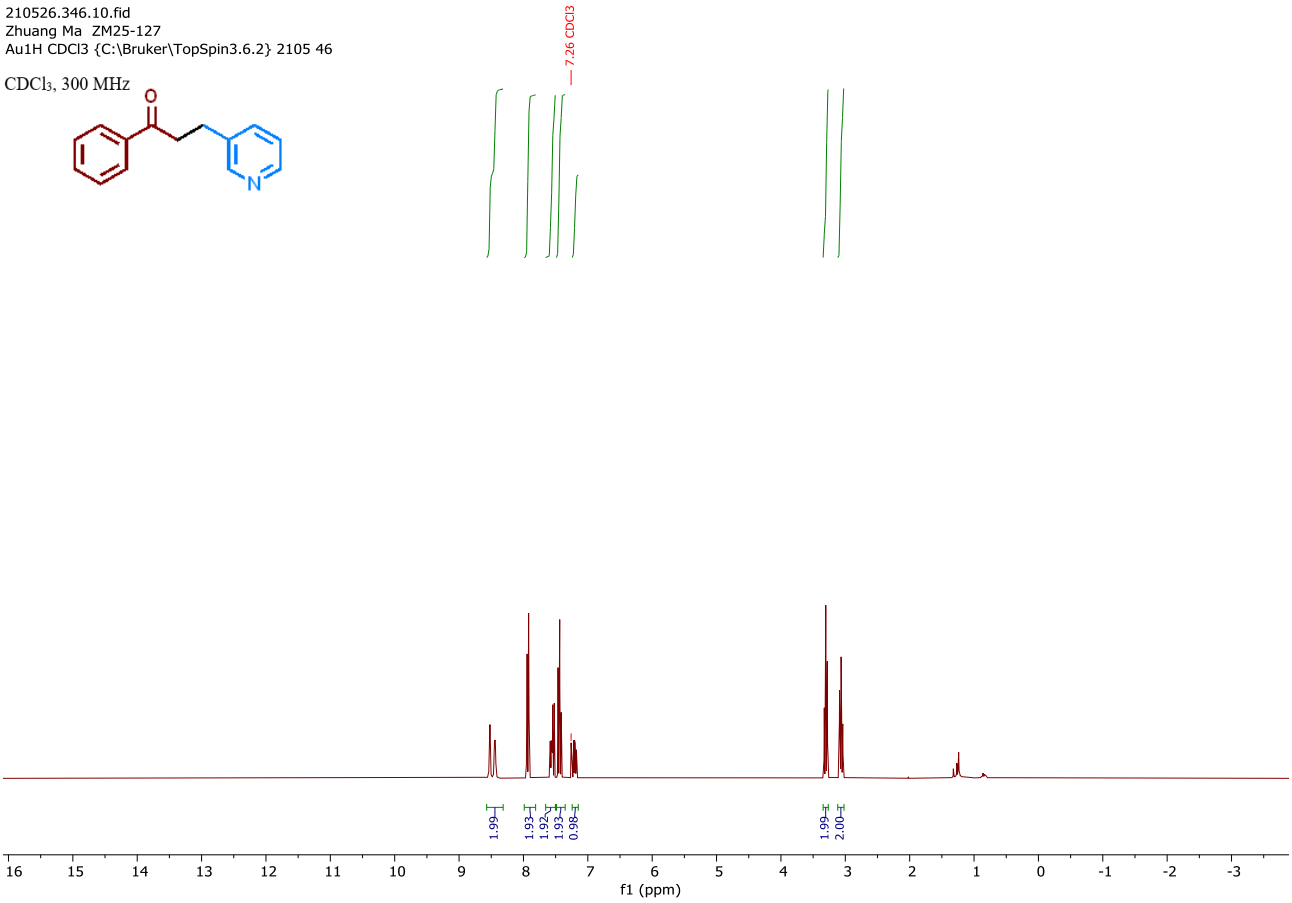
987


210511.331.10.fid
Ma/ ZM25-116
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 31
CDCl3, 300 MHz
7.26
1.58 HDO
2.13
2.94
1.04
2.02
2.06
2.00
f1 (ppm)

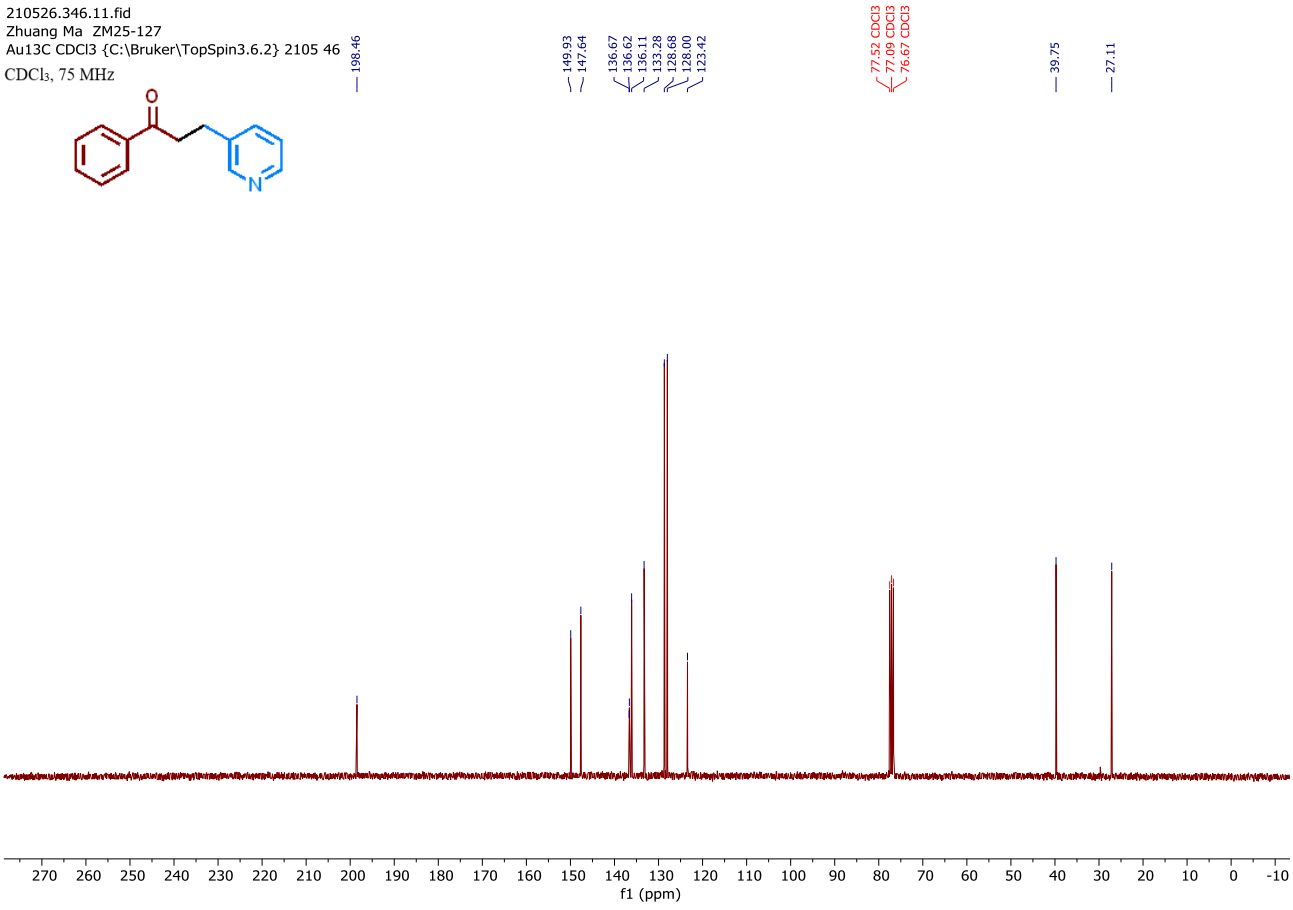
988


210511.331.11.fid
Ma/ ZM25-116
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 31
CDCl3, 75 MHz
198.12
147.53
136.82
133.20
128.64
128.16
126.74
124.30
123.35
77.46 CDCl3
77.03 CDCl3
76.61 CDCl3
45.62
32.44
f1 (ppm)

989

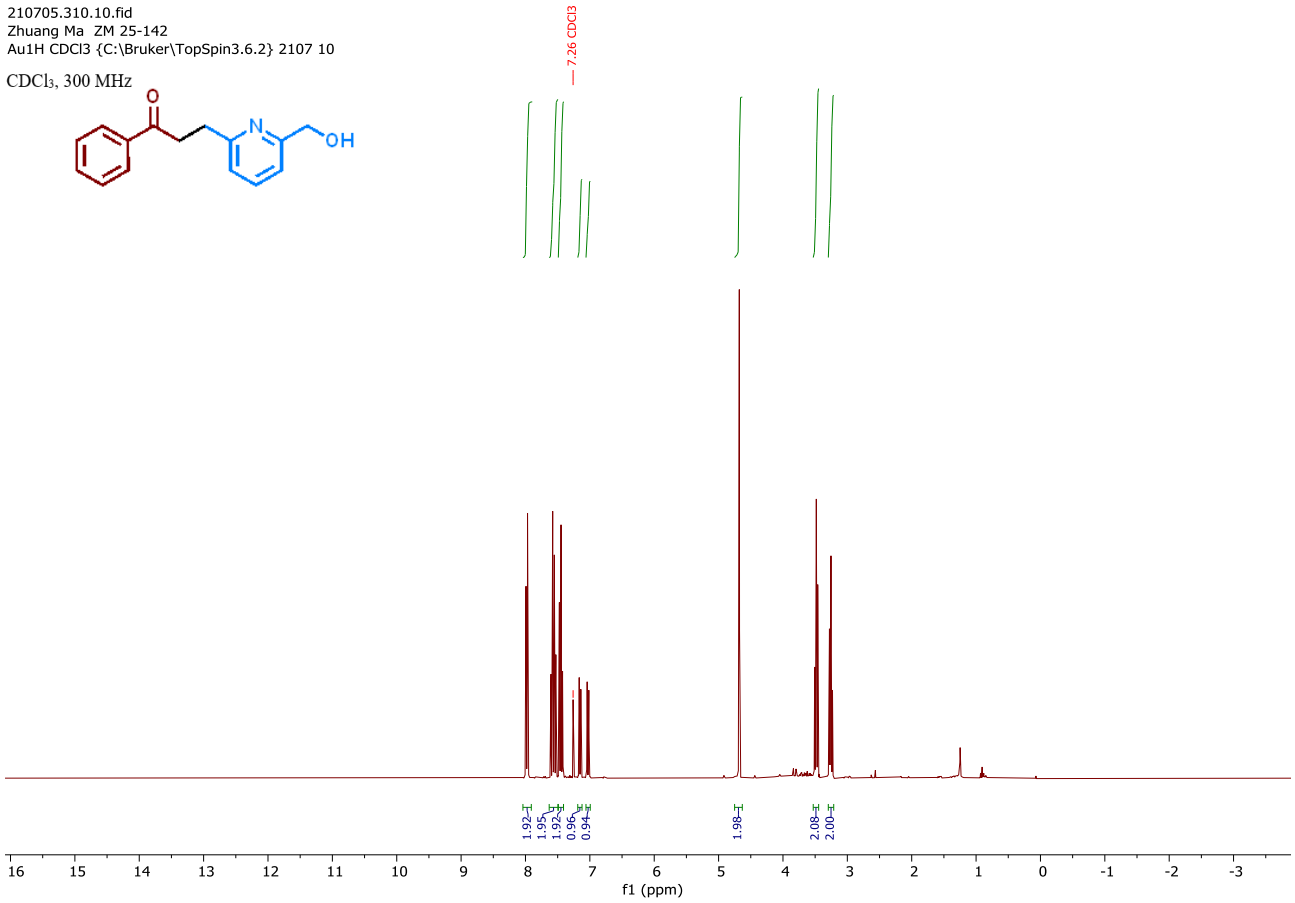

210526.346.10.fid
Zhuang Ma ZM25-127
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 46
CDCl3, 300 MHz
7.26 CDCl3
1.99
1.93
1.92
1.93
0.98
1.99
2.00
f1 (ppm)

990

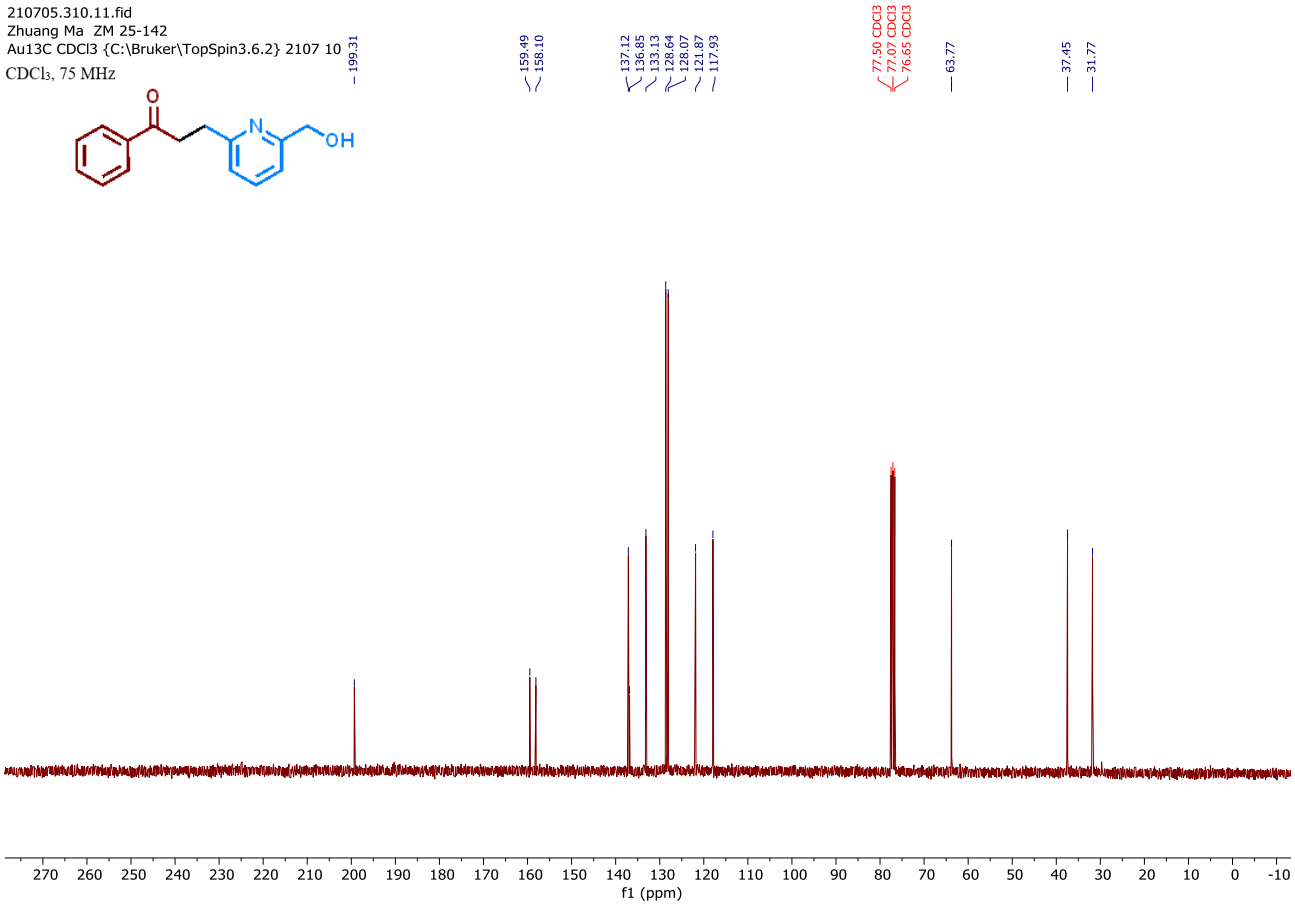

210526.346.11.fid
Zhuang Ma ZM25-127
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 46
CDCl3, 75 MHz
198.46
149.93
147.64
136.67
136.62
136.11
133.28
128.68
128.00
123.42
77.52 CDCl3
77.09 CDCl3
76.67 CDCl3
39.75
27.11
f1 (ppm)

991

992

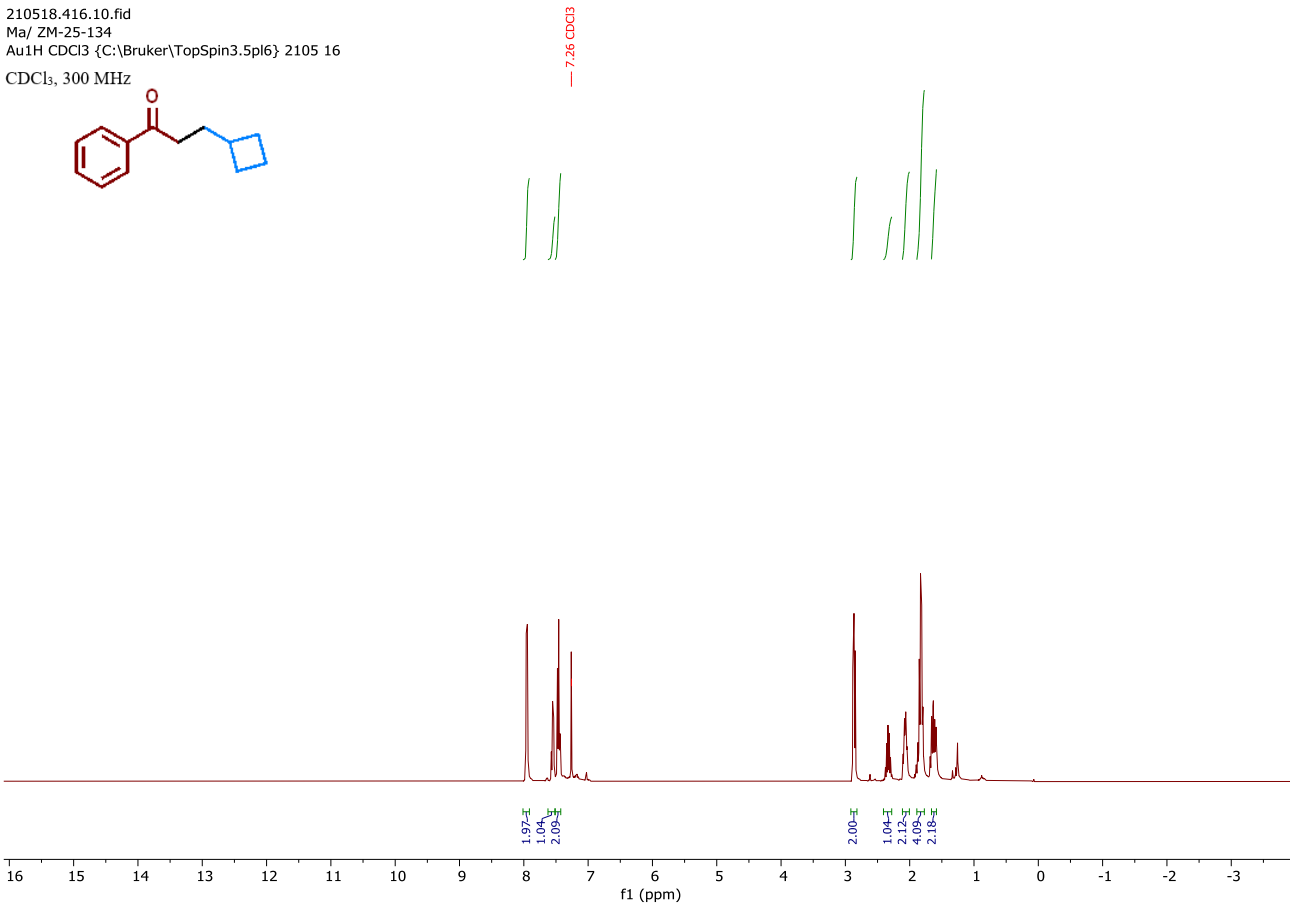

210705.310.10.fid
Zhuang Ma ZM 25-142
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 10
CDCl3, 300 MHz
7.26 CDCl3
1.92
1.95
1.92
0.96
0.94
1.98
2.08
2.00
f1 (ppm)

993


210705.310.11.fid
Zhuang Ma ZM 25-142
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 10
CDCl3, 75 MHz
199.31
159.49
158.10
137.12
136.85
133.13
128.64
128.07
121.87
117.93
77.50 CDCl3
77.07 CDCl3
76.65 CDCl3
63.77
37.45
31.77
f1 (ppm)

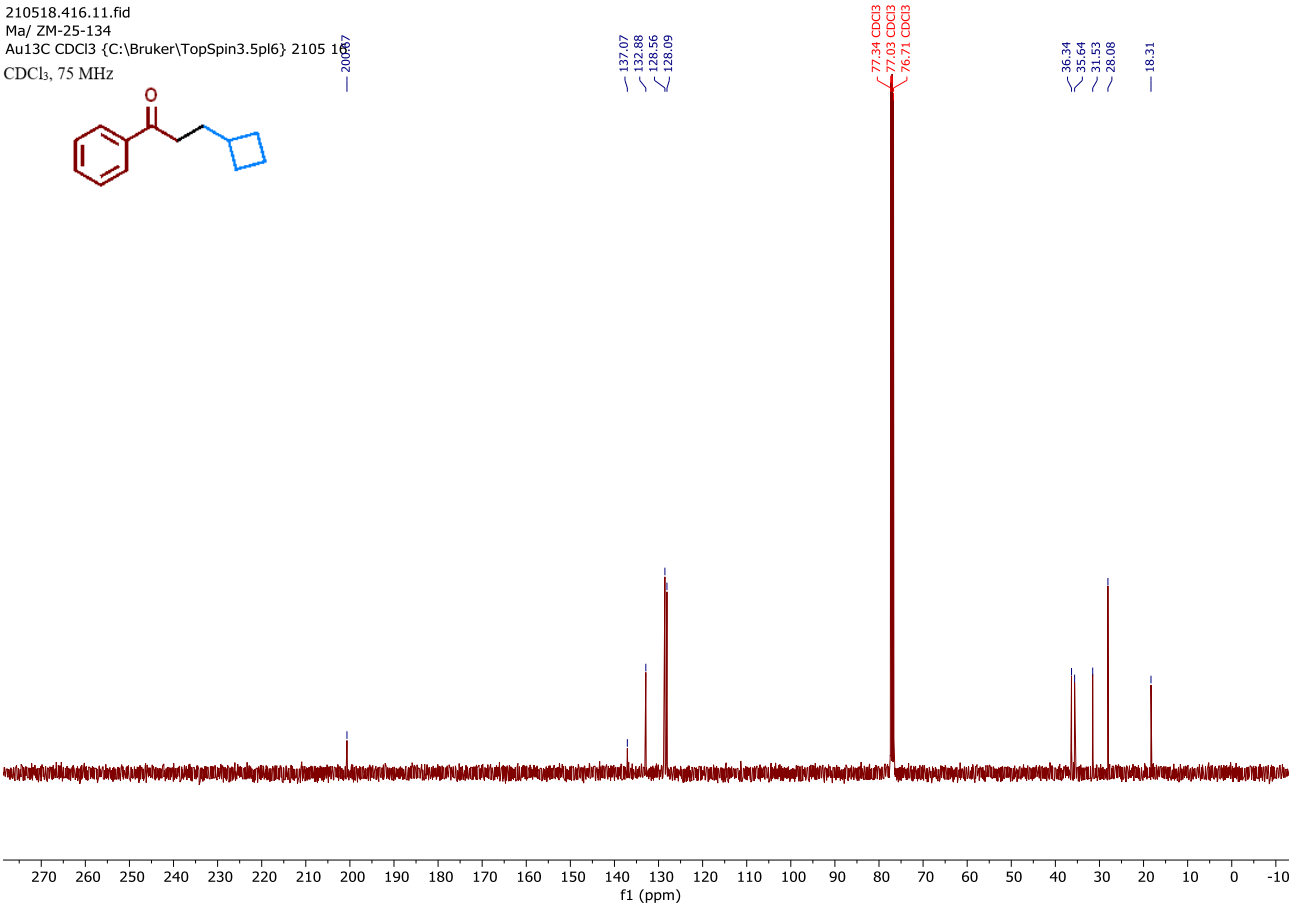
994

995

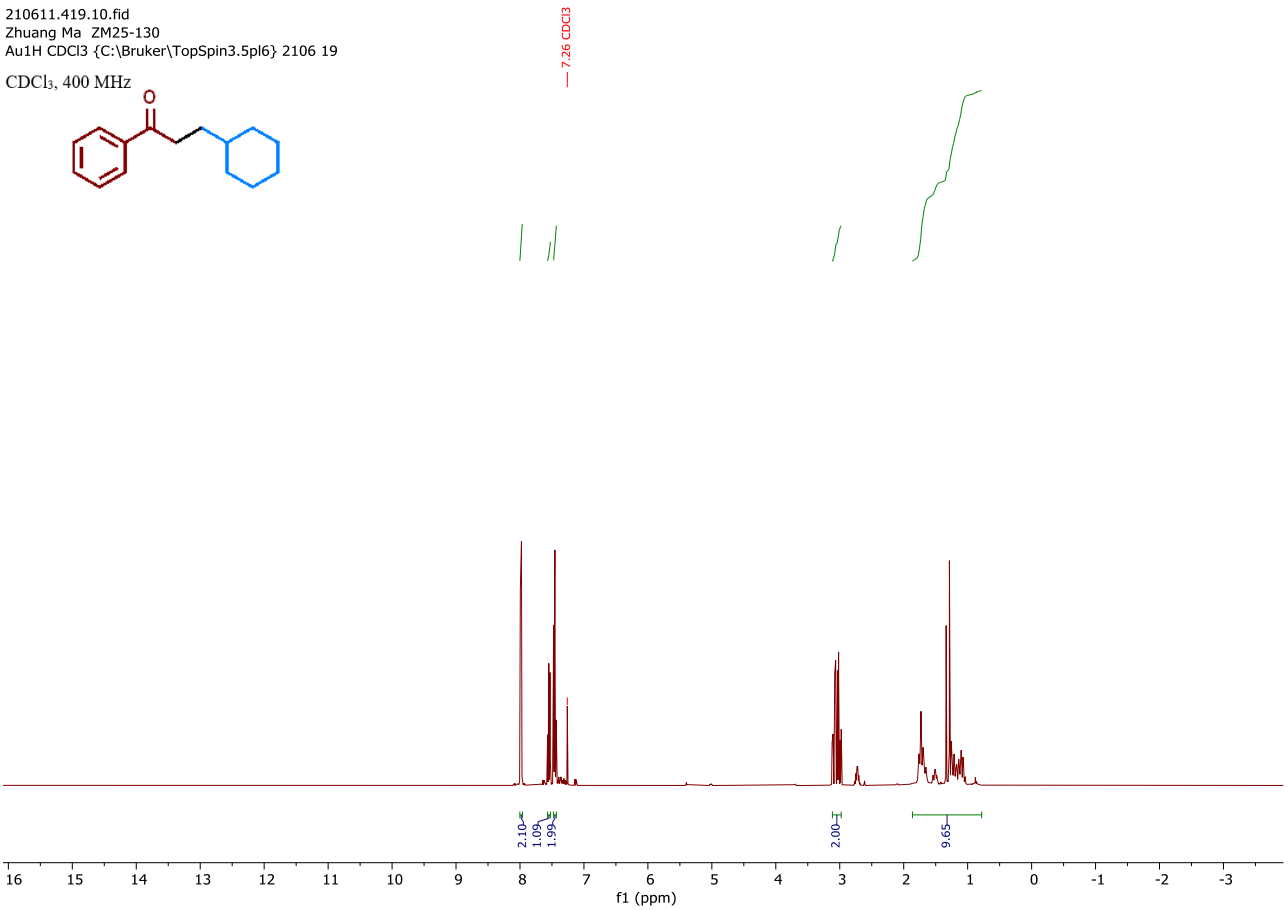

210518.416.10.fid
Ma/ ZM-25-134
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2105 16
CDCl3, 300 MHz
7.26 CDCl3
1.97
1.04
2.09
2.00
1.04
2.12
4.09
2.18
f1 (ppm)

996

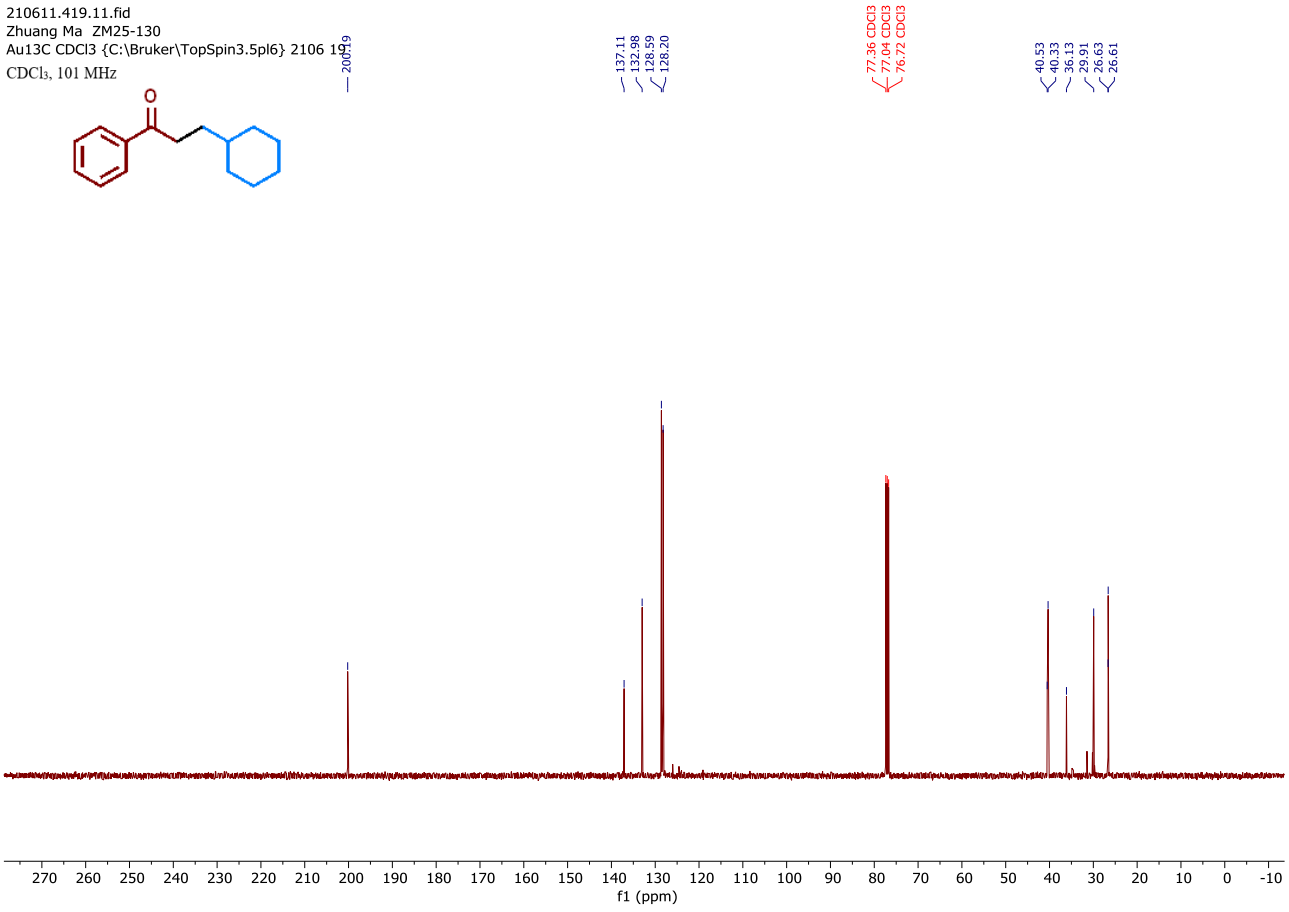
997


210518.416.11.fid
Ma/ ZM-25-134
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2105 16
CDCl3, 75 MHz
200.67
137.07
132.88
128.56
128.09
77.34 CDCl3
77.03 CDCl3
76.71 CDCl3
36.34
35.64
31.53
28.08
18.31
f1 (ppm)

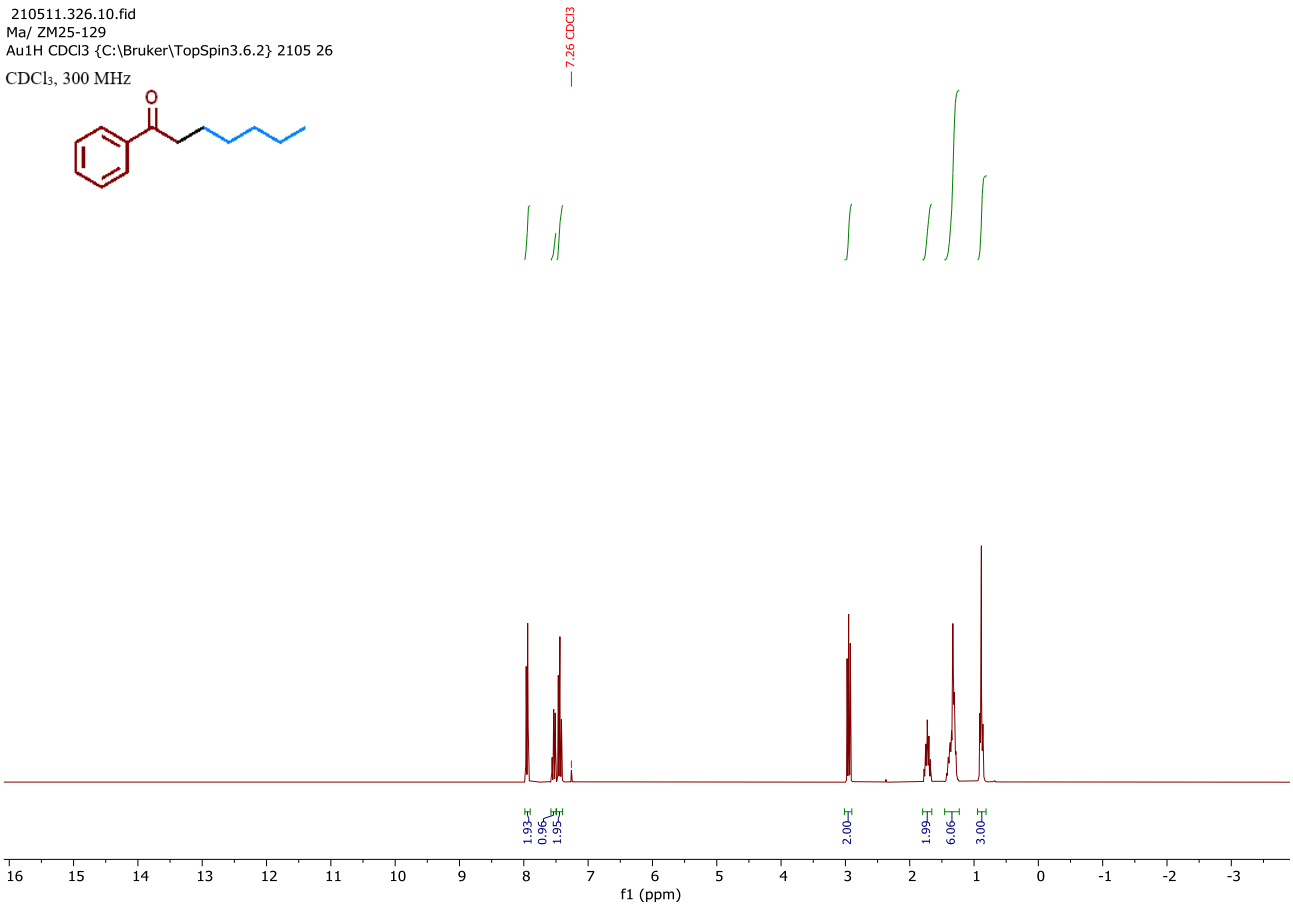
998


210611.419.10.fid
Zhuang Ma ZM25-130
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2106 19
CDCl3, 400 MHz
7.26 CDCl3
2.10
1.09
1.99
2.00
9.65
f1 (ppm)

999

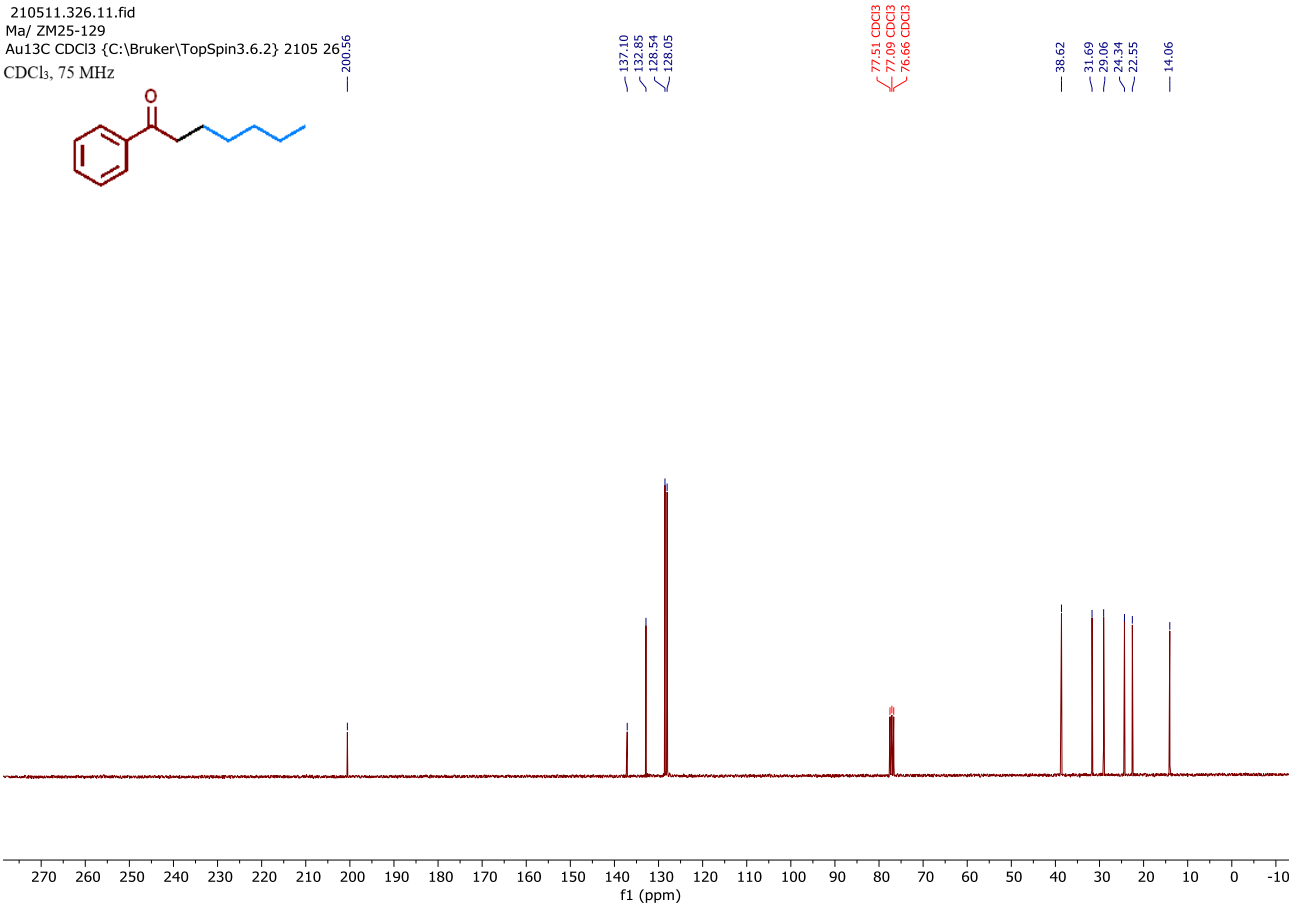

210611.419.11.fid
Zhuang Ma ZM25-130
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2106 19
CDCl3, 101 MHz
200.19
137.11
132.98
128.59
128.20
77.36 CDCl3
77.04 CDCl3
76.72 CDCl3
40.53
40.33
36.13
29.91
26.63
26.61
f1 (ppm)

1000



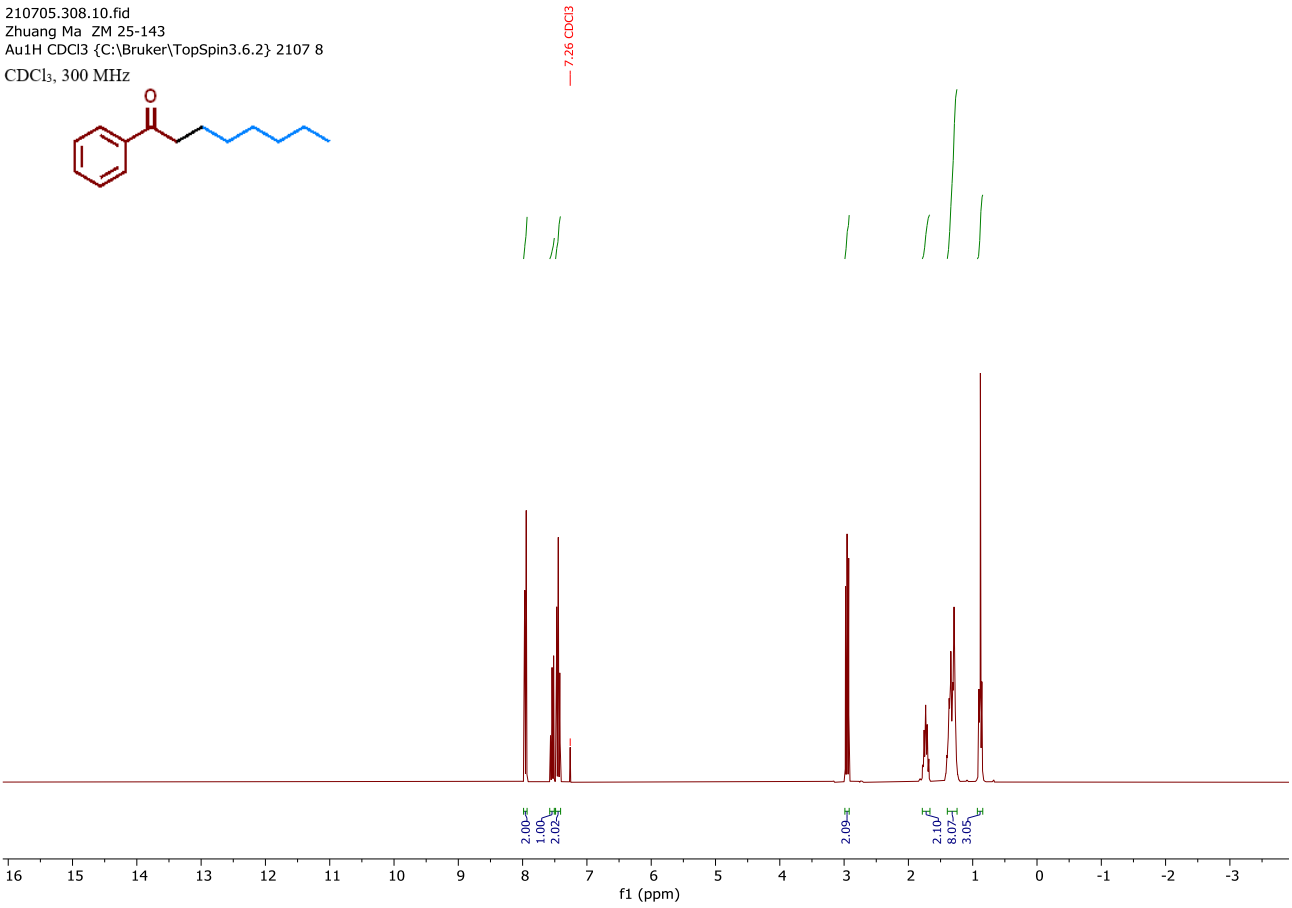
1001

1002

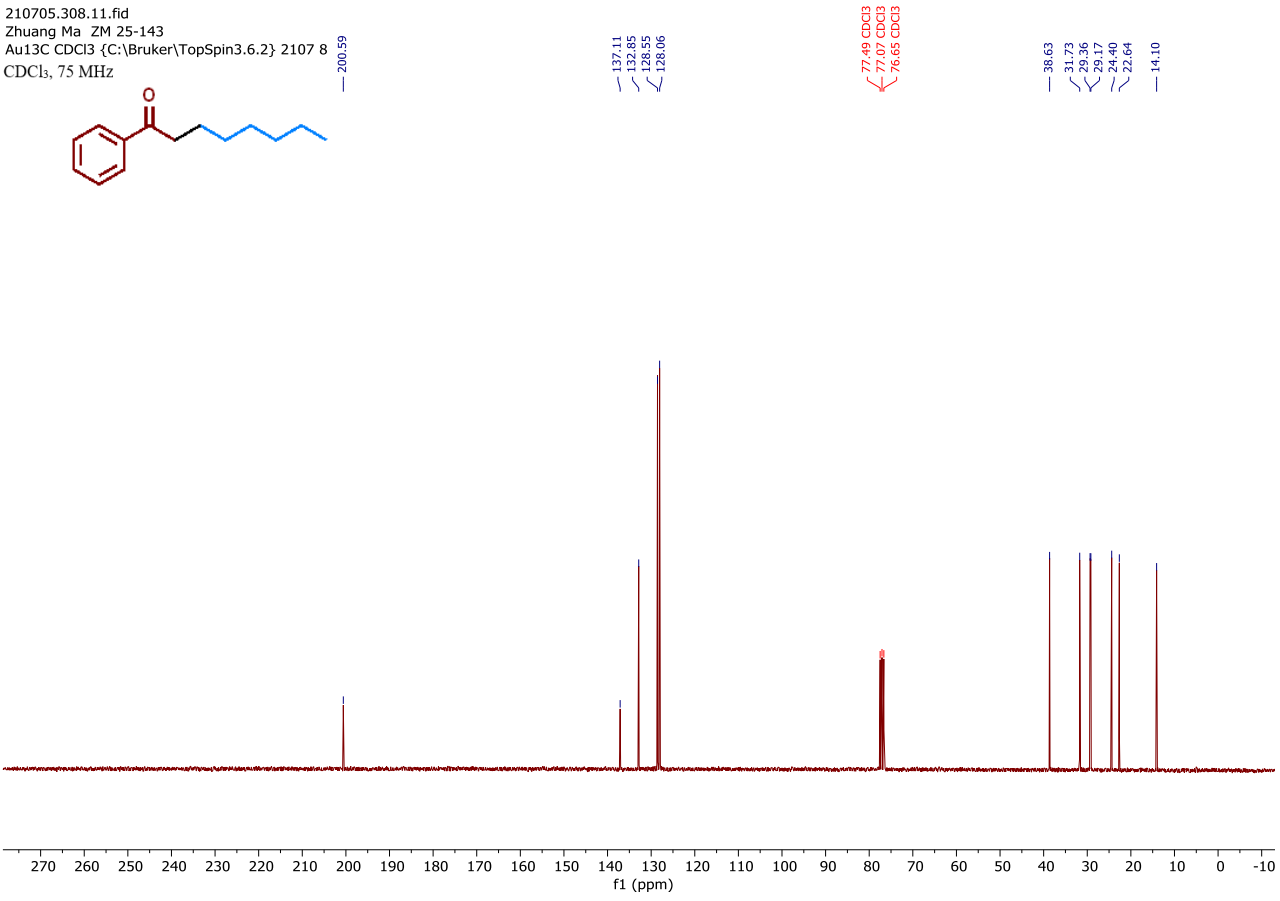


1003

1004

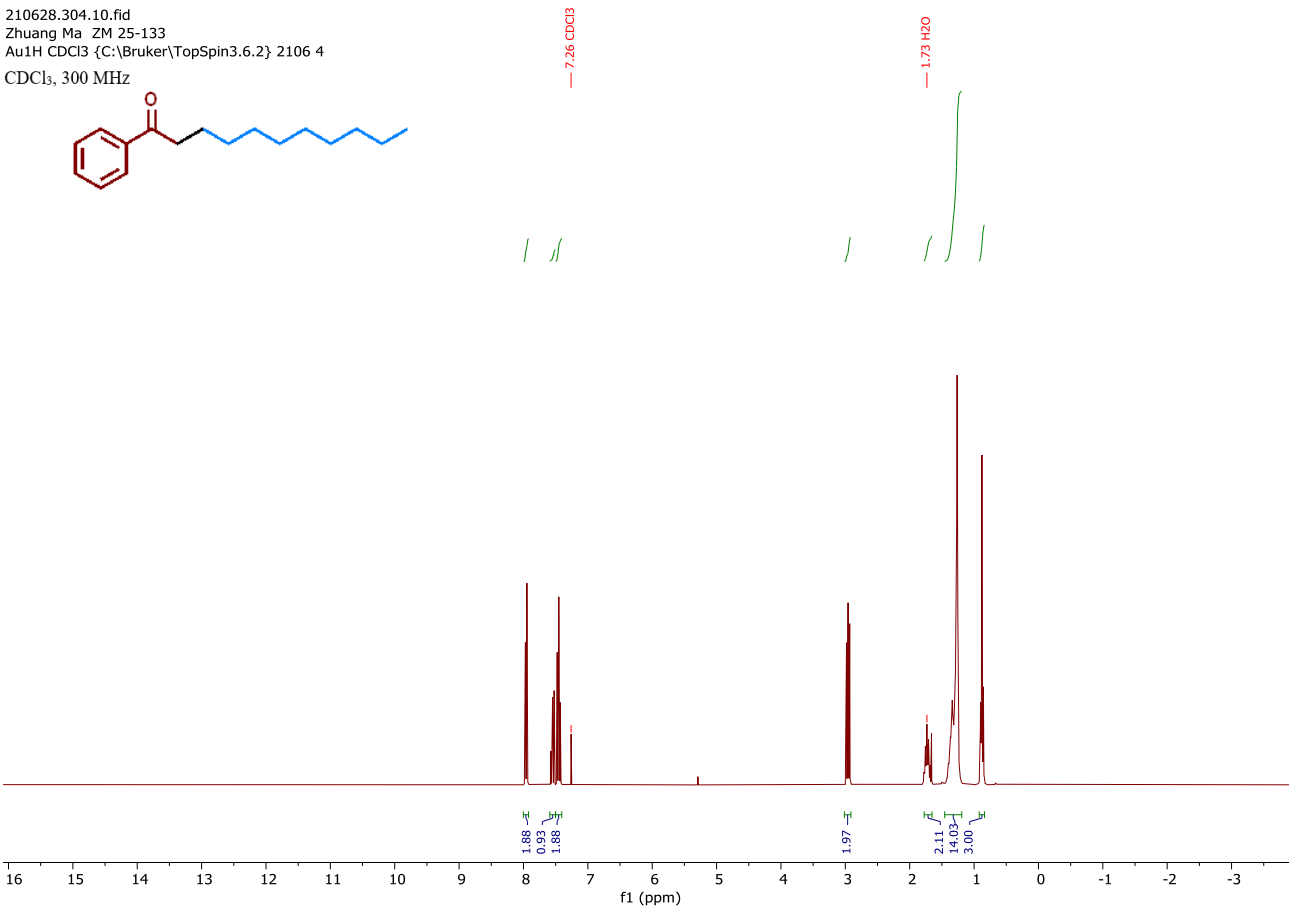


1005

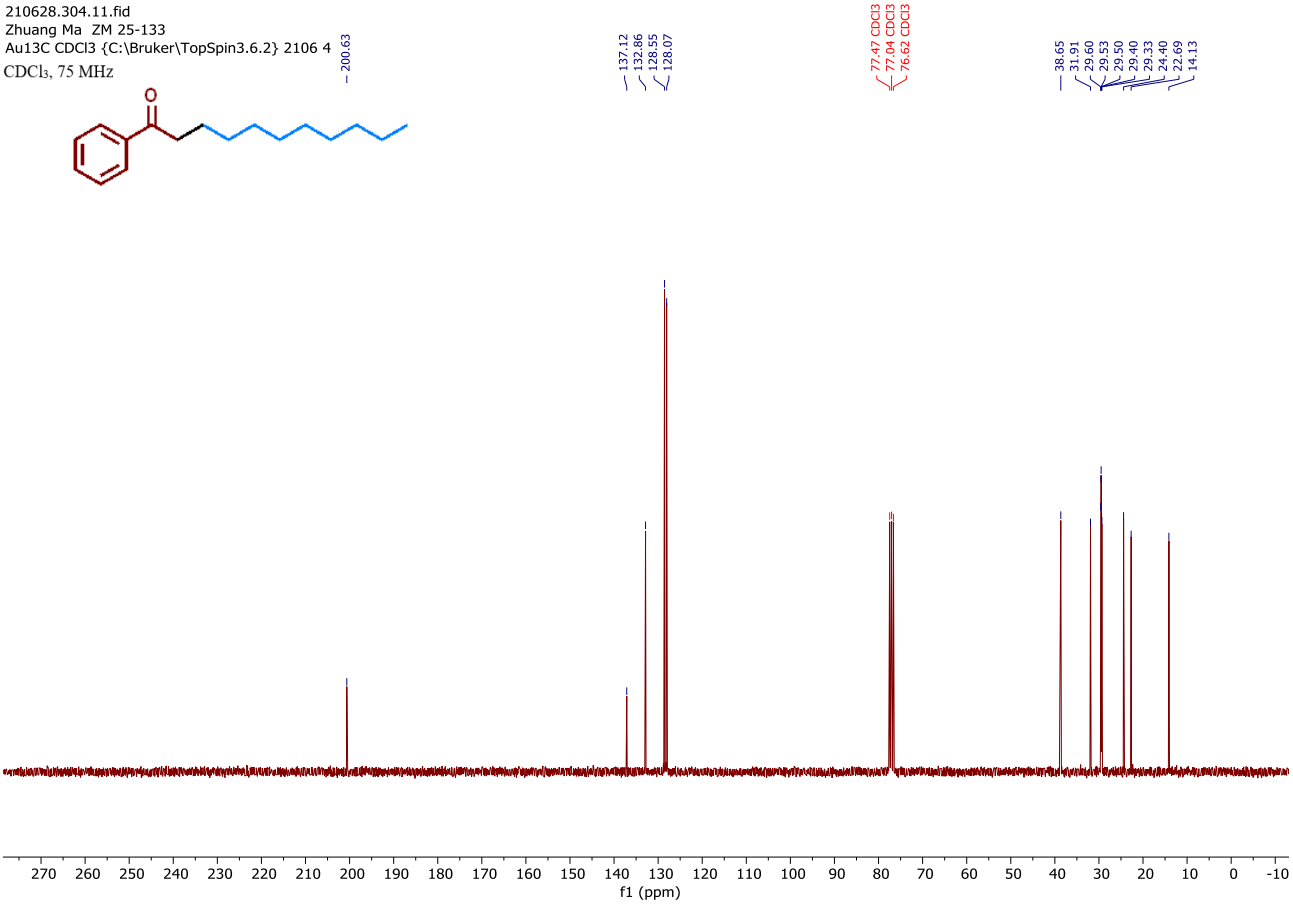


1006

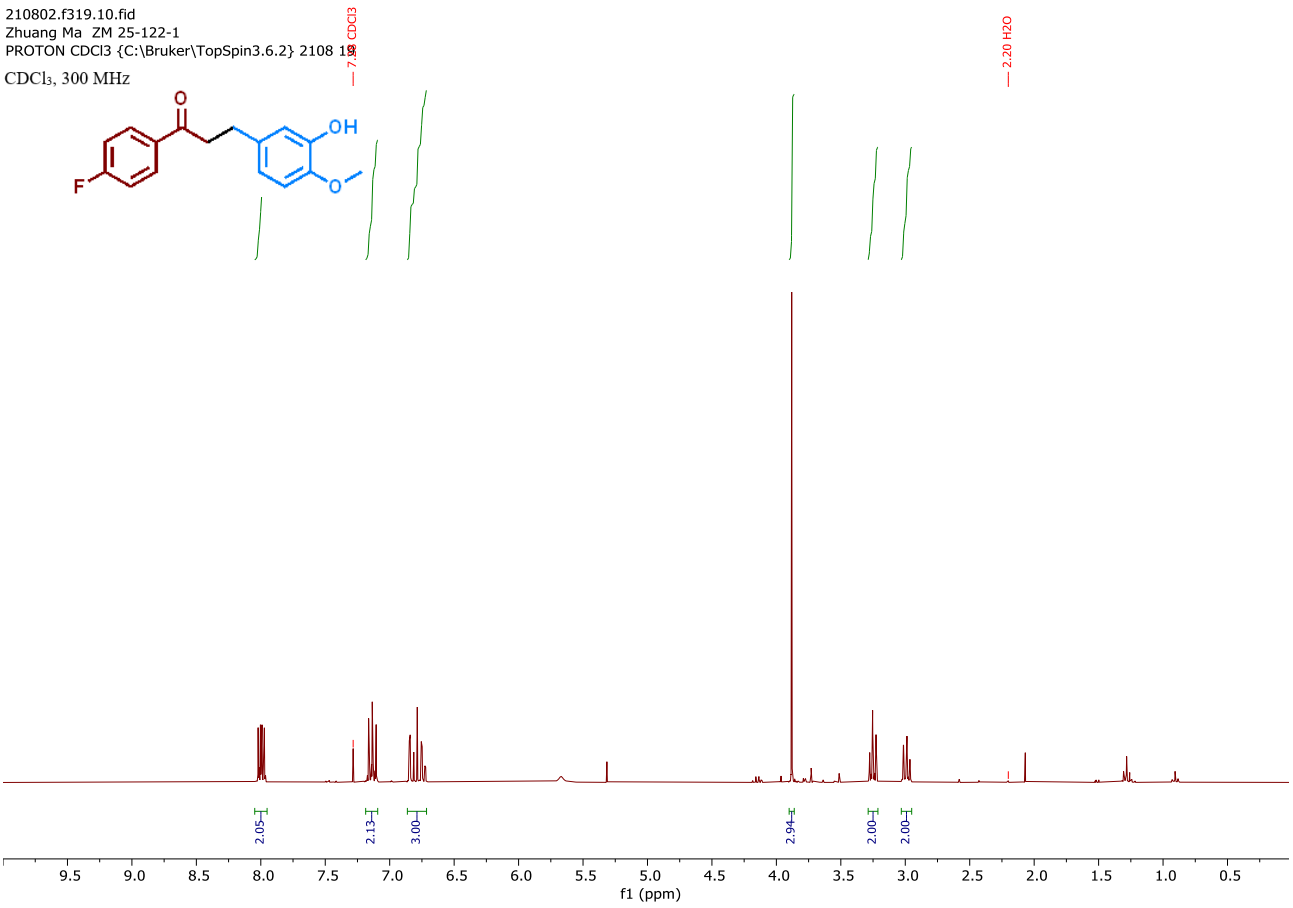
1007



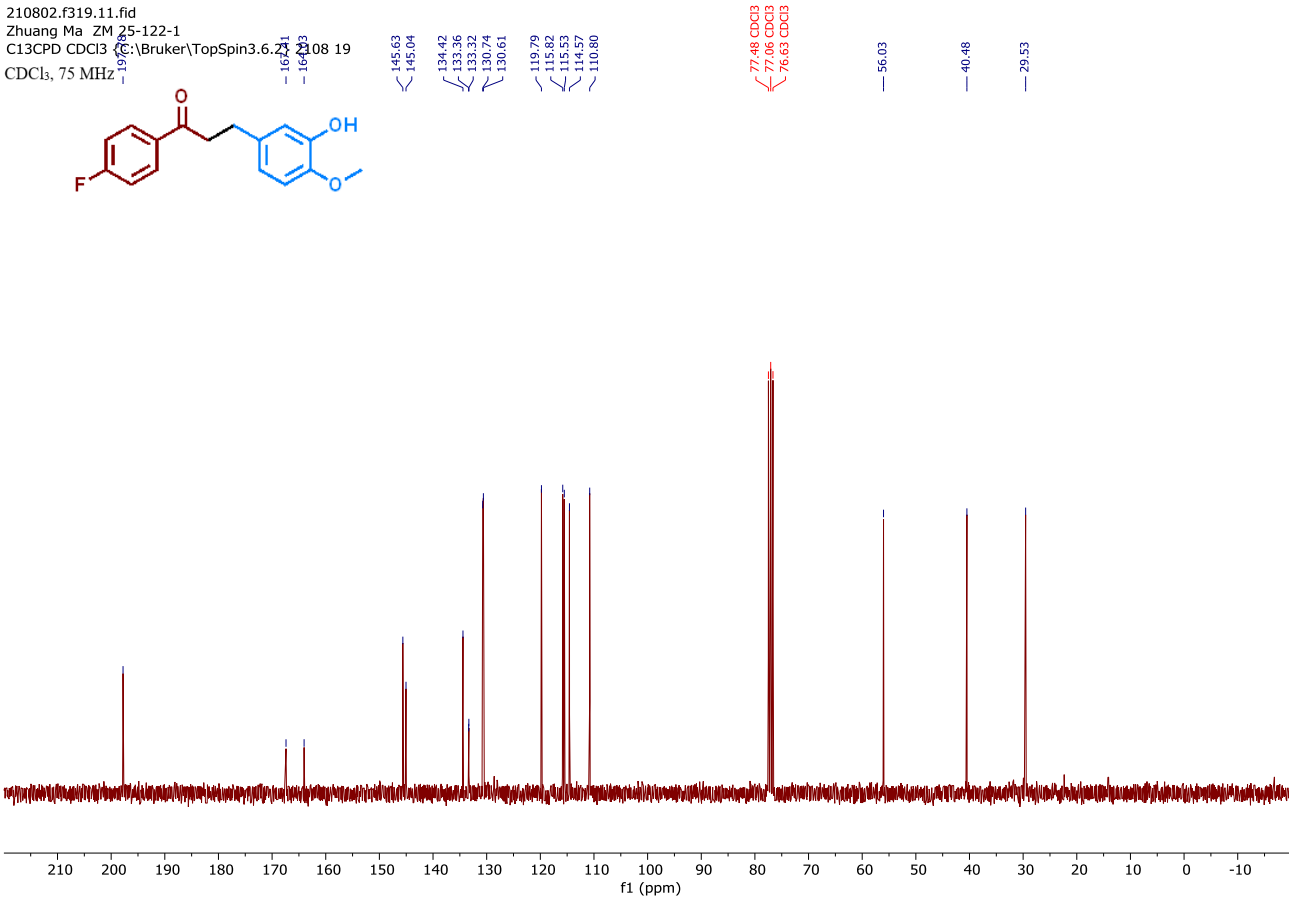
1008



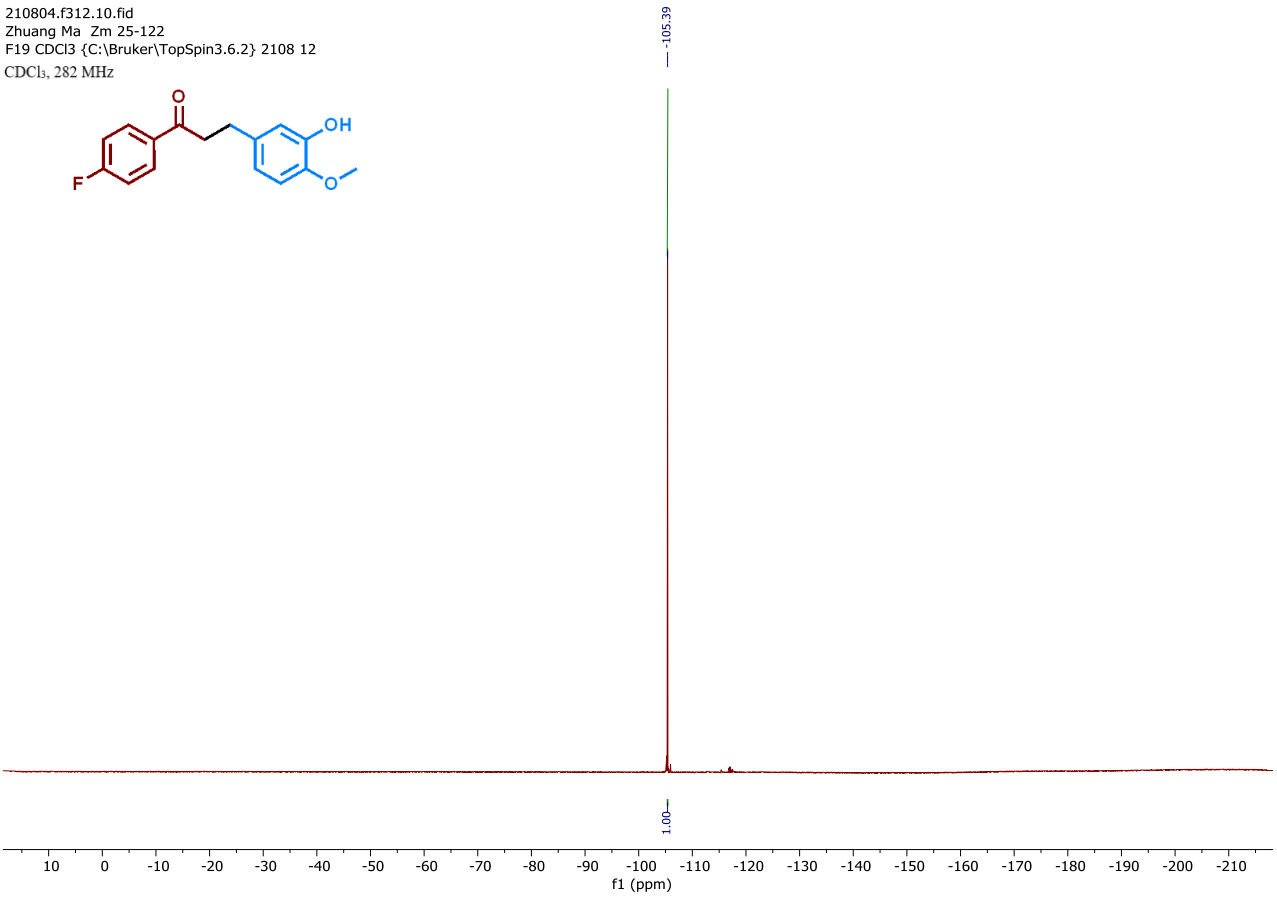
1009

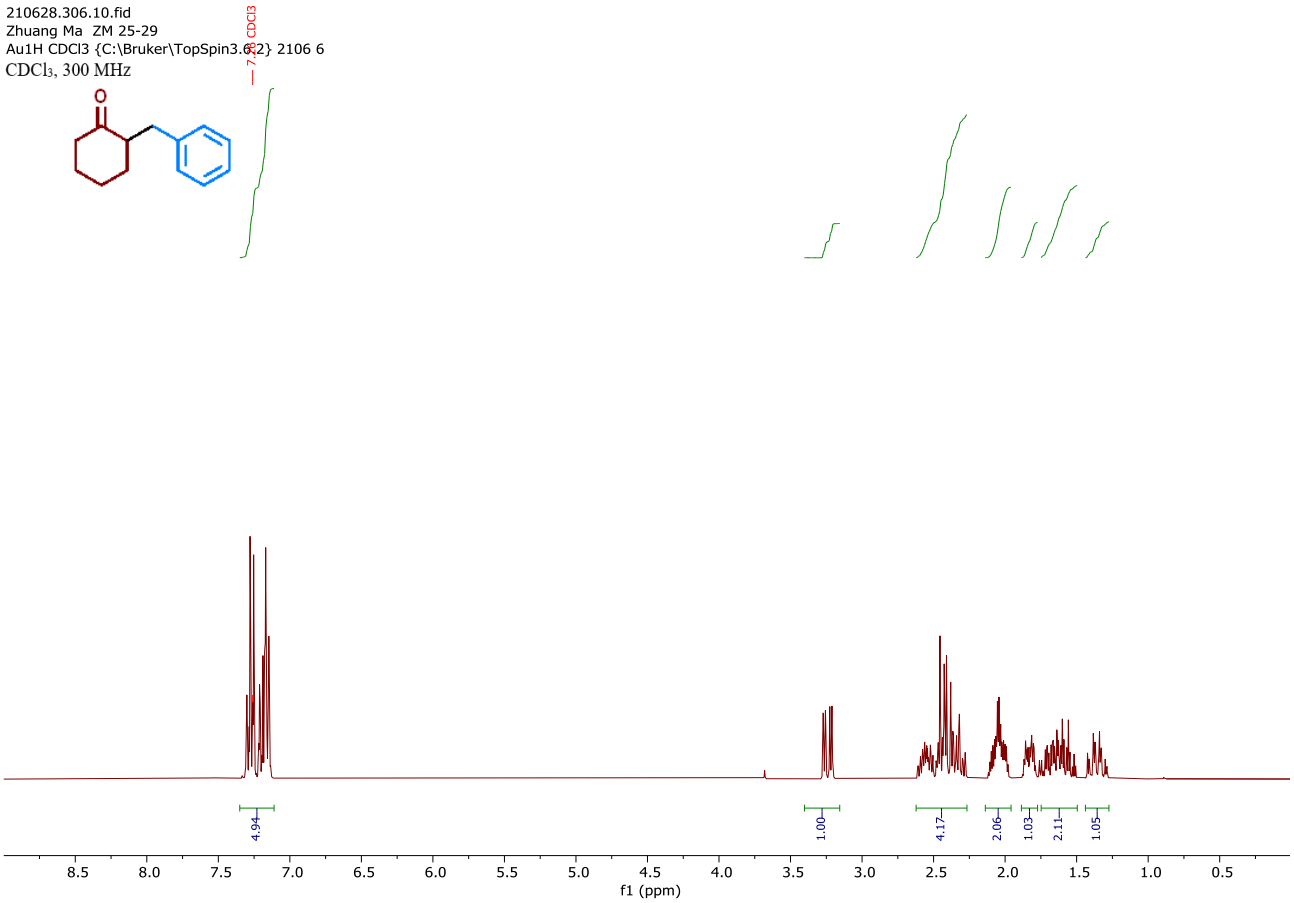

210802.f319.10.fid
Zhuang Ma ZM 25-122-1
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2108 19
CDCl3, 300 MHz
7.26 CDCl3
2.20 H2O
O
OH
F
O
2.05
2.13
3.00
2.94
2.00
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

1010

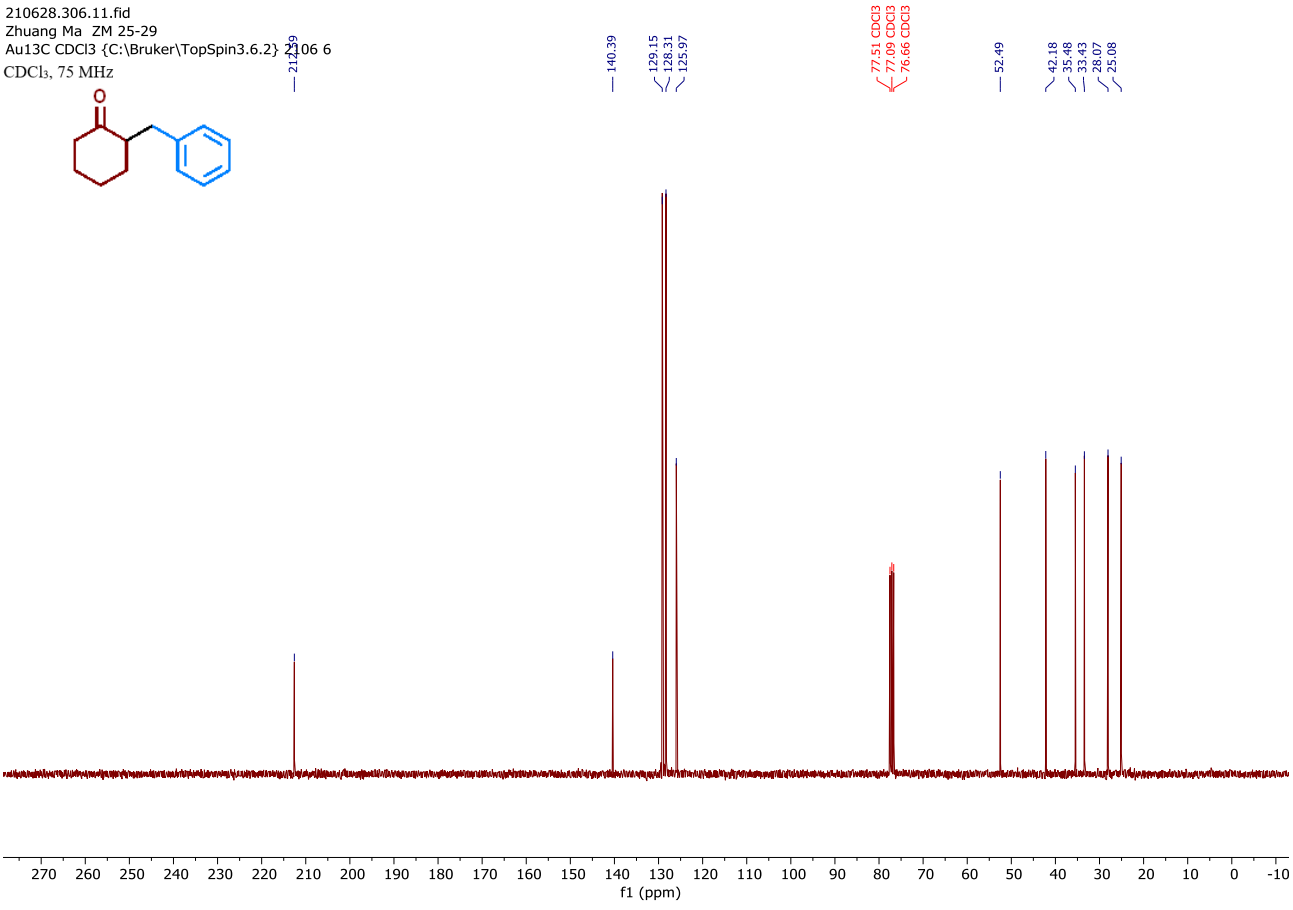

210802.f319.11.fid
Zhuang Ma ZM 25-122-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2108 19
CDCl3, 75 MHz
197.28
164.31
164.03
145.63
145.04
134.42
133.36
133.32
130.74
130.61
119.79
115.82
115.53
114.57
110.80
77.48 CDCl3
77.06 CDCl3
76.63 CDCl3
56.03
40.48
29.53
O
OH
F
O
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

1011

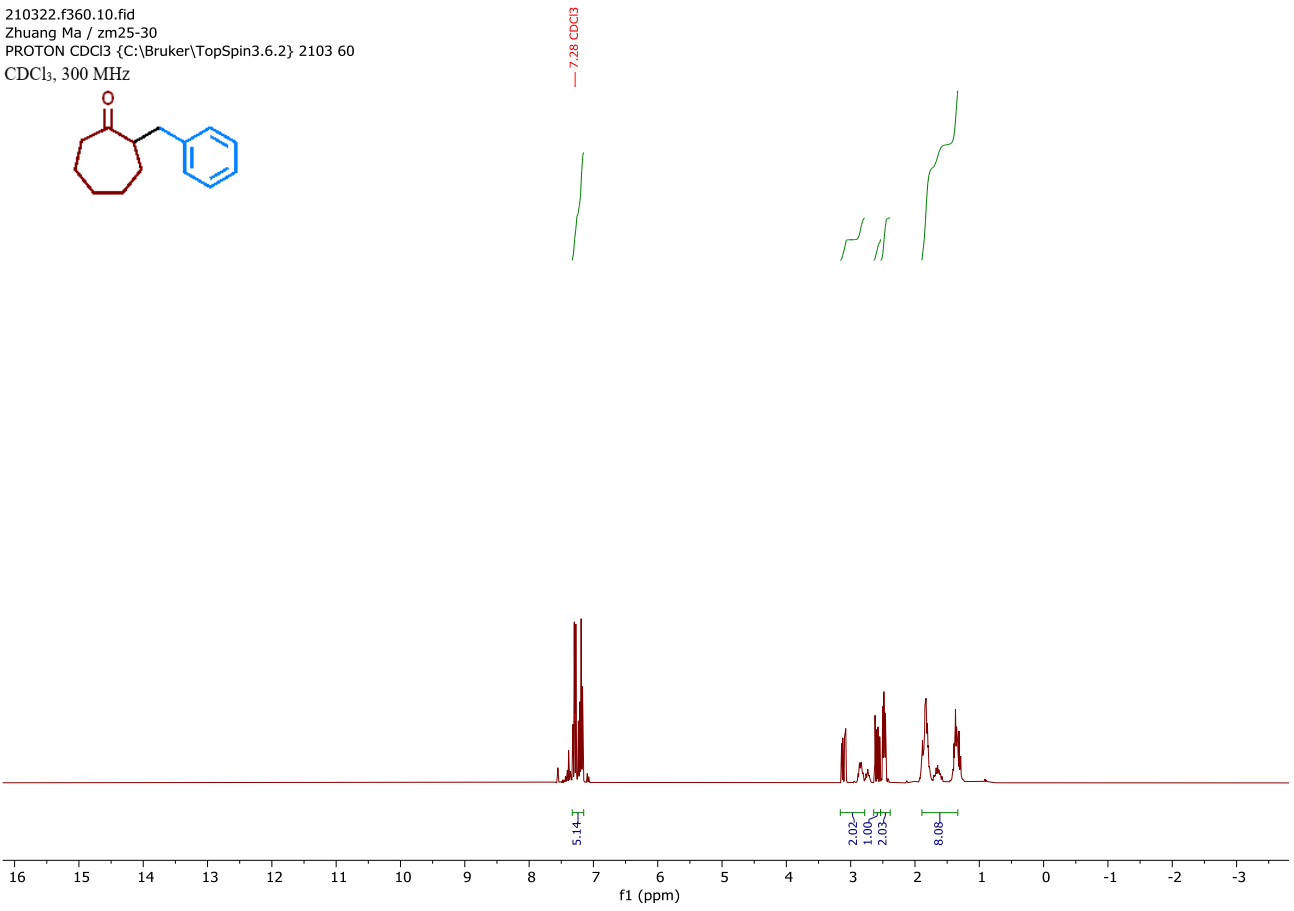

210804.f312.10.fid
Zhuang Ma Zm 25-122
F19 CDCl3 {C:\Bruker\TopSpin3.6.2} 2108 12
CDCl3, 282 MHz
O
OH
F
O
-105.39
1.00
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)


210628.306.10.fid
Zhuang Ma ZM 25-29
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 6
CDCl3, 300 MHz
7.26 CDCl3
4.94
1.00
4.17
2.06
1.03
2.11
1.05
f1 (ppm)

1017


210628.306.11.fid
Zhuang Ma ZM 25-29
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2106 6
CDCl3, 75 MHz
140.39
129.15
128.31
125.97
77.51 CDCl3
77.09 CDCl3
76.66 CDCl3
52.49
42.18
35.48
33.43
28.07
25.08
f1 (ppm)

1018



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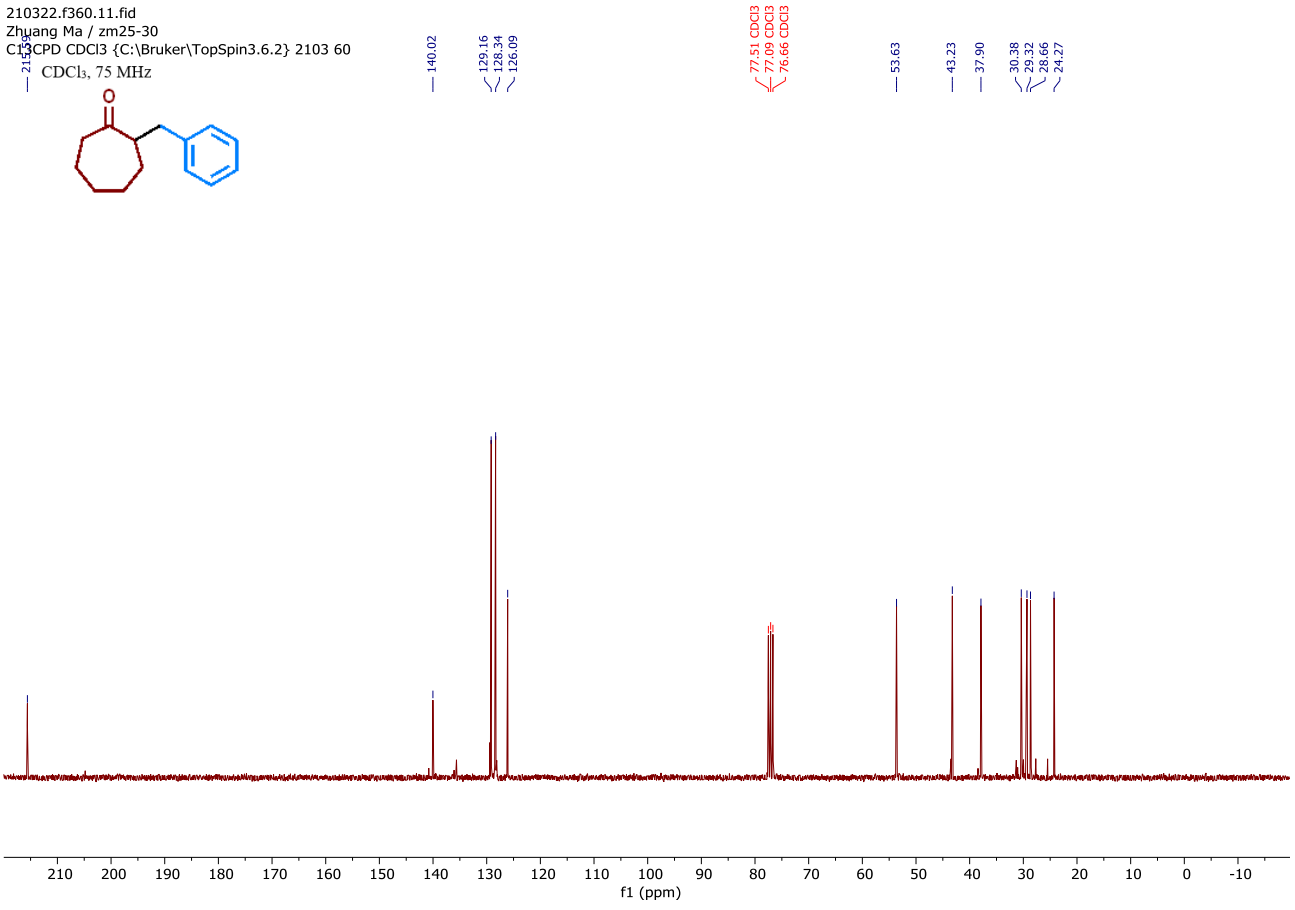
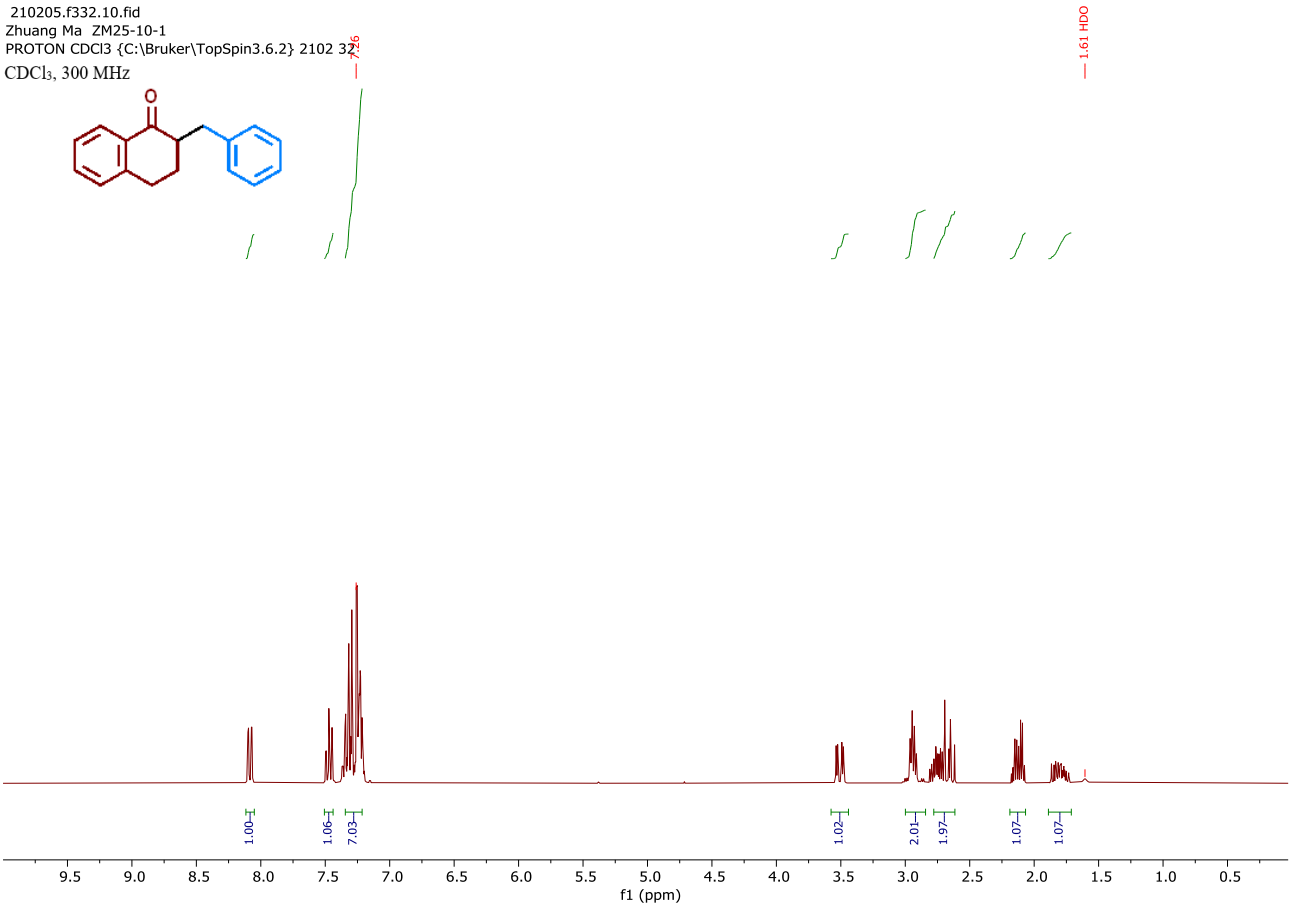
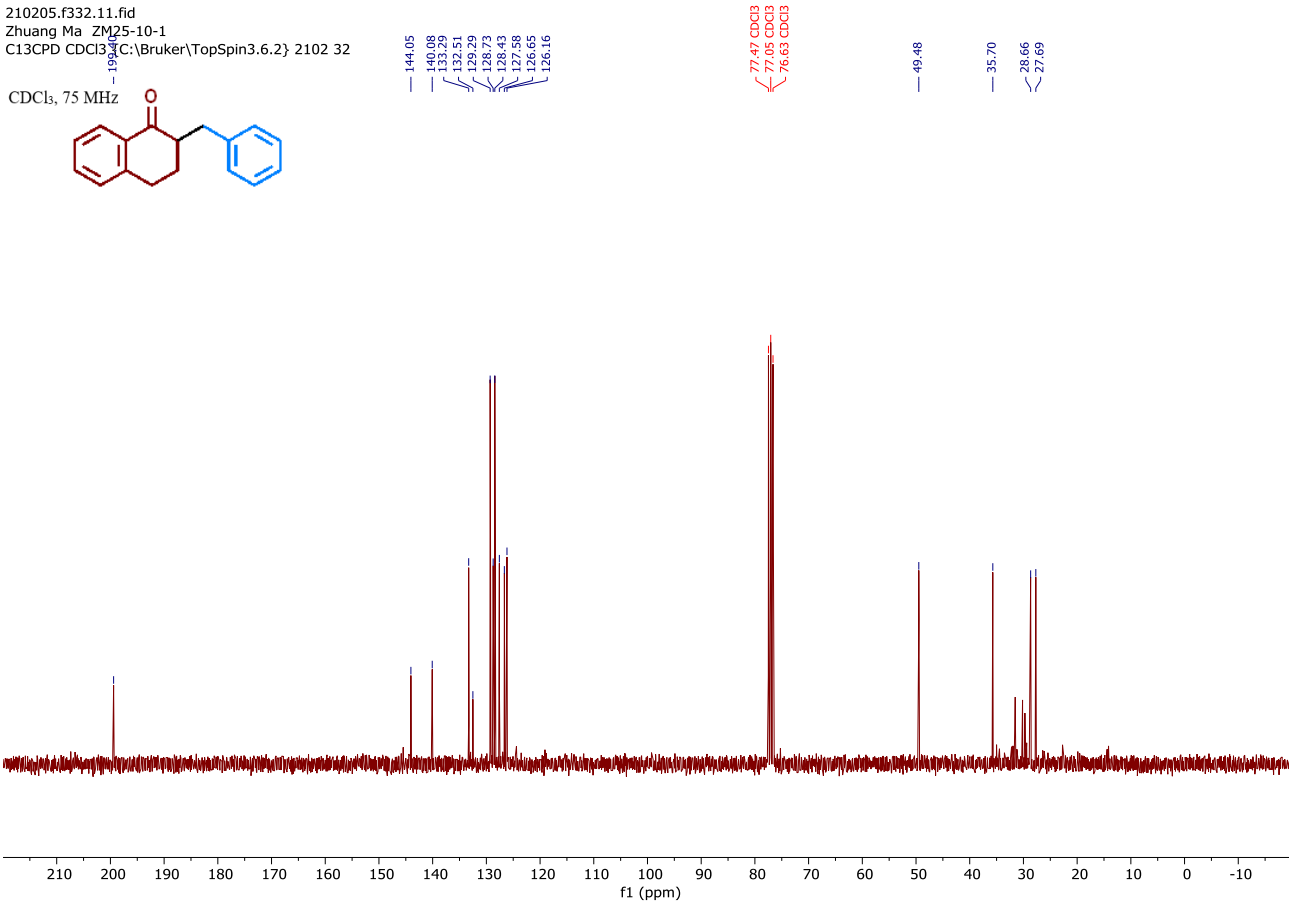


1020

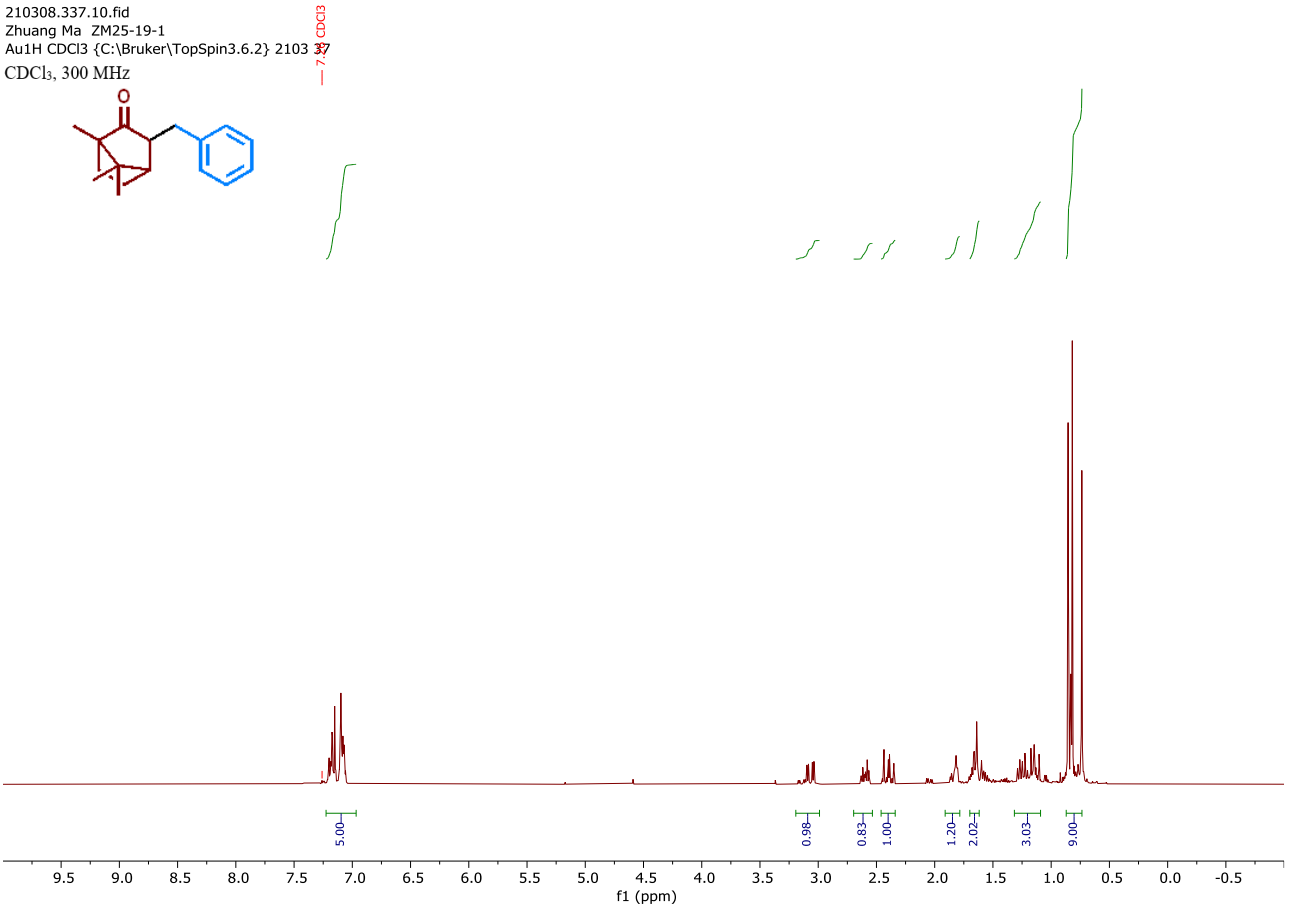
1021


210205.f332.10.fid
Zhuang Ma ZM25-10-1
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2102 32
CDCl3, 300 MHz
7.26
1.61 HDO
1.00
1.06
7.03
1.02
2.01
1.97
1.07
1.07
f1 (ppm)

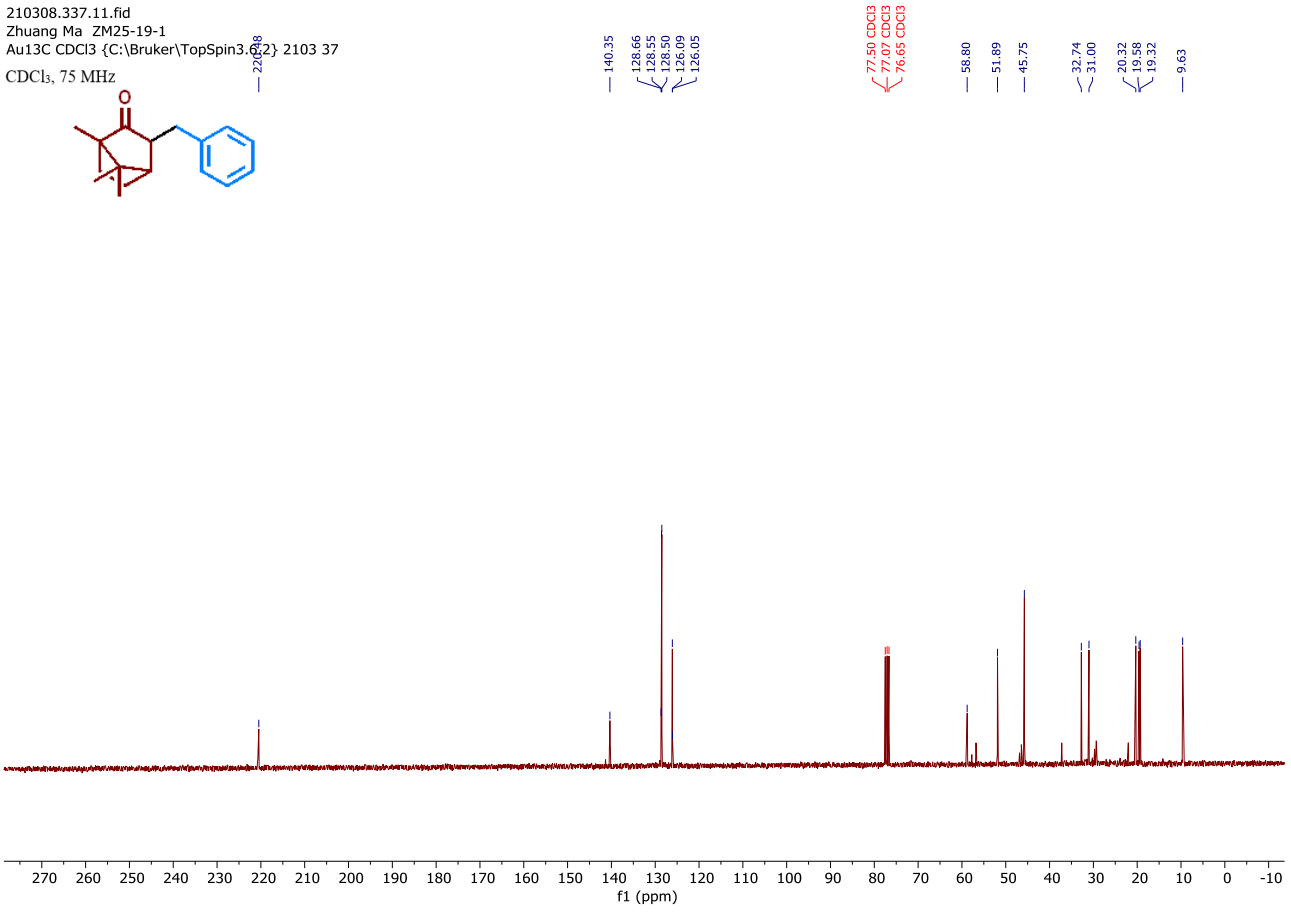
1022


210205.f332.11.fid
Zhuang Ma ZM25-10-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2102 32
CDCl3, 75 MHz
199.40
144.05
140.08
133.29
132.51
129.29
128.73
128.43
127.58
126.65
126.16
77.47 CDCl3
77.05 CDCl3
76.63 CDCl3
49.48
35.70
28.66
27.69
f1 (ppm)

1023



1024



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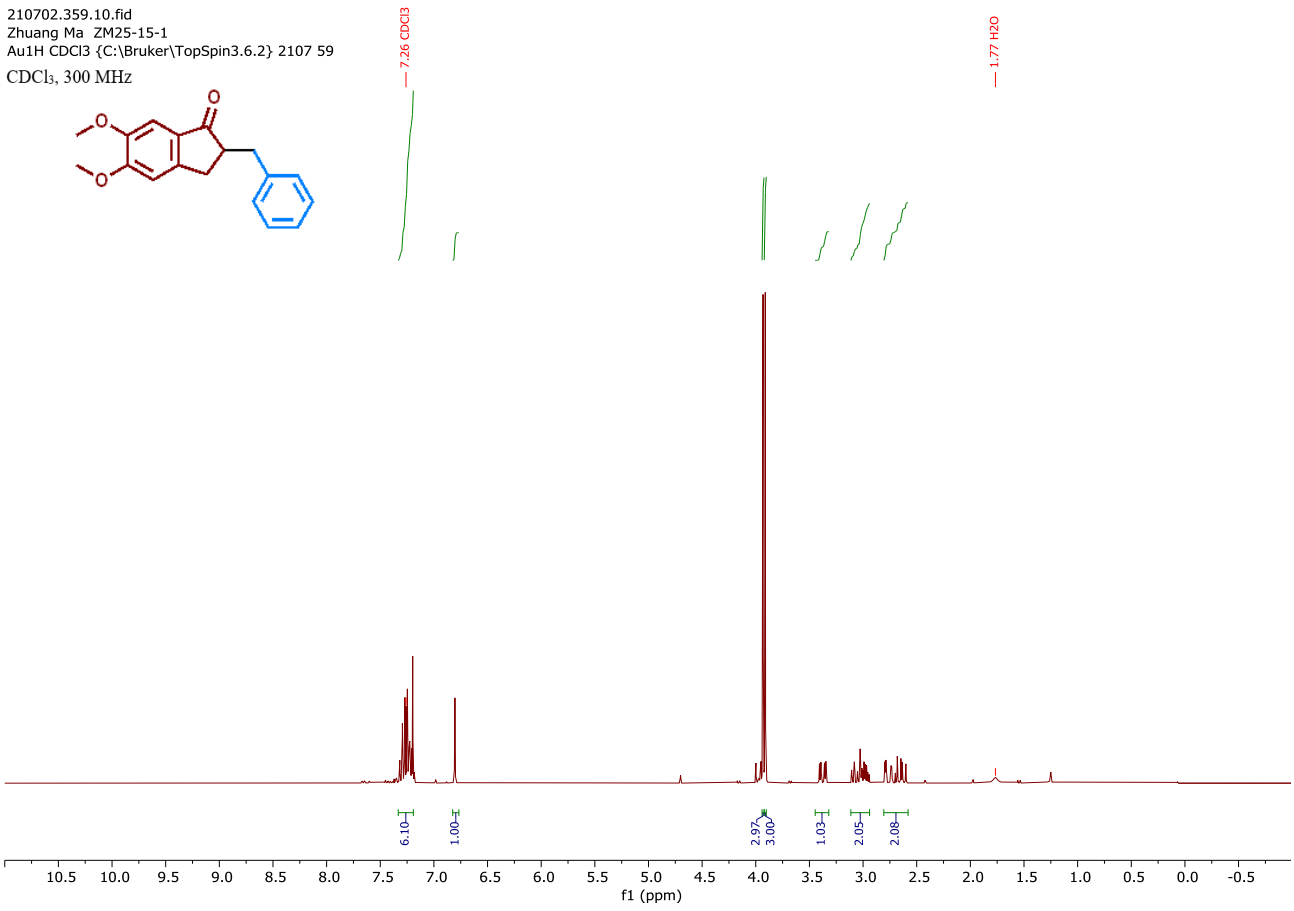

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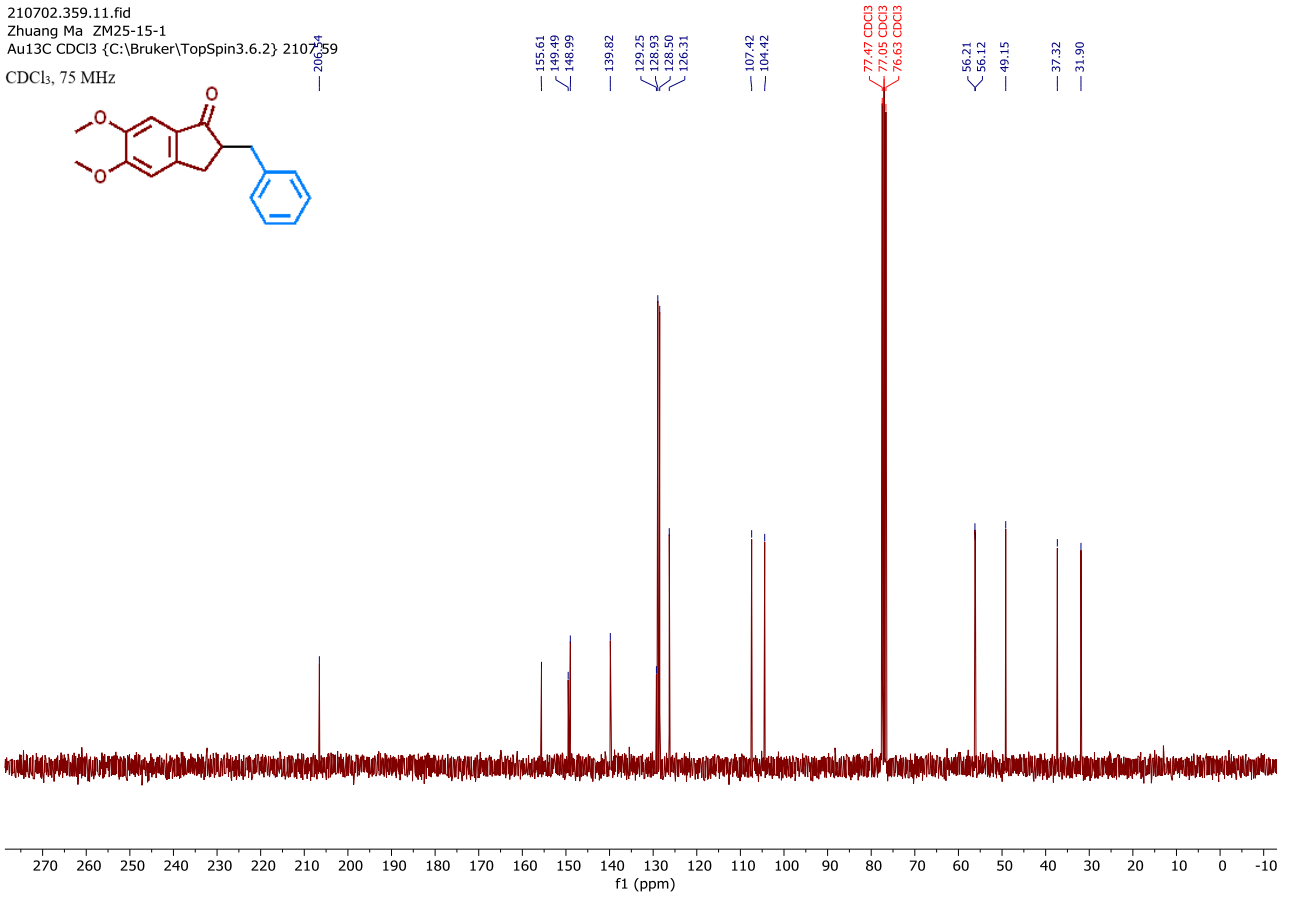

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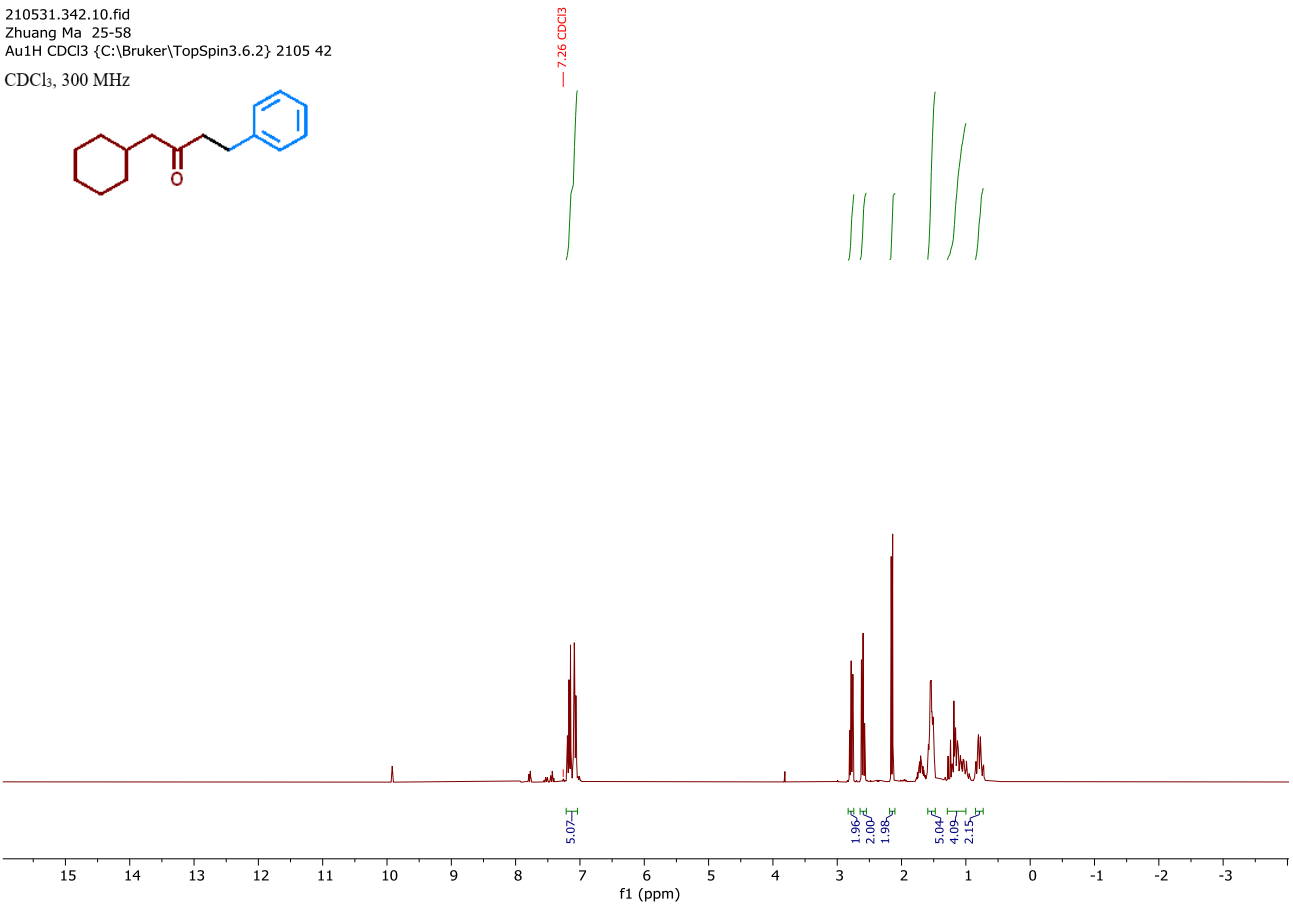
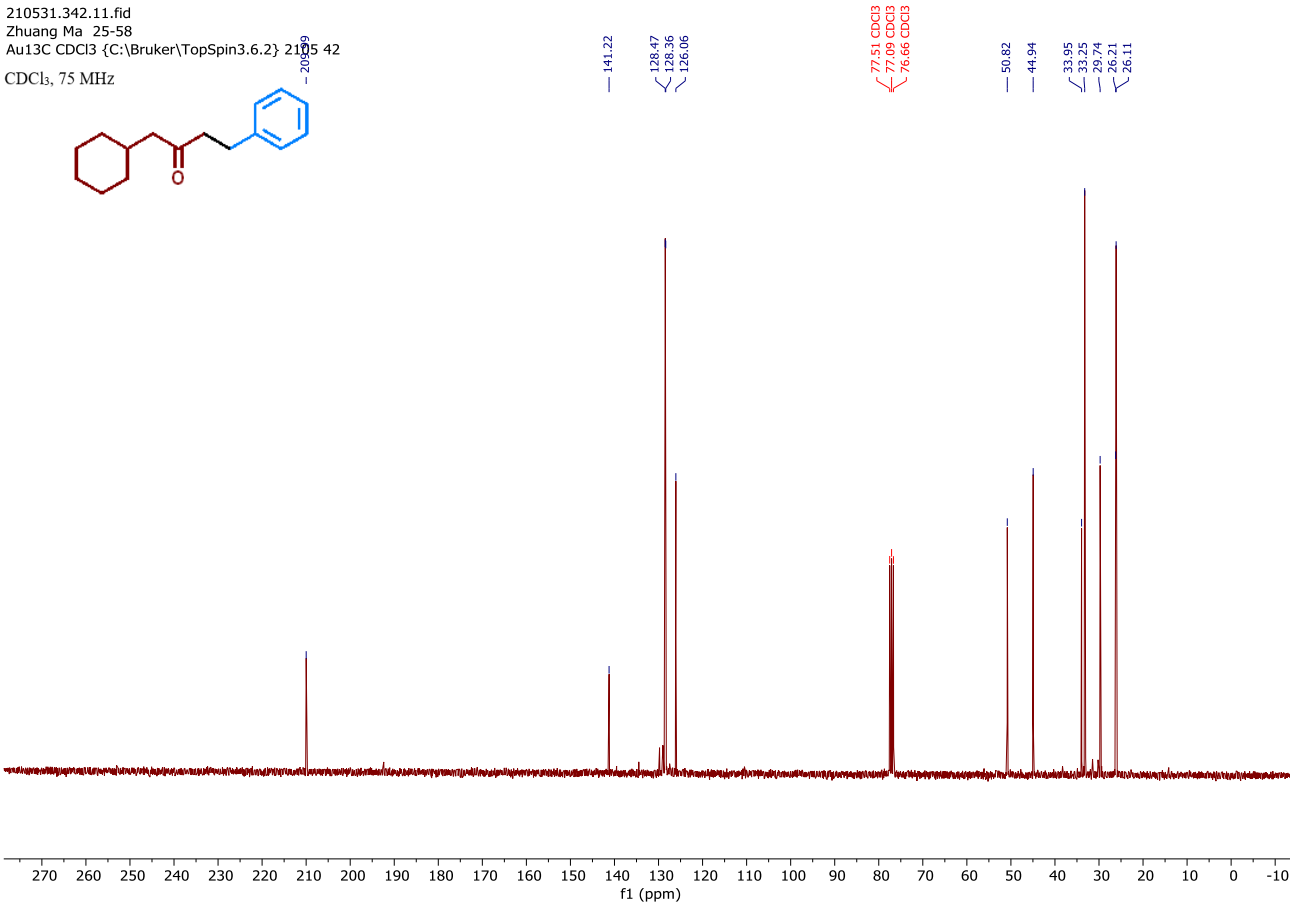
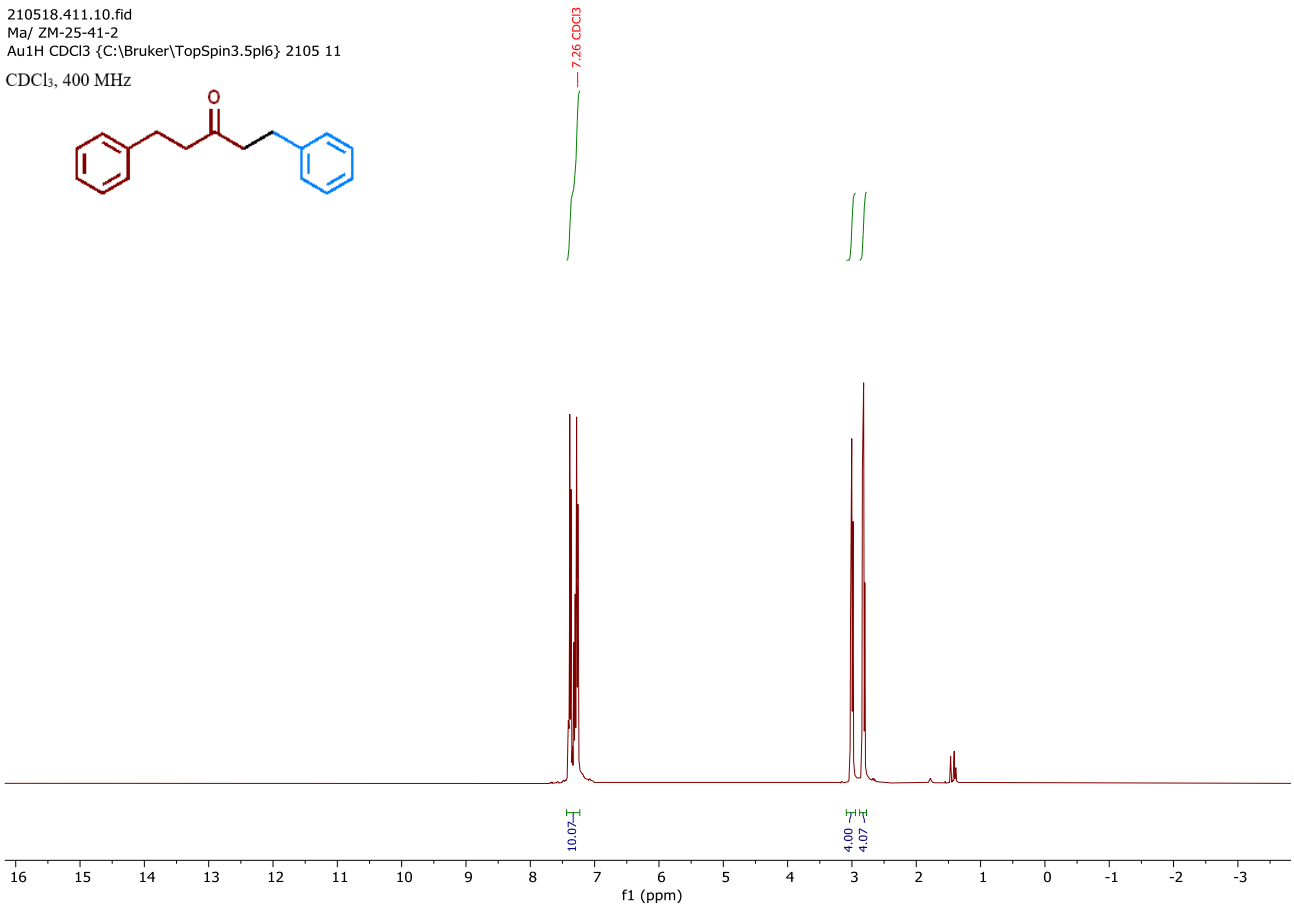
1029


210531.342.10.fid
Zhuang Ma 25-58
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 42
CDCl3, 300 MHz
7.26 CDCl3
5.07
1.96
2.00
1.98
5.04
4.09
2.15
f1 (ppm)

1030


210531.342.11.fid
Zhuang Ma 25-58
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 42
CDCl3, 75 MHz
141.22
128.47
128.36
126.06
77.51 CDCl3
77.09 CDCl3
76.66 CDCl3
50.82
44.94
33.95
33.25
29.74
26.21
26.11
f1 (ppm)

1031



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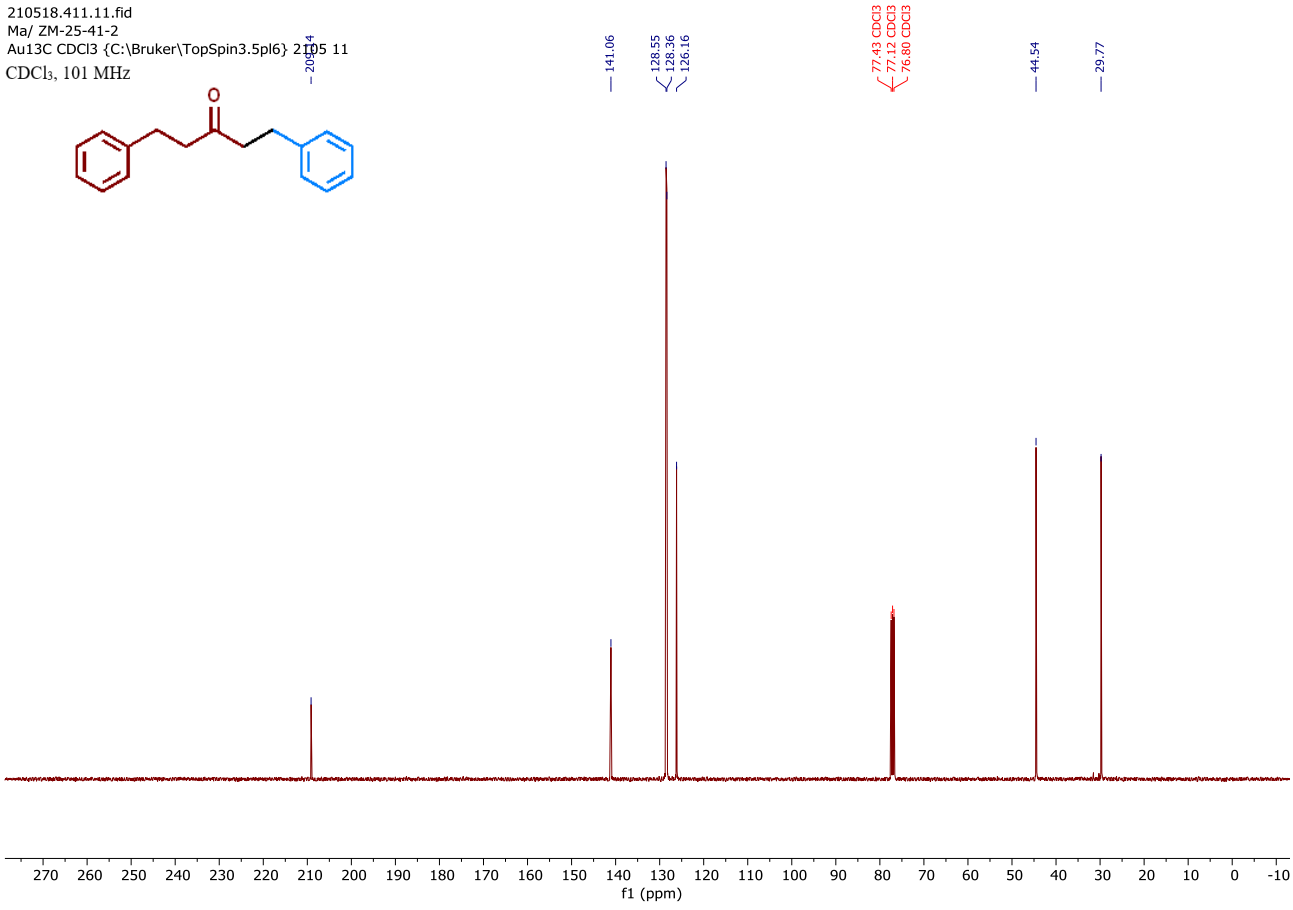

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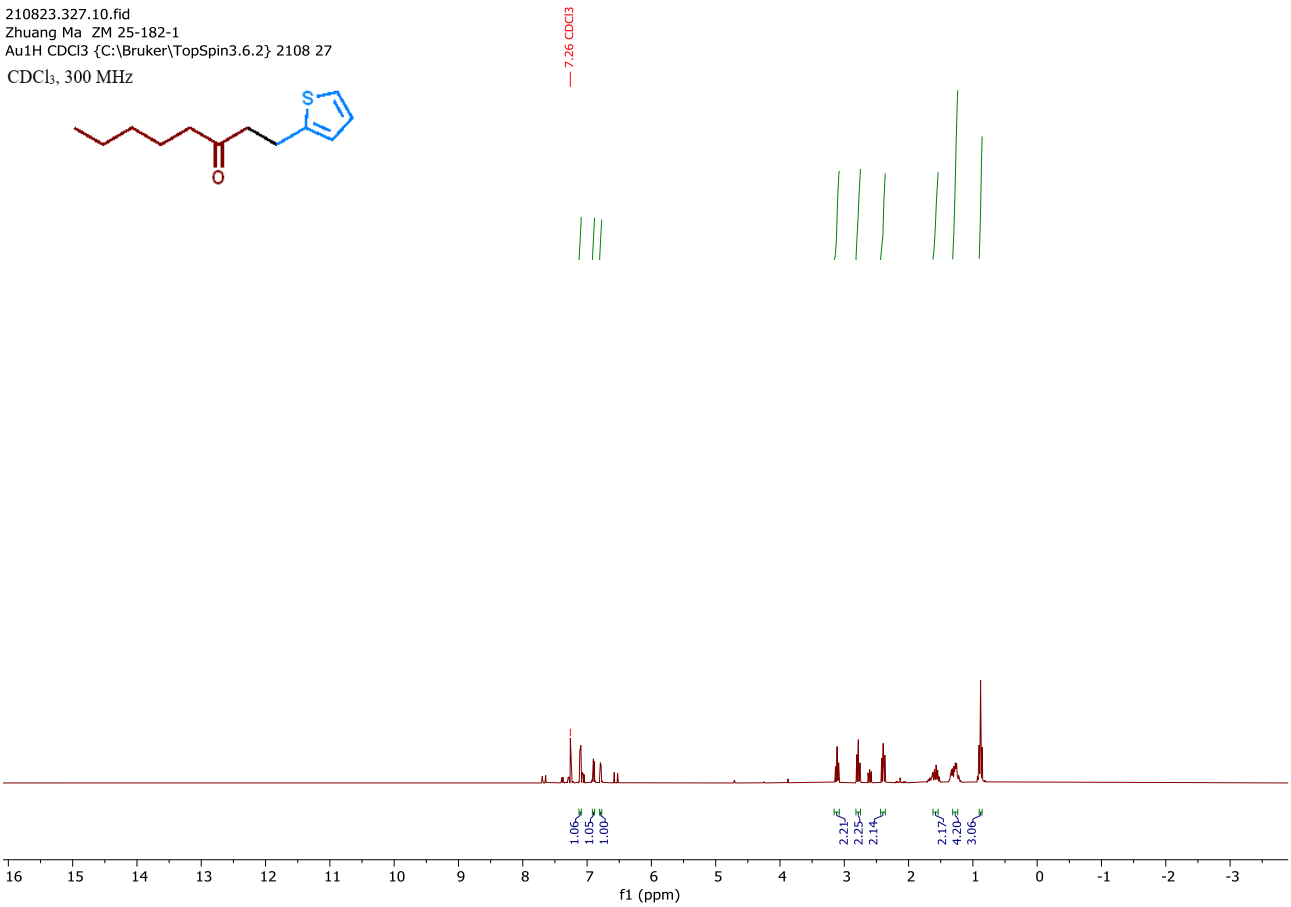
1034



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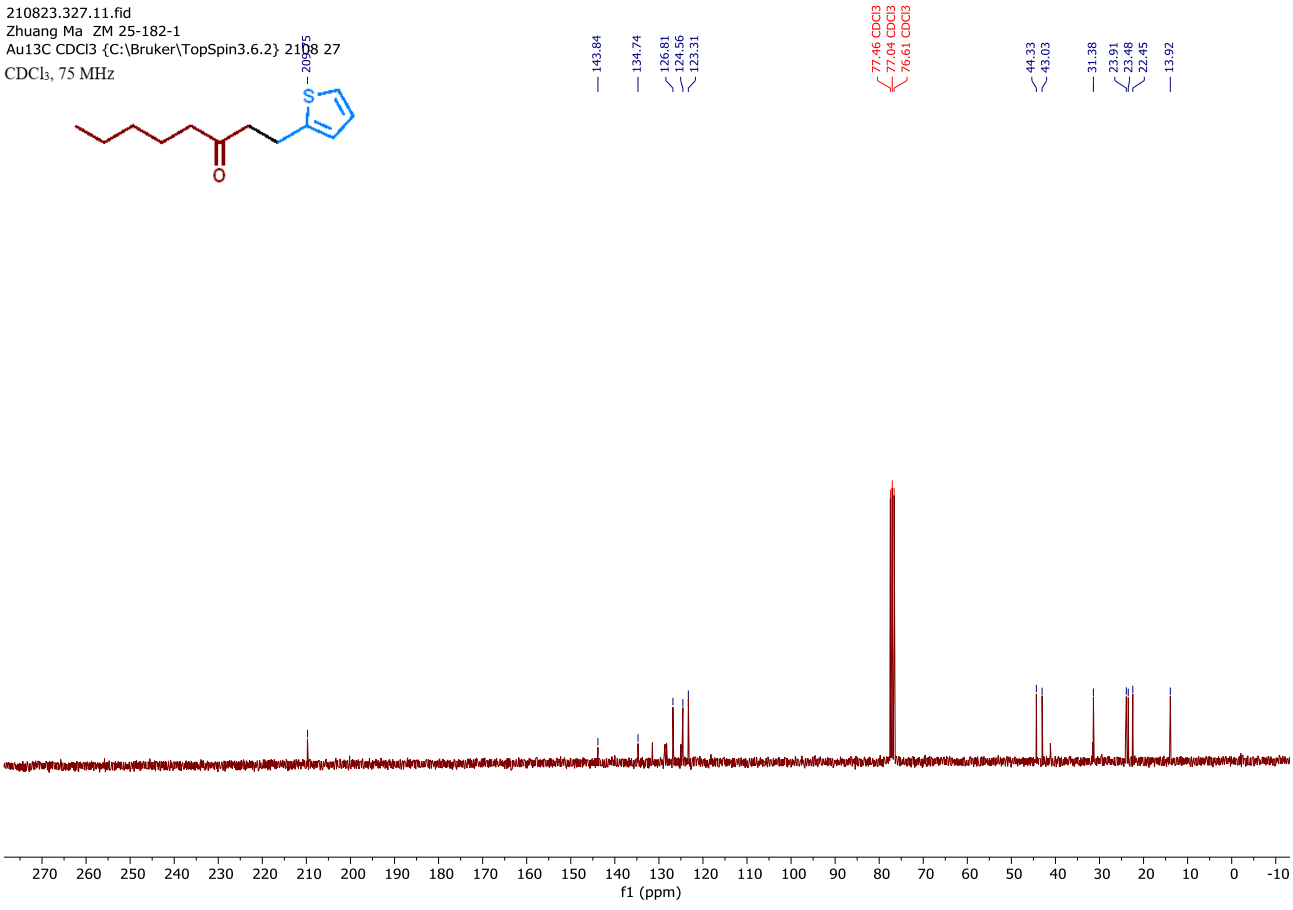

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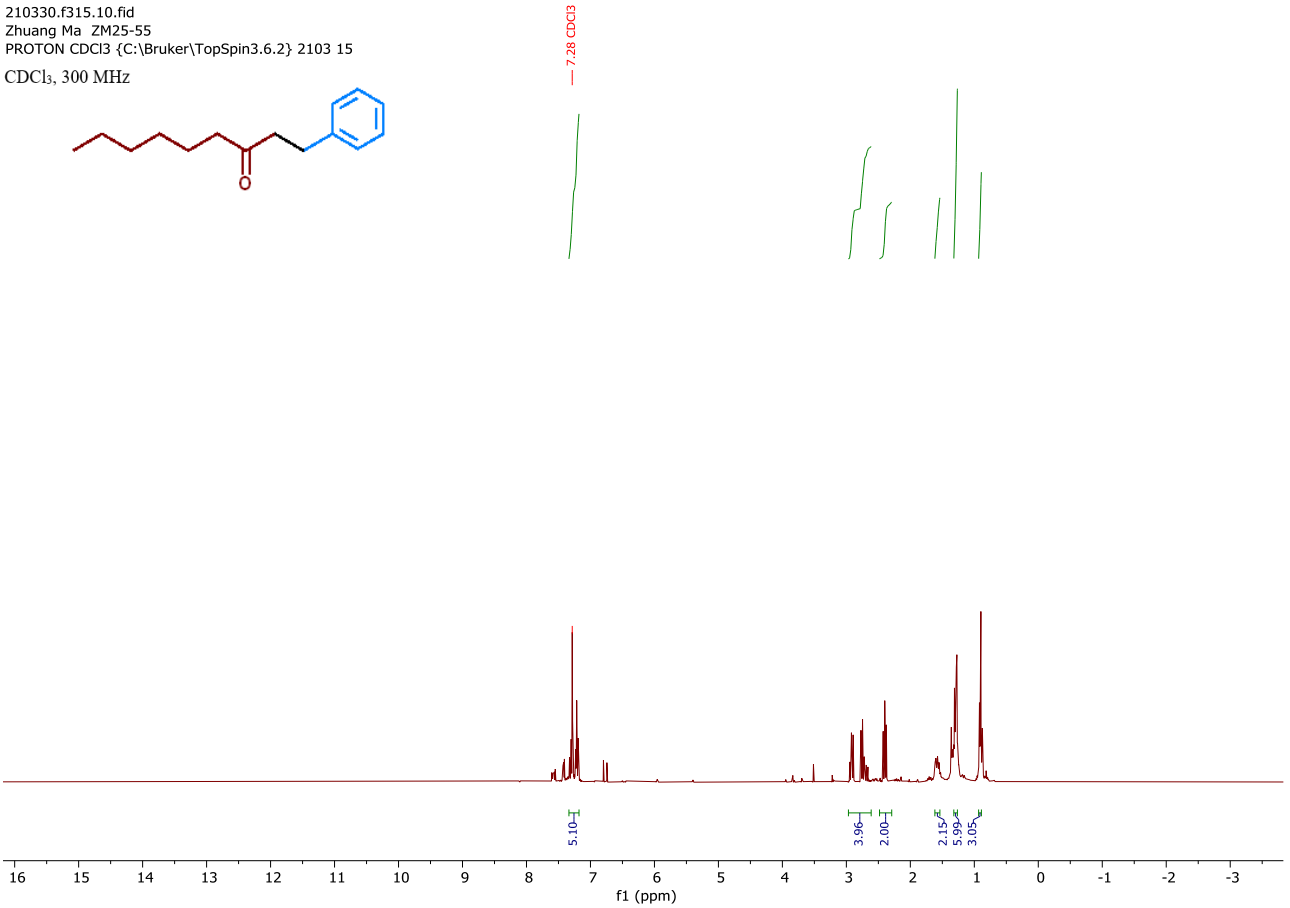
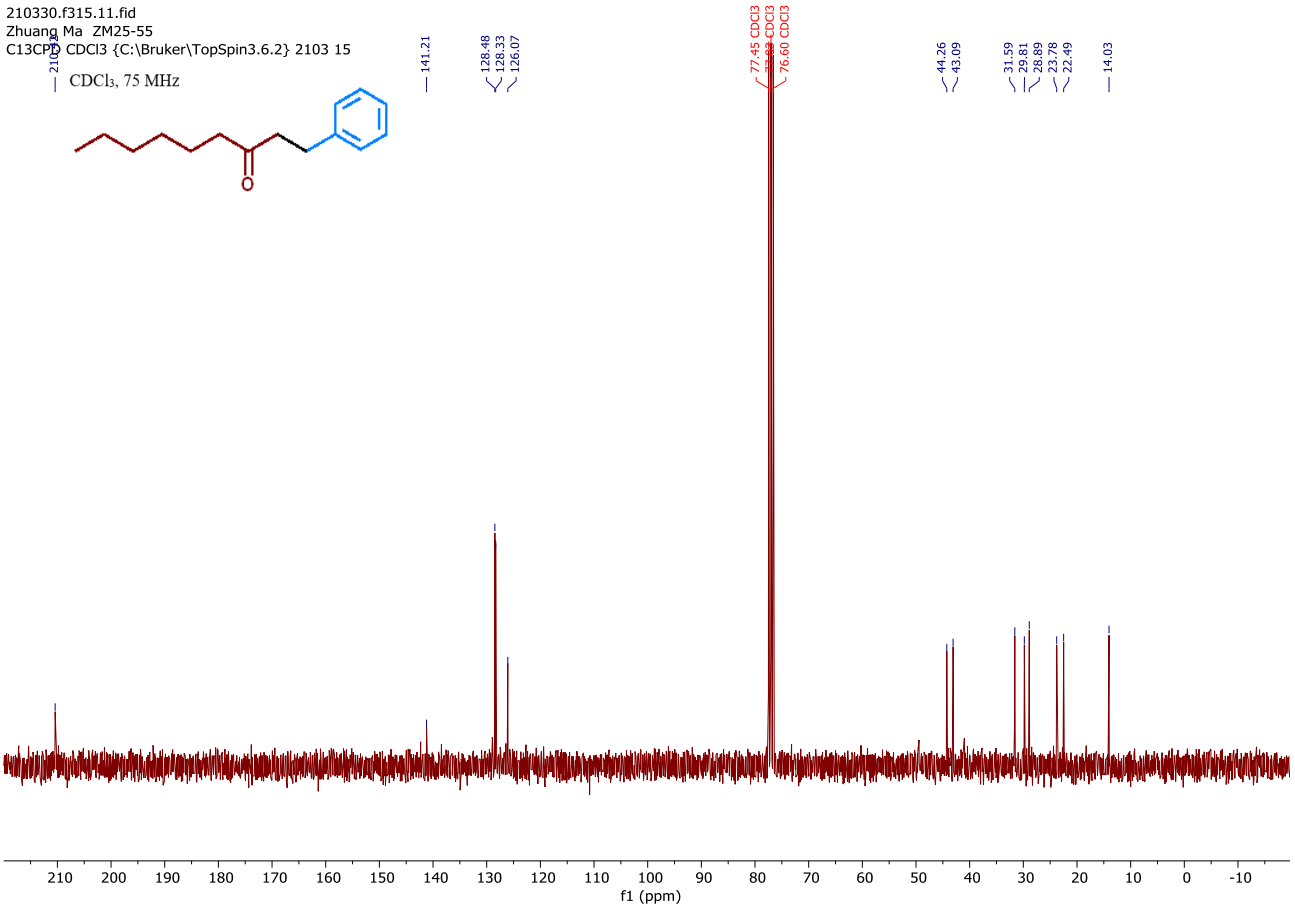


1038



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1040

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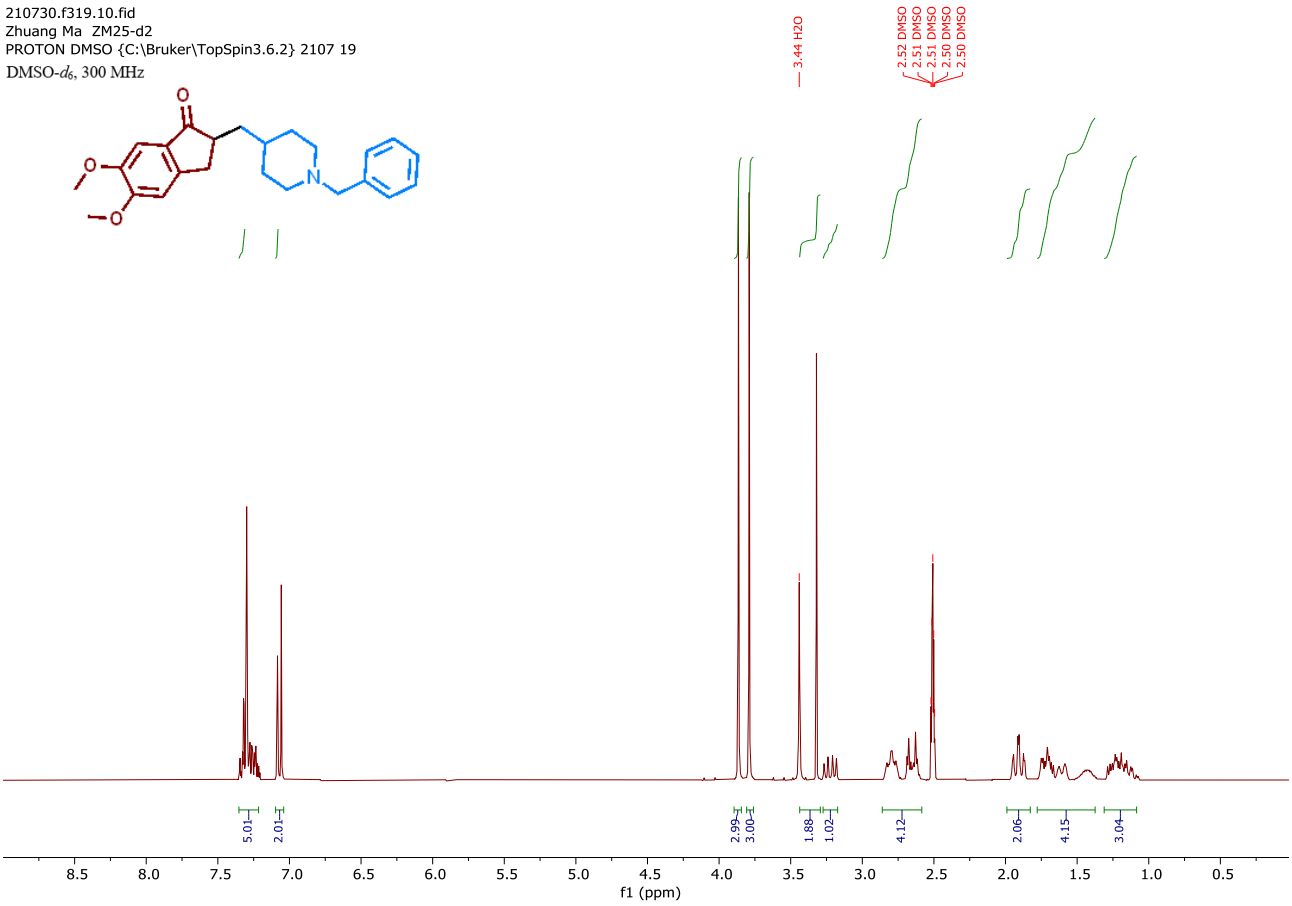

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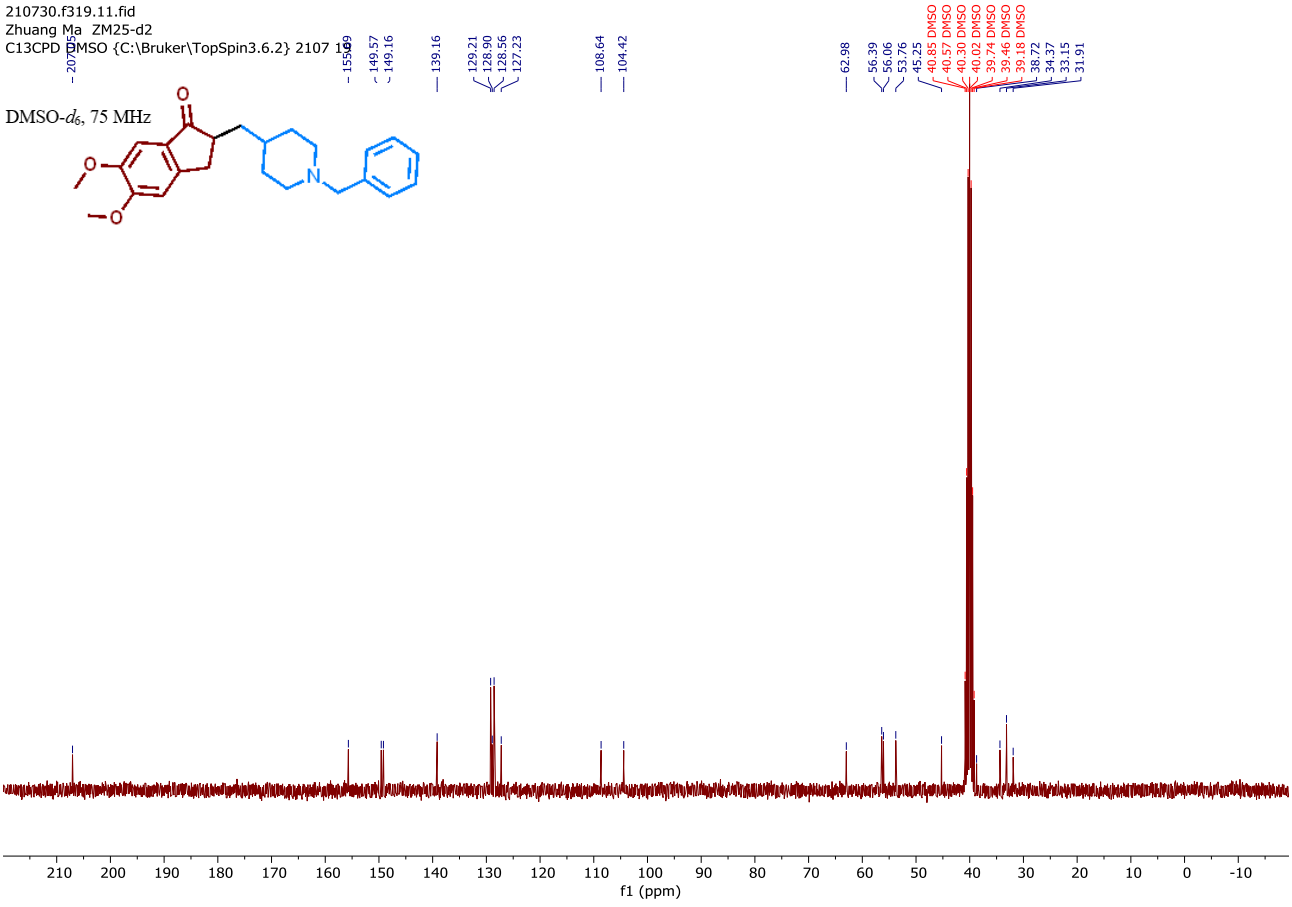
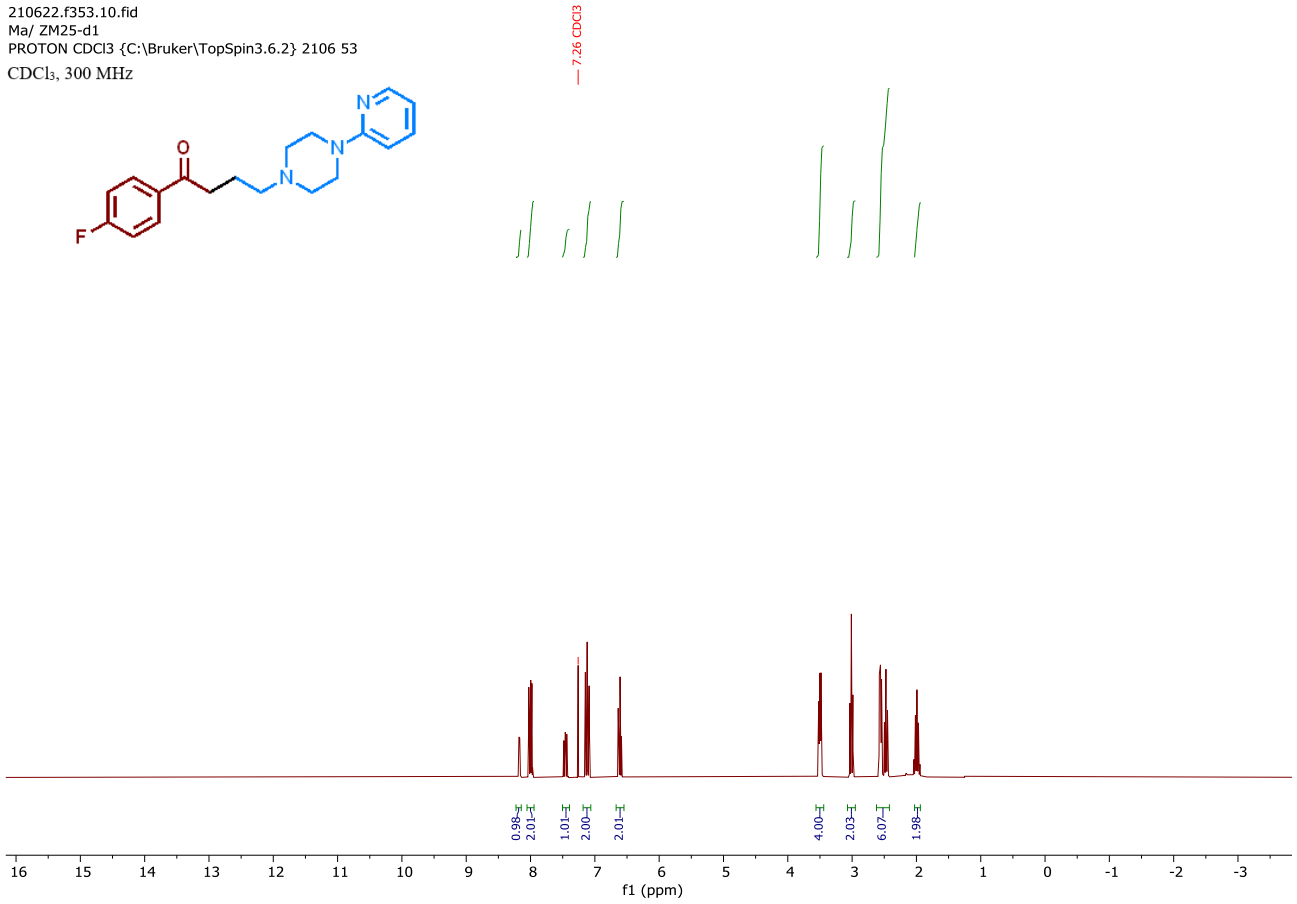


1043

1044



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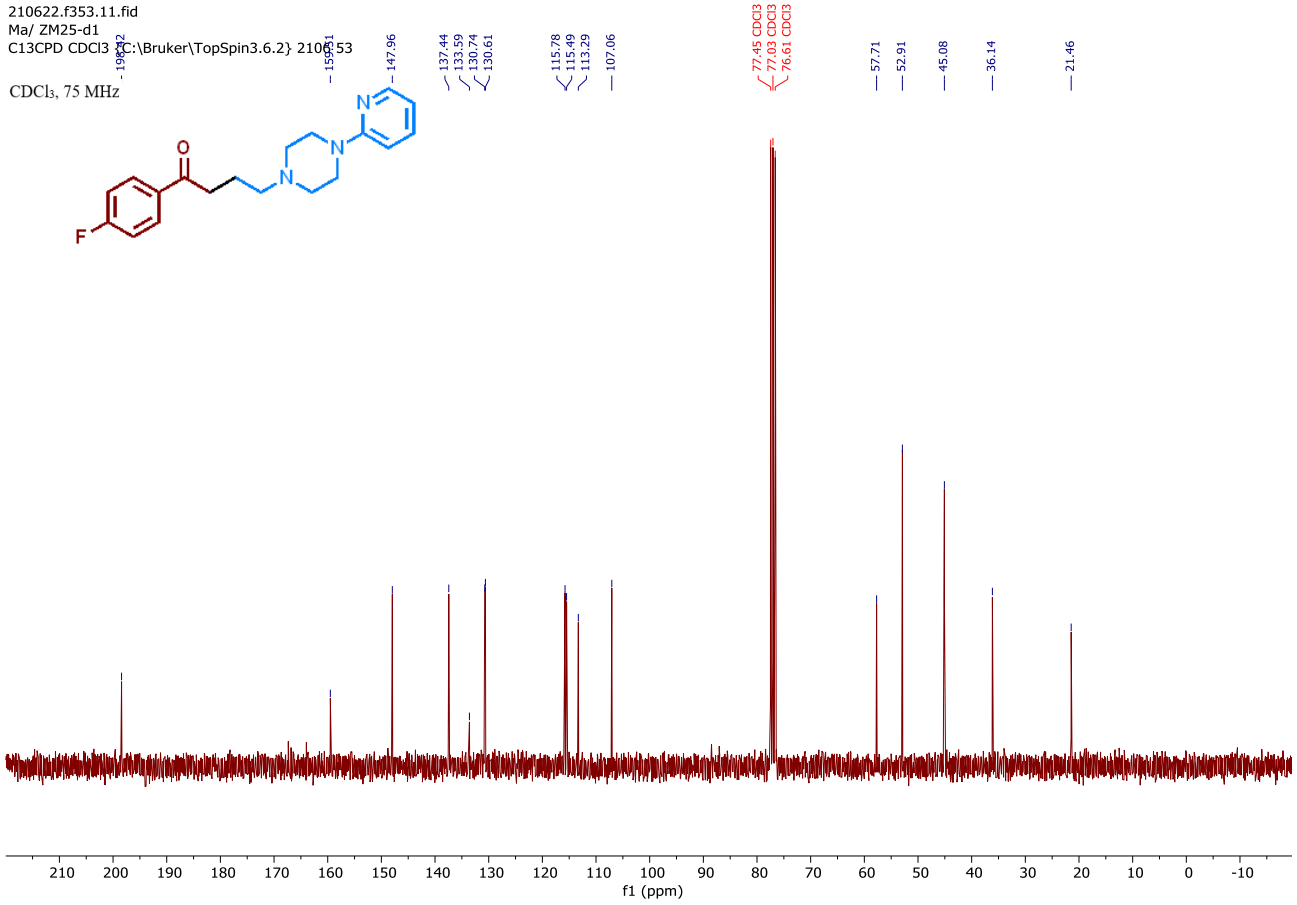

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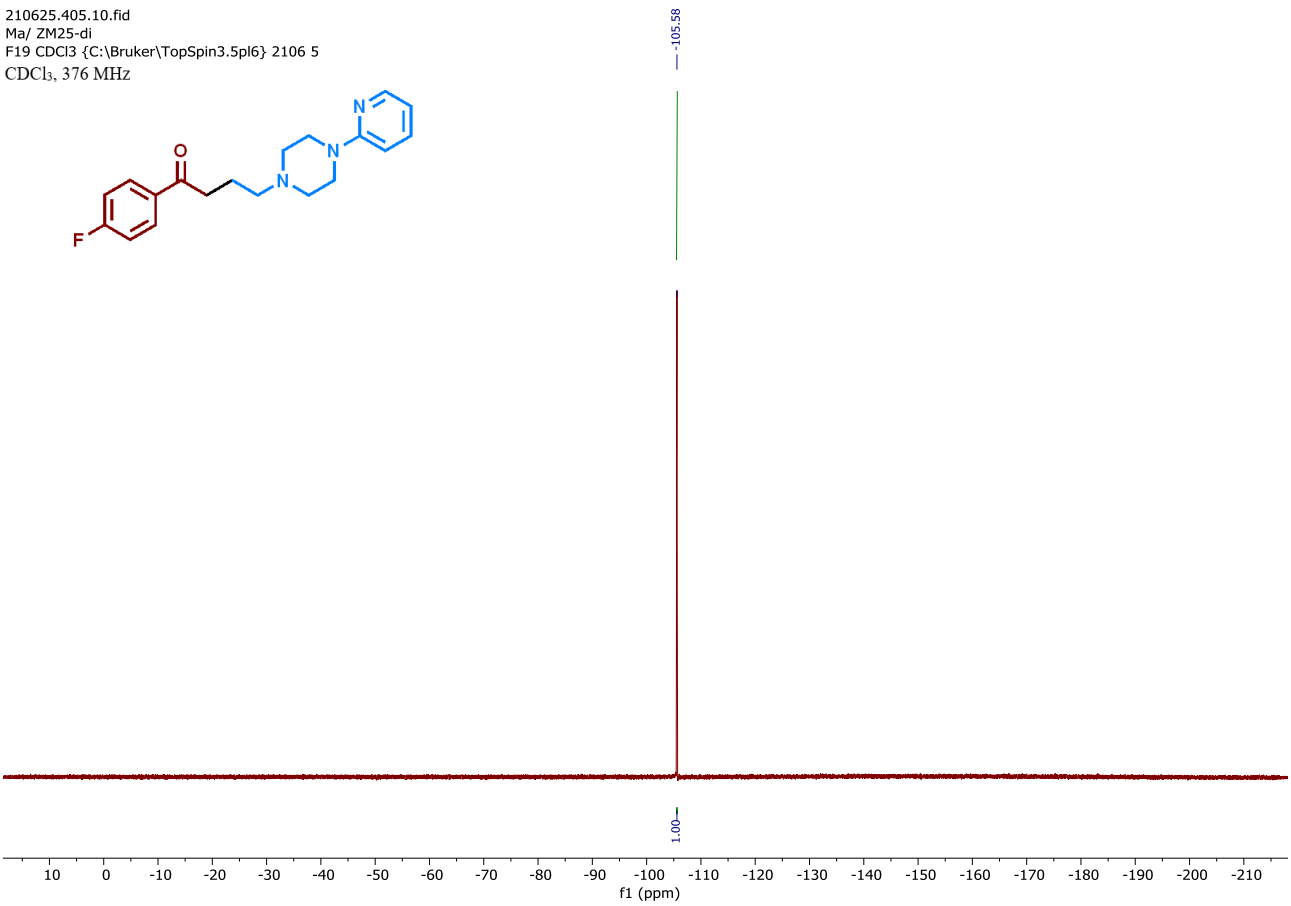
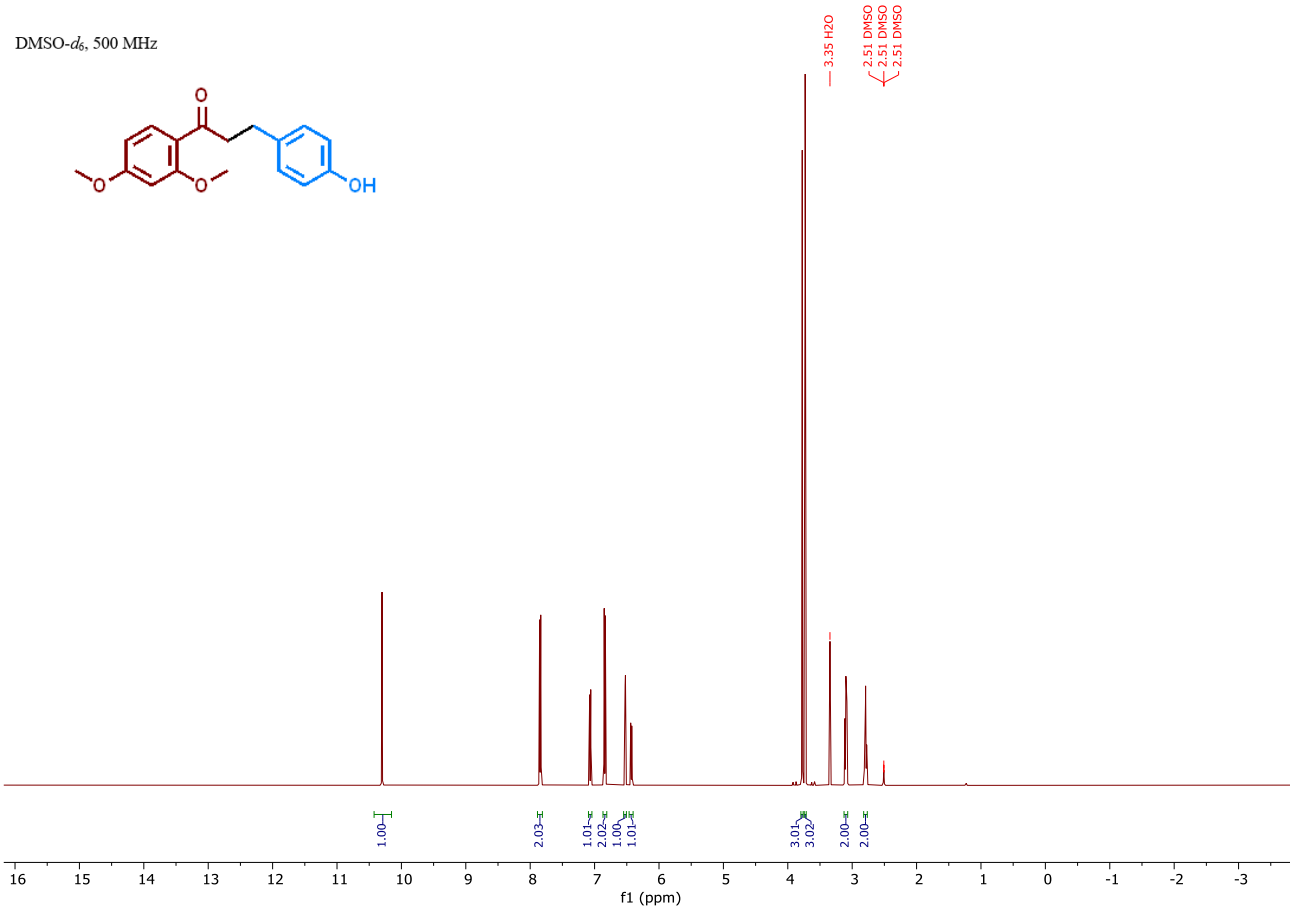

210625.405.10.fid
Ma/ ZM25-di
F19 CDCl3 {C:\Bruker\TopSpin3.5pl6} 2106 5
CDCl3, 376 MHz
-105.58
1.00
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)



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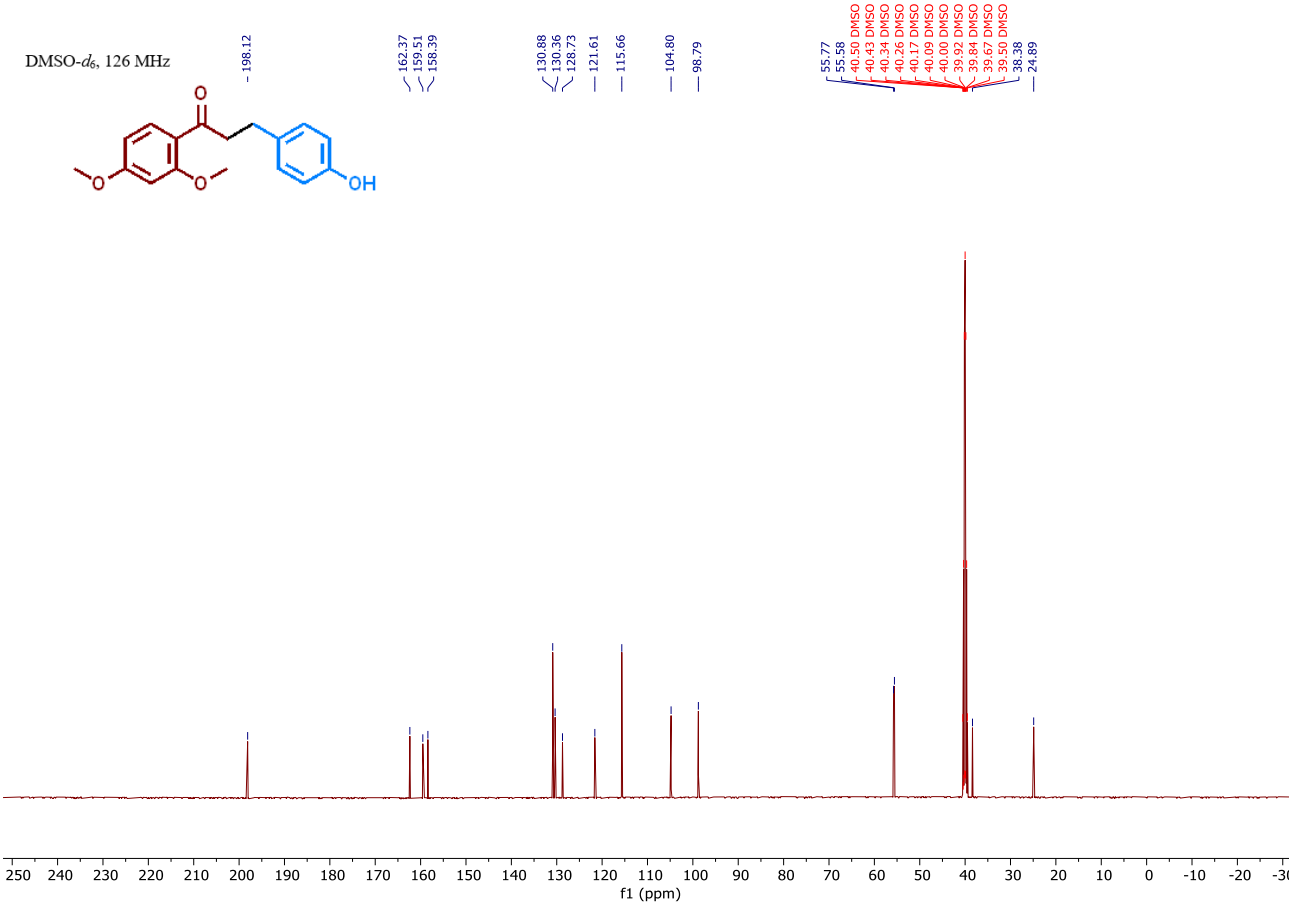

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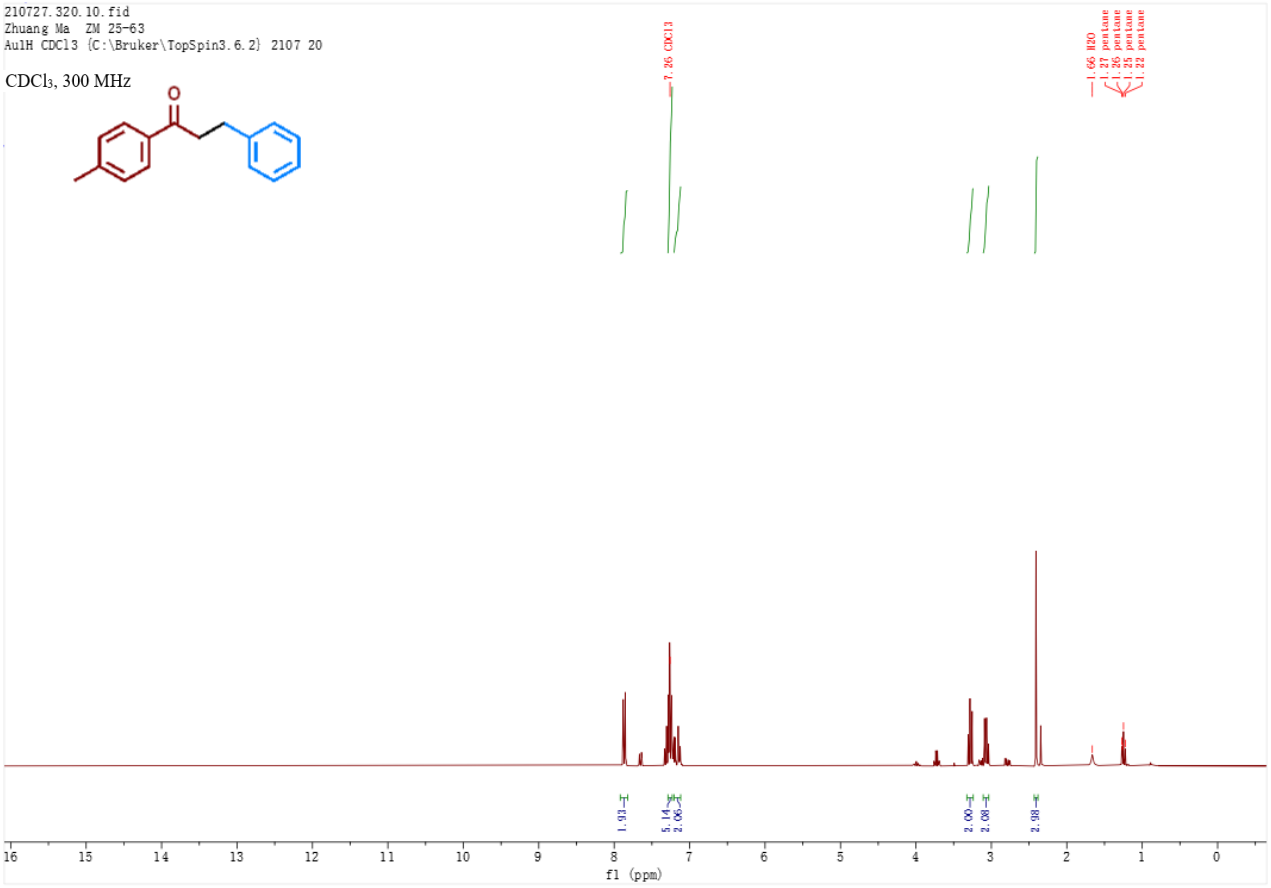
1073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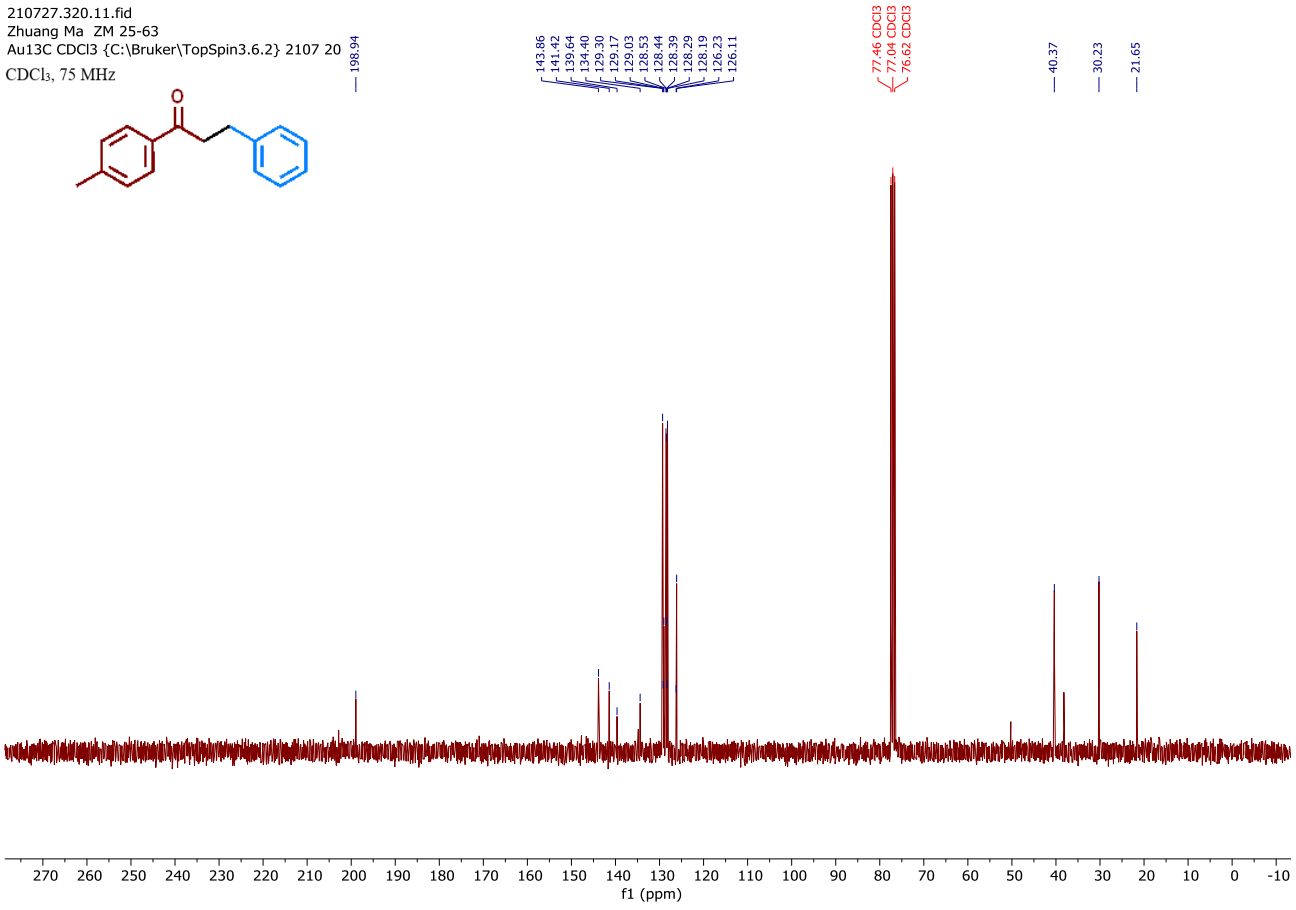
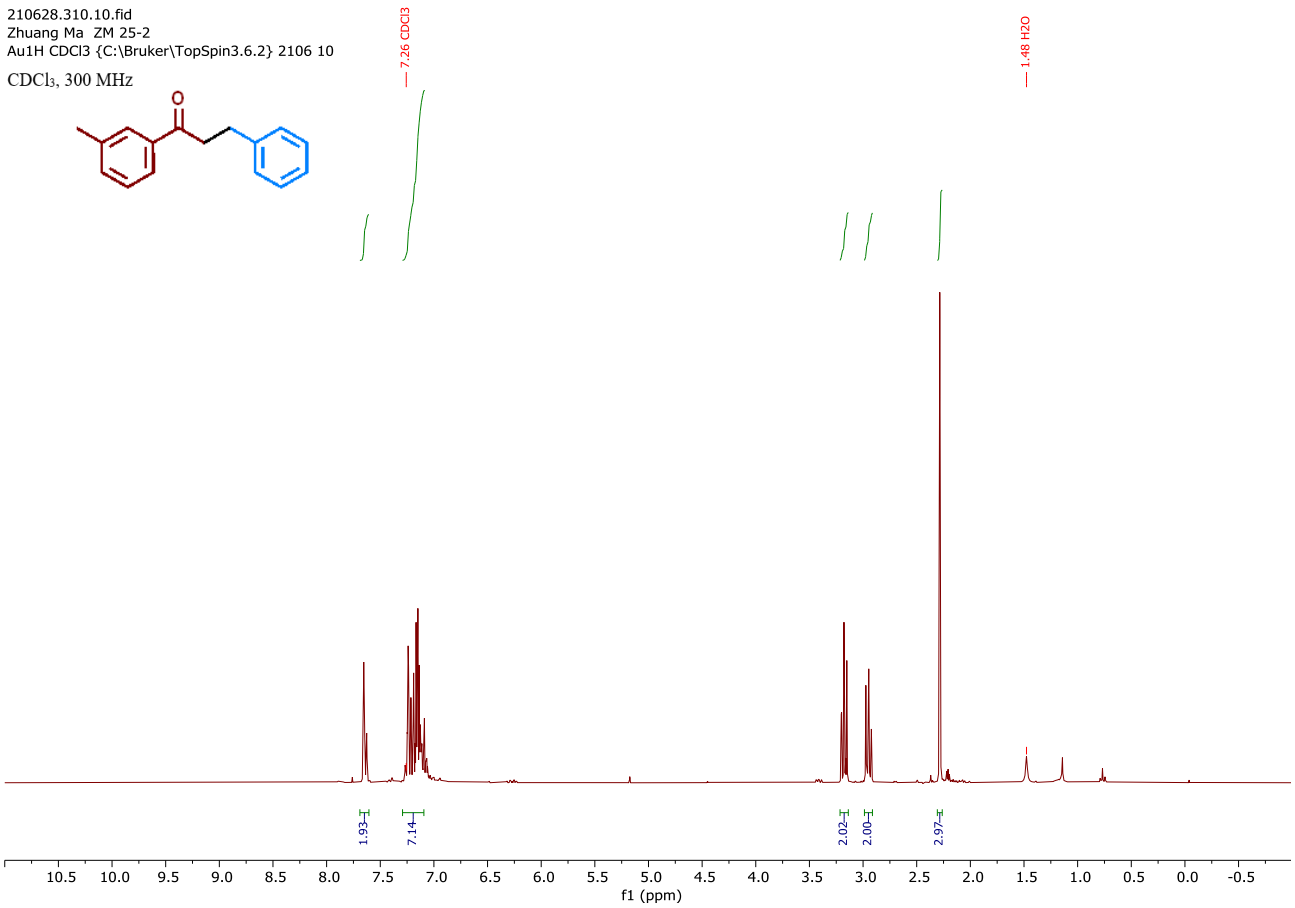
Zhuang Ma ZM 25-63
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 20
CDCl3, 300 MHz
7.26 CDCl3
1.66 H2O
1.27 pentane
1.26 pentane
1.25 pentane
1.22 pentane
1.93
5.14
2.06
2.00
2.08
2.98
f1 (ppm)

1074


210727.320.11.fid
Zhuang Ma ZM 25-63
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 20
CDCl3, 75 MHz
198.94
143.86
141.42
139.64
134.40
129.30
129.17
129.03
128.53
128.44
128.39
128.29
128.19
126.23
126.11
77.46 CDCl3
77.04 CDCl3
76.62 CDCl3
40.37
30.23
21.65
f1 (ppm)

1075



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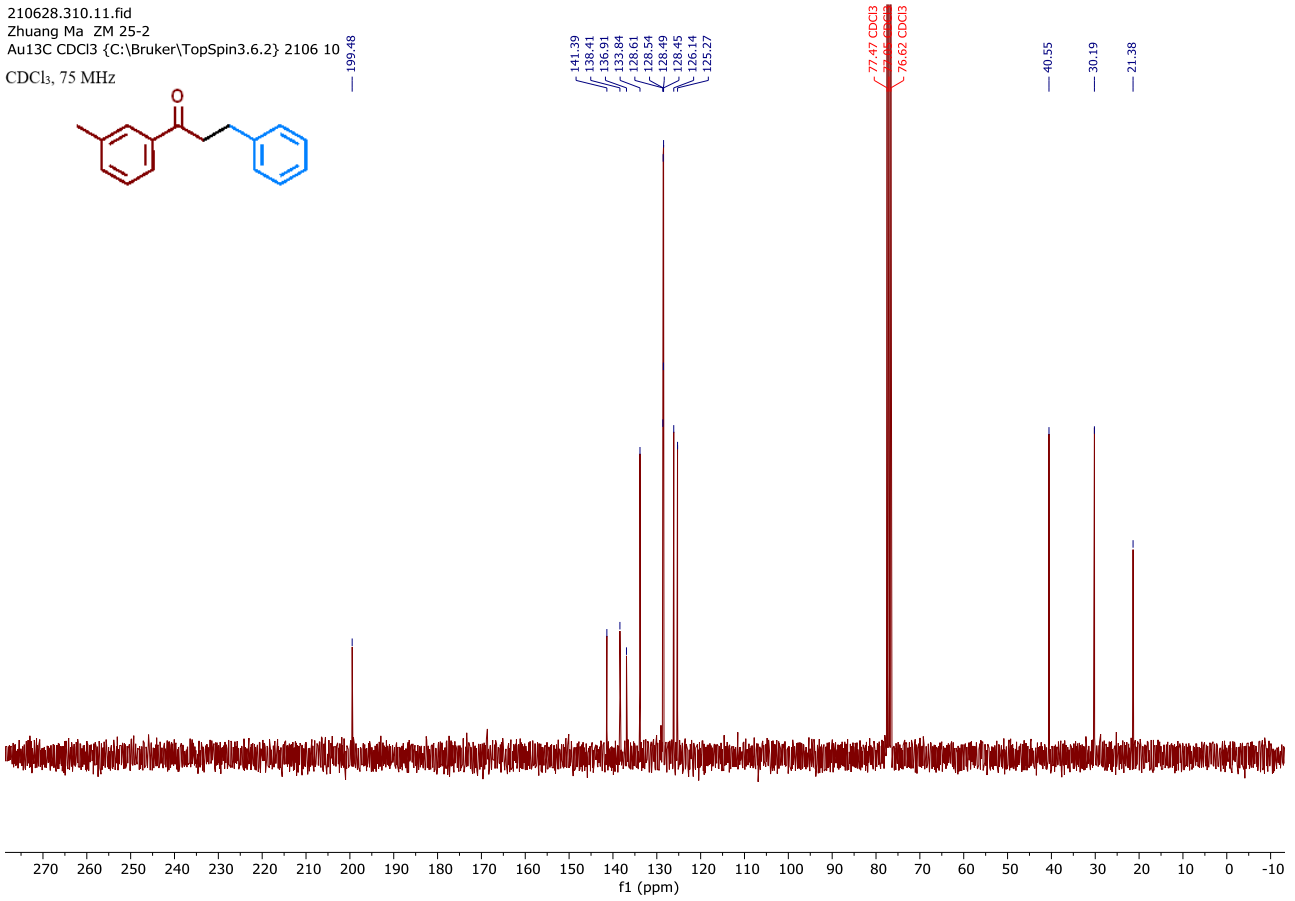
1077



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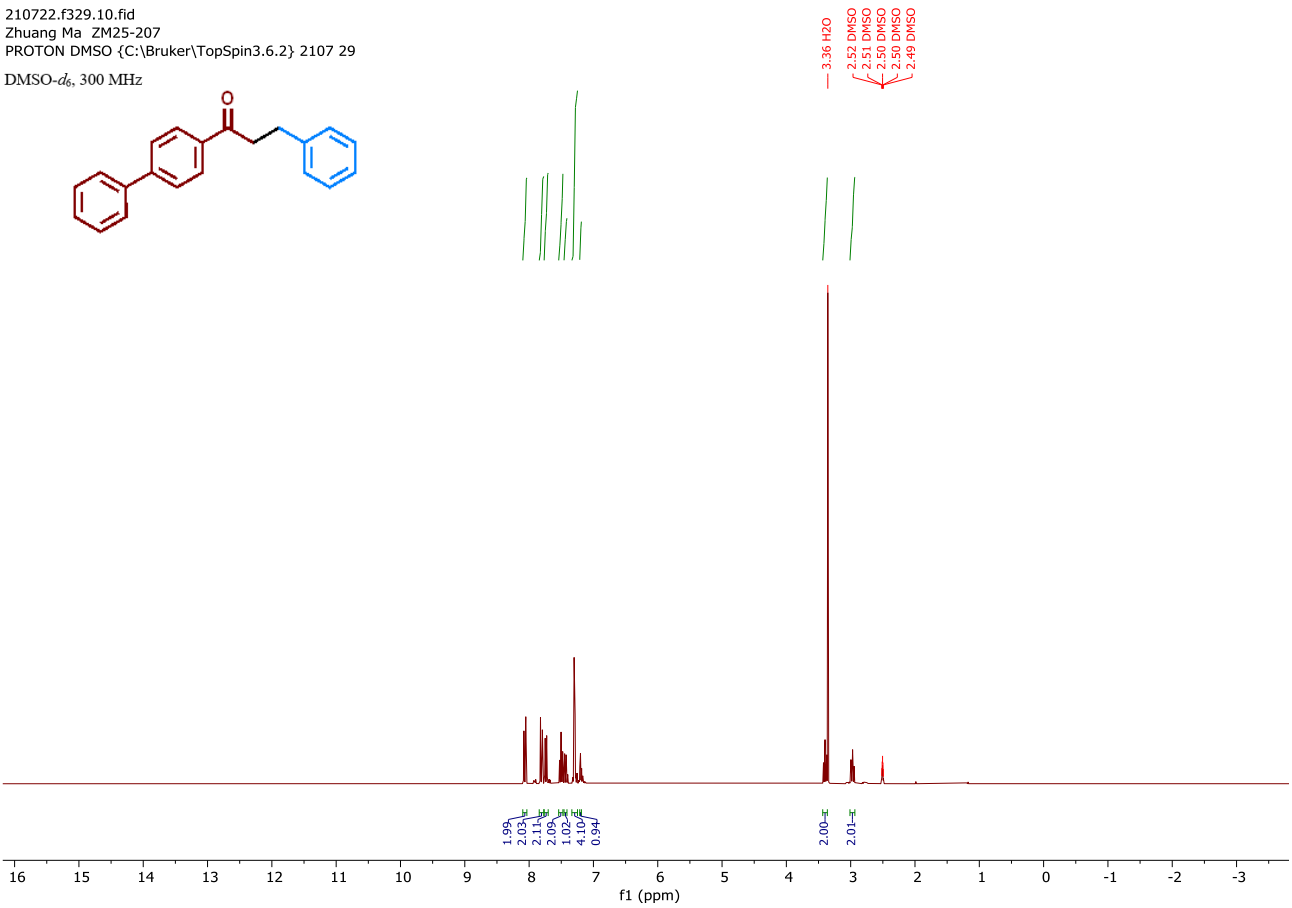
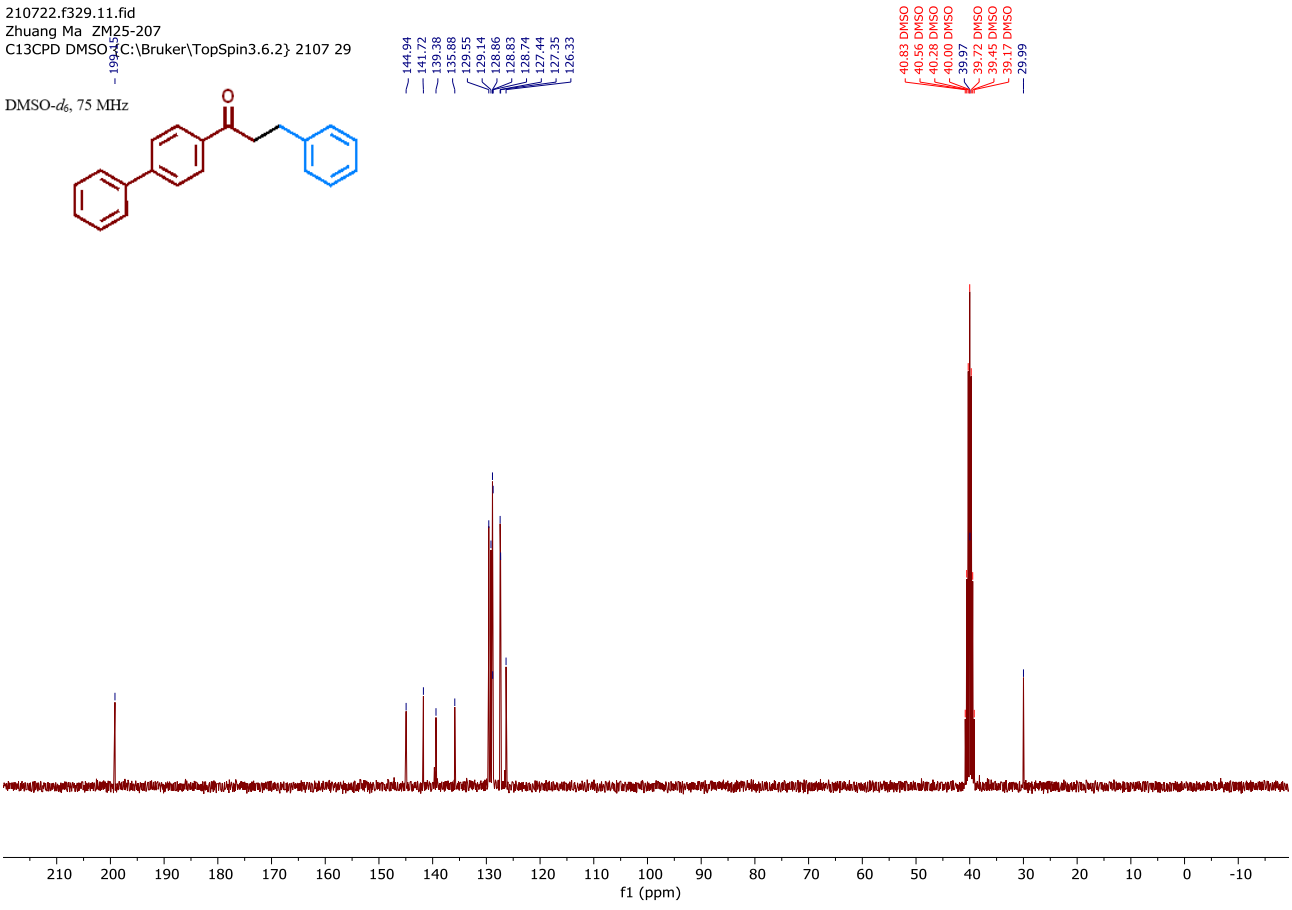


1079



1080

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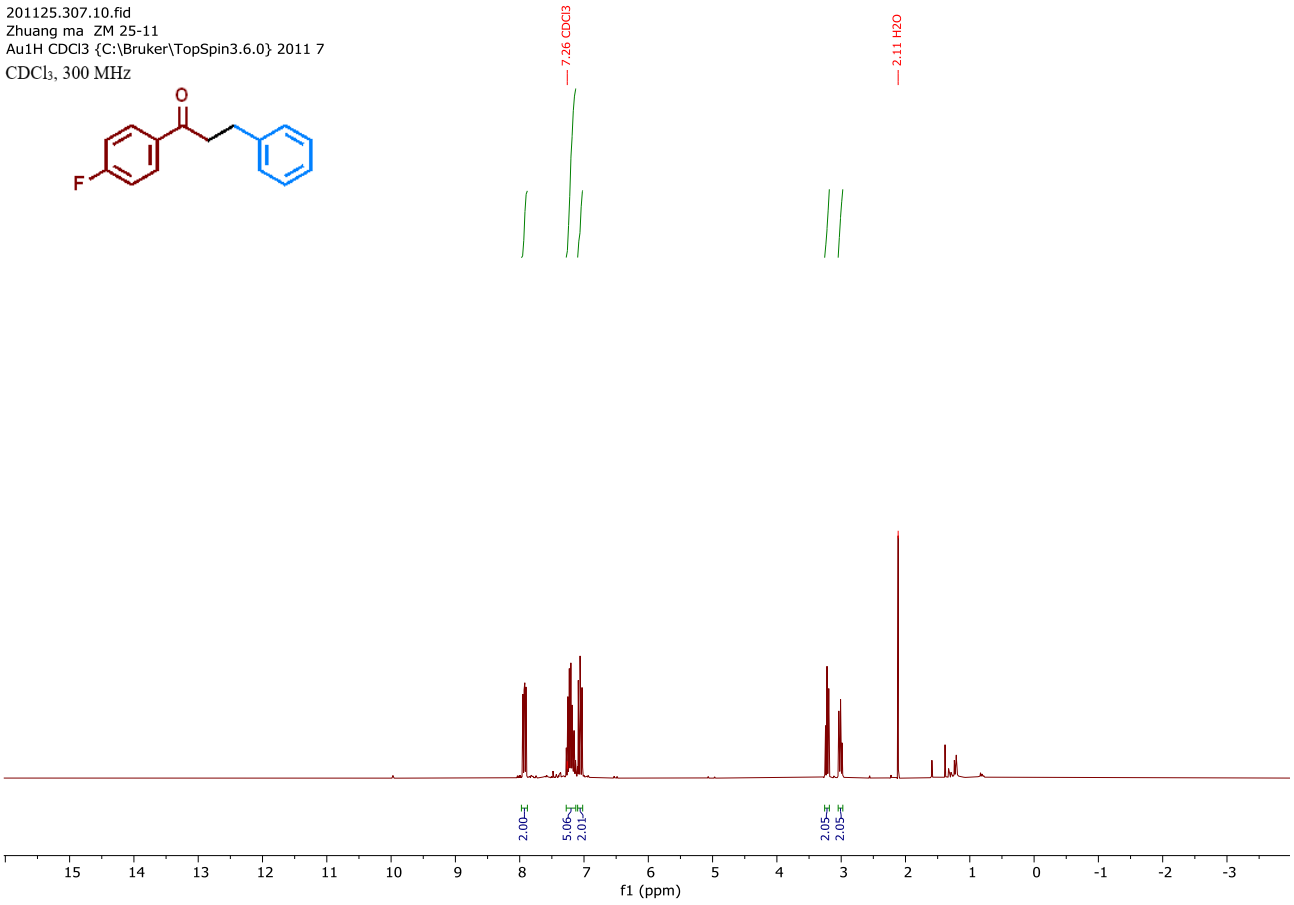
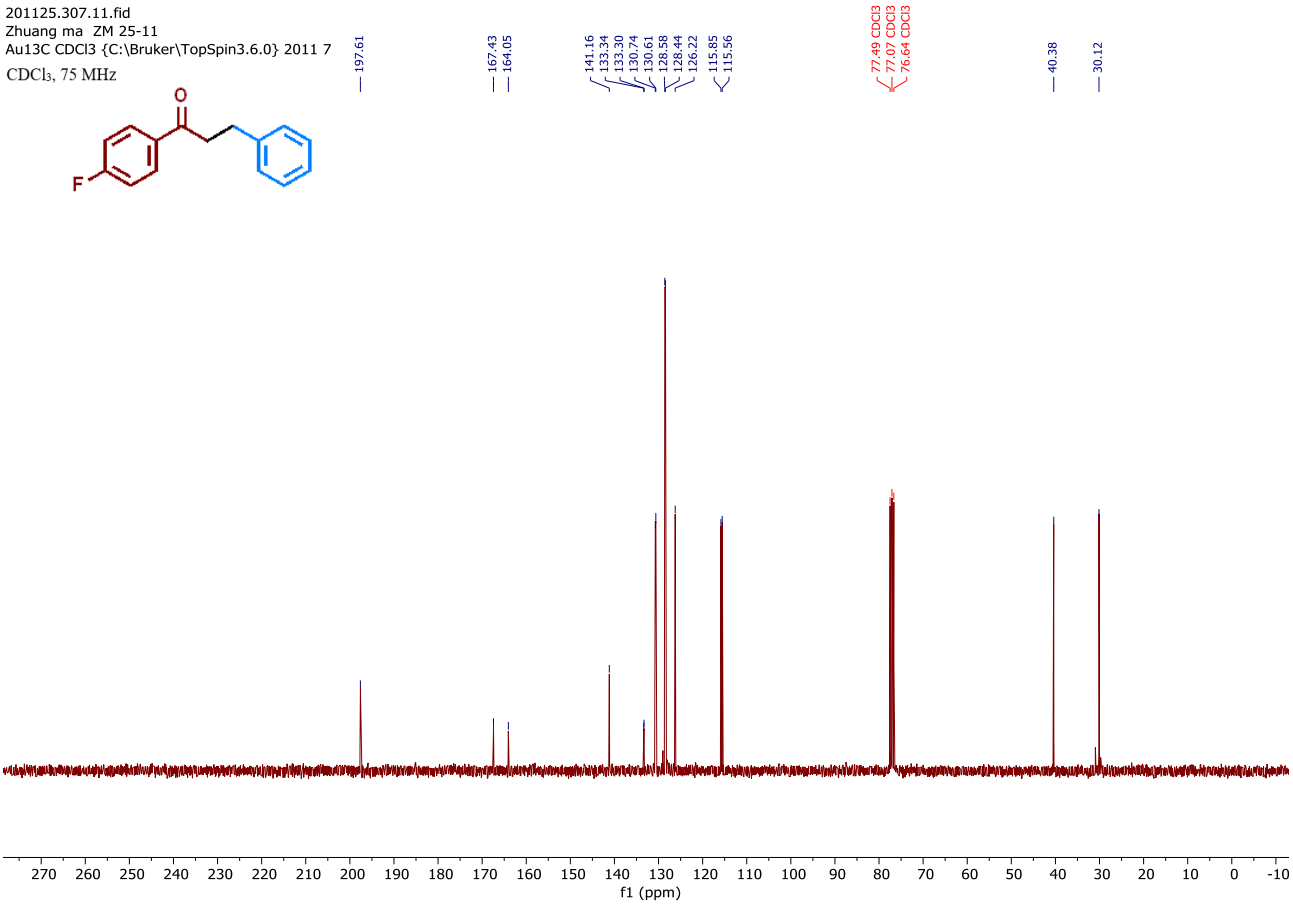
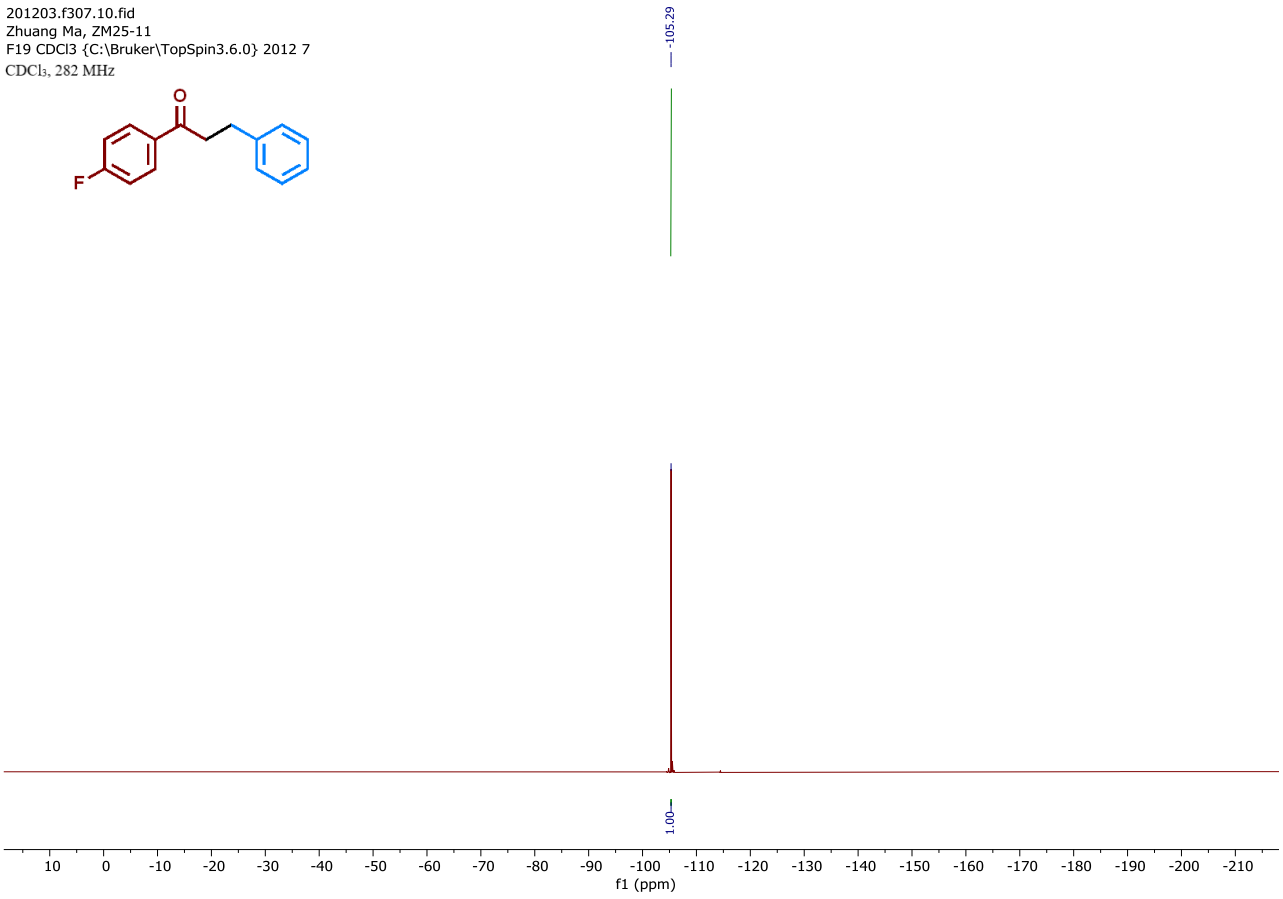


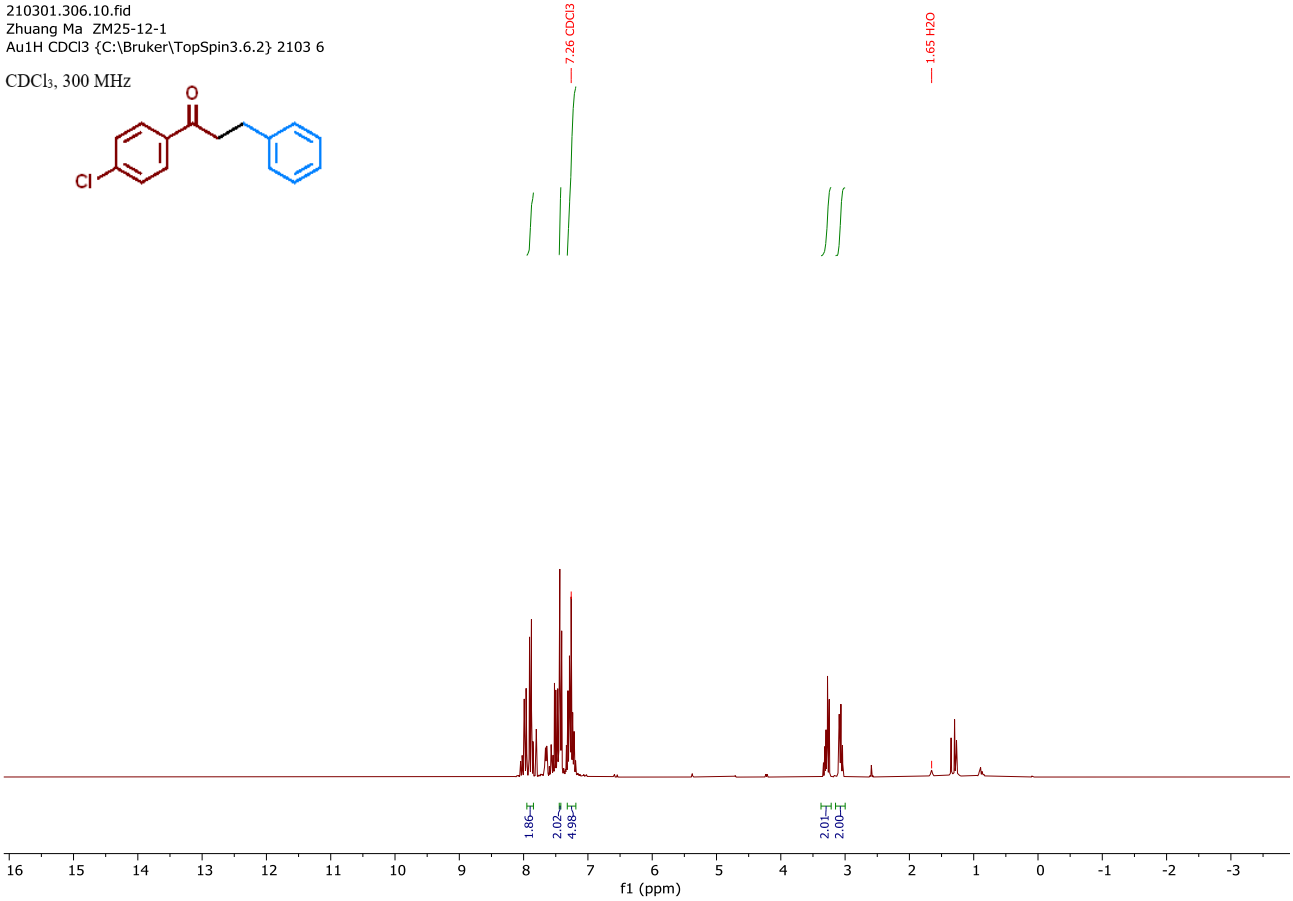
1082



1083

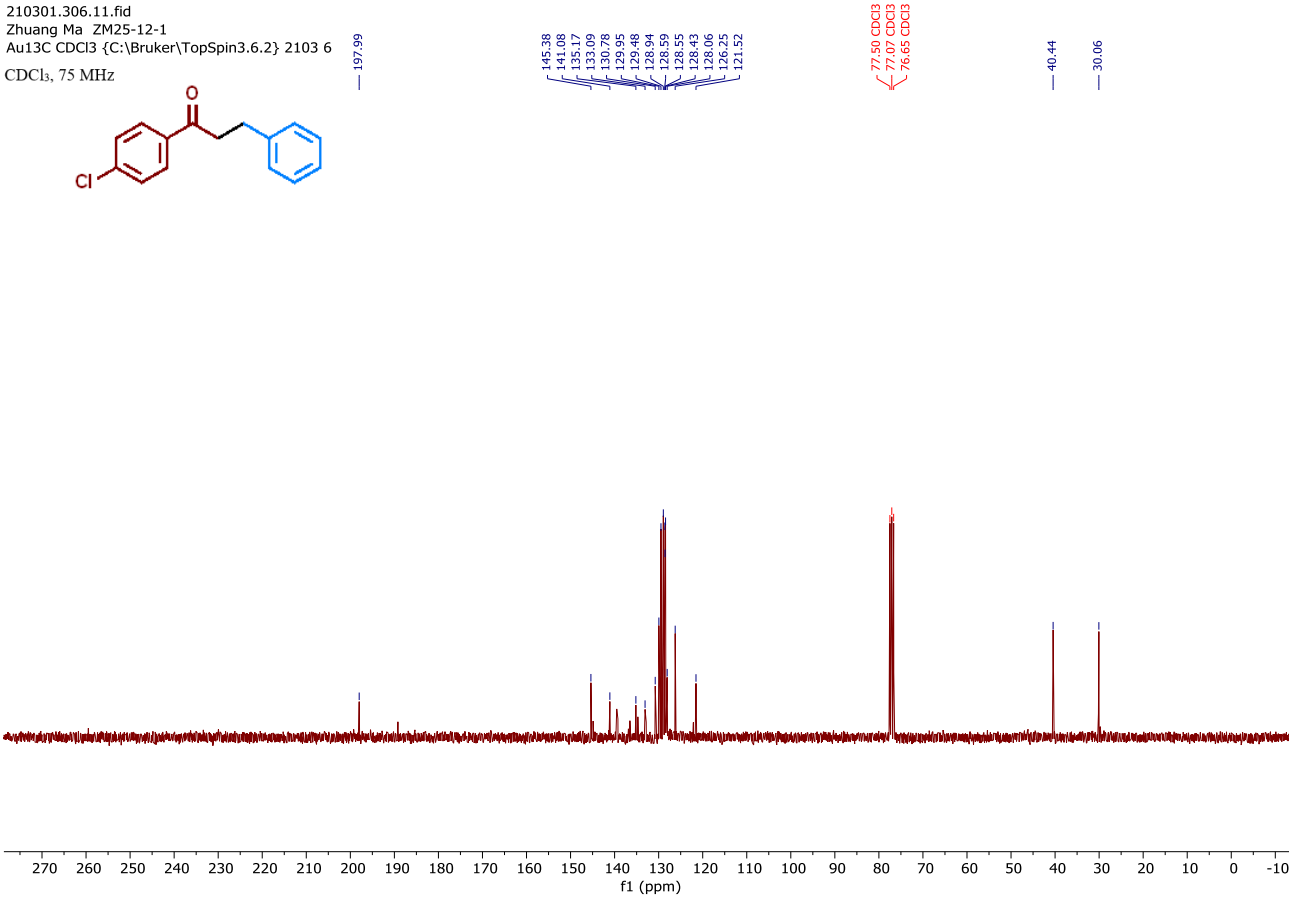
1084


201203.f307.10.fid
Zhuang Ma, ZM25-11
F19 CDCl3 {C:\Bruker\TopSpin3.6.0} 2012 7
CDCl3, 282 MHz
O
F
-105.29
1.00
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

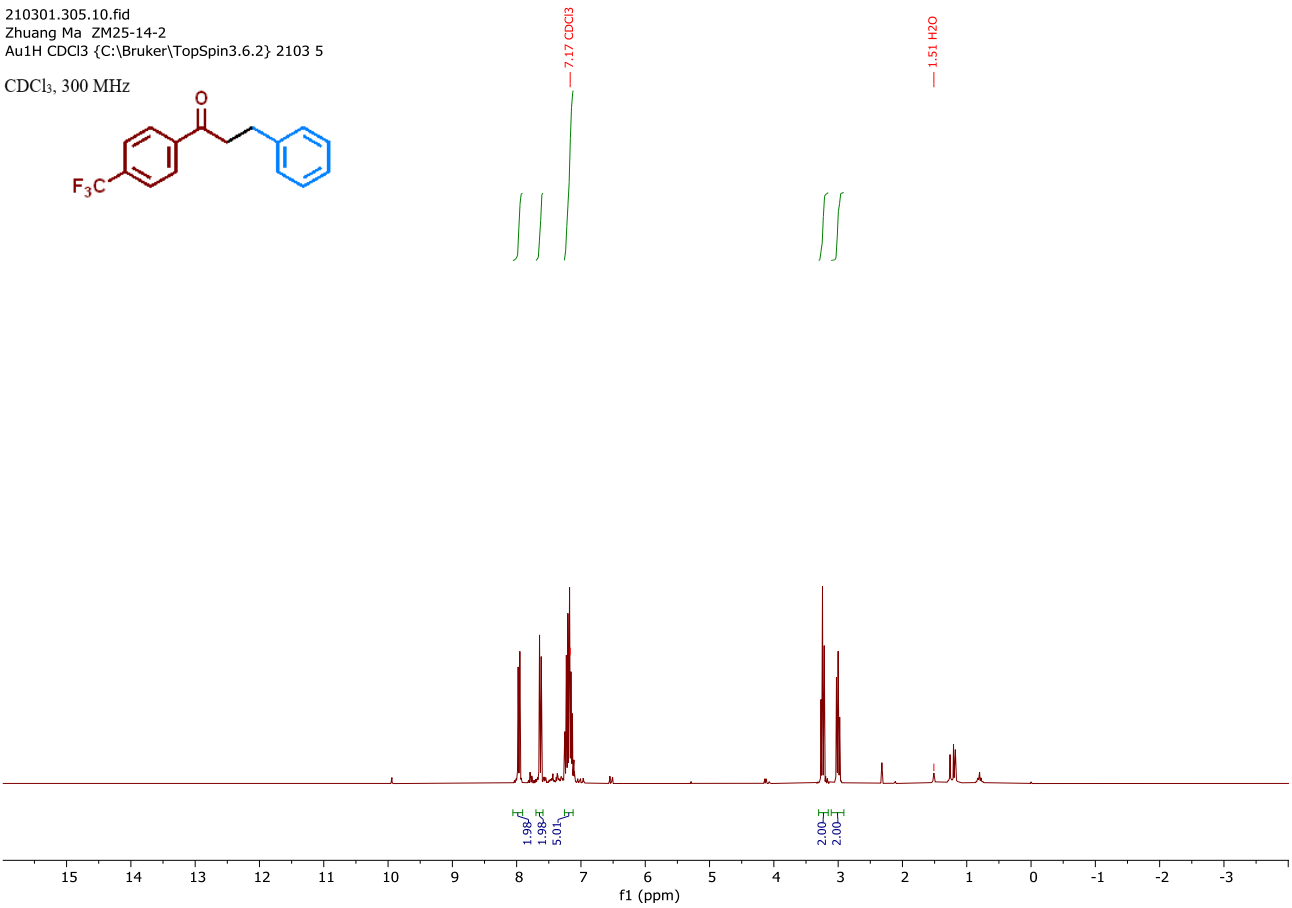


1098

1099

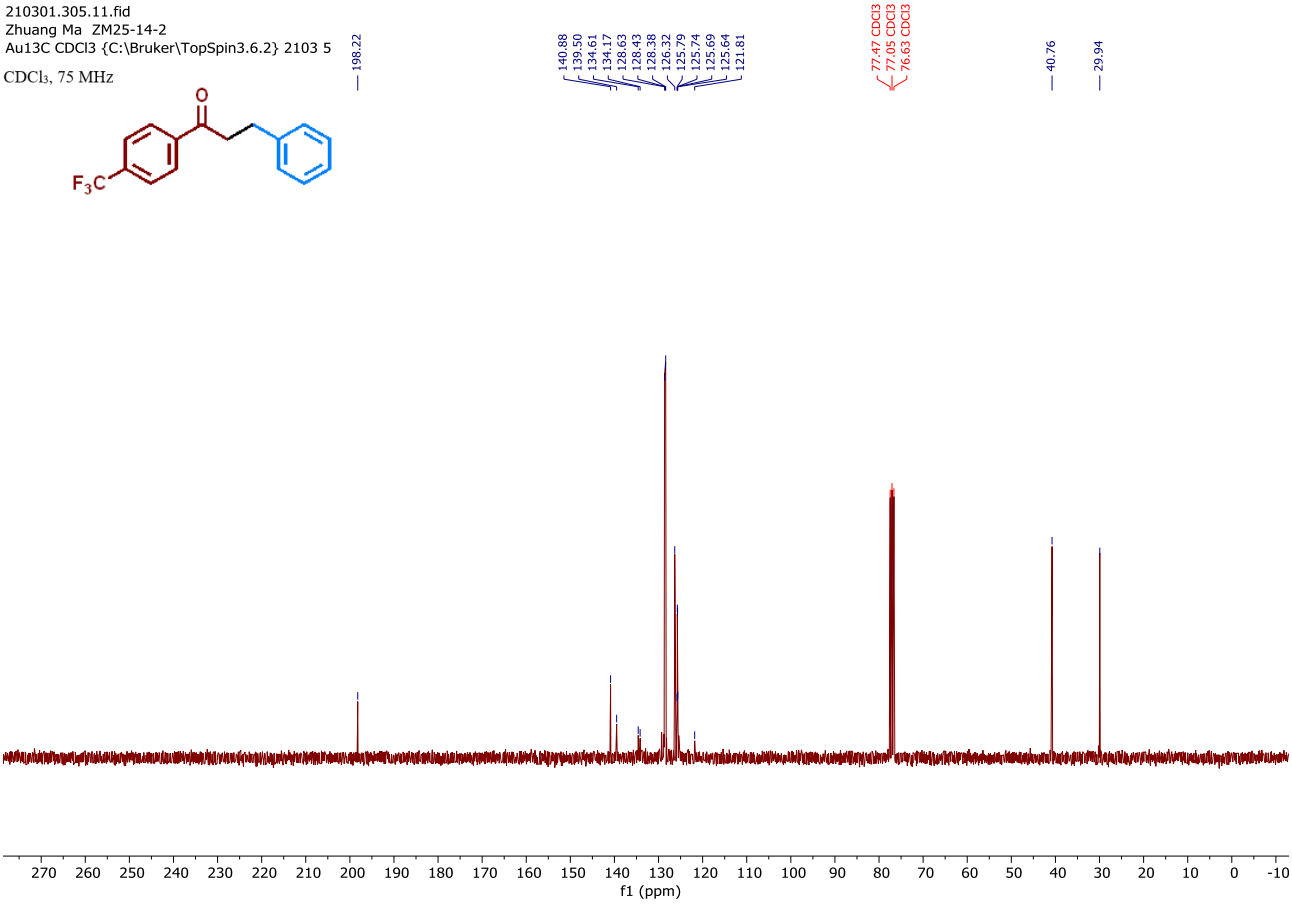


1100

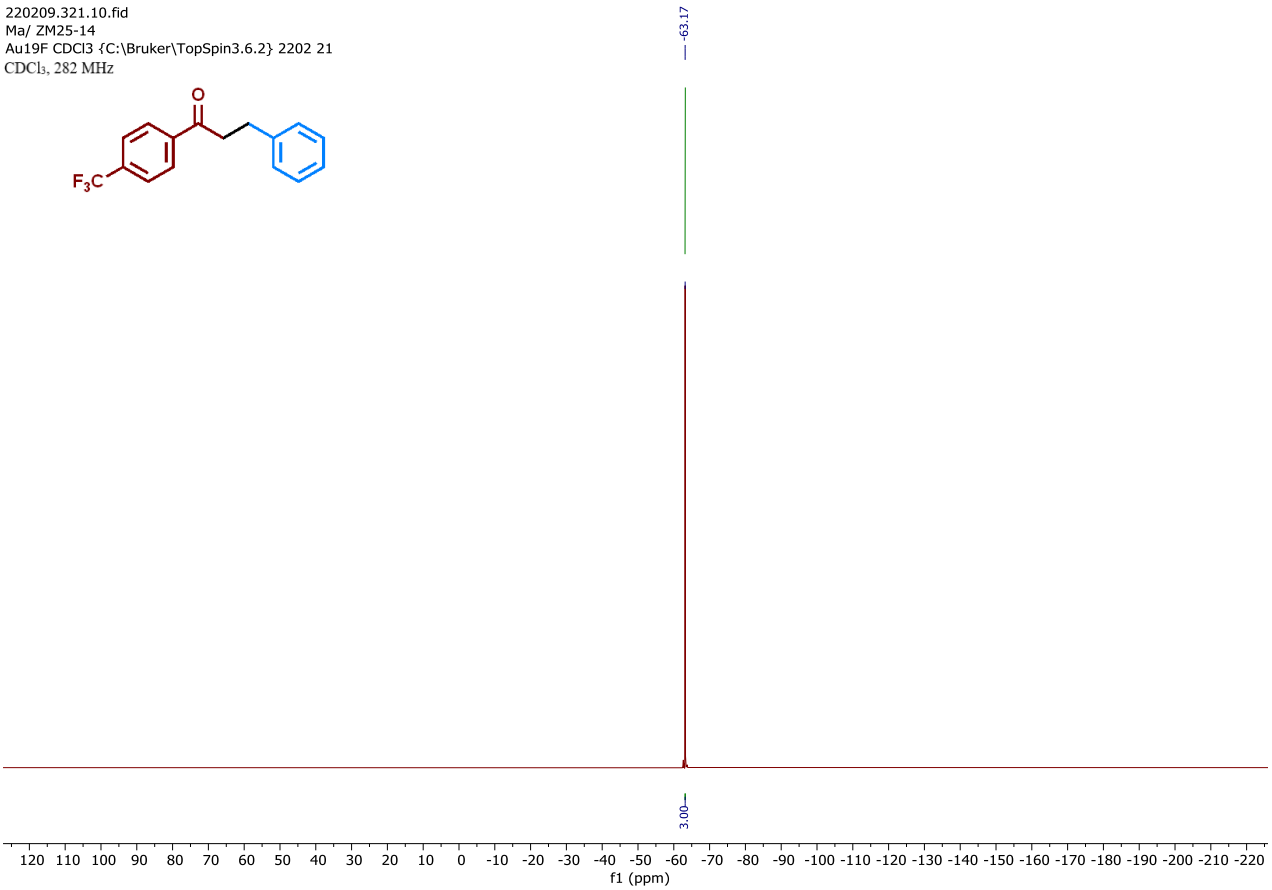


1101

1102



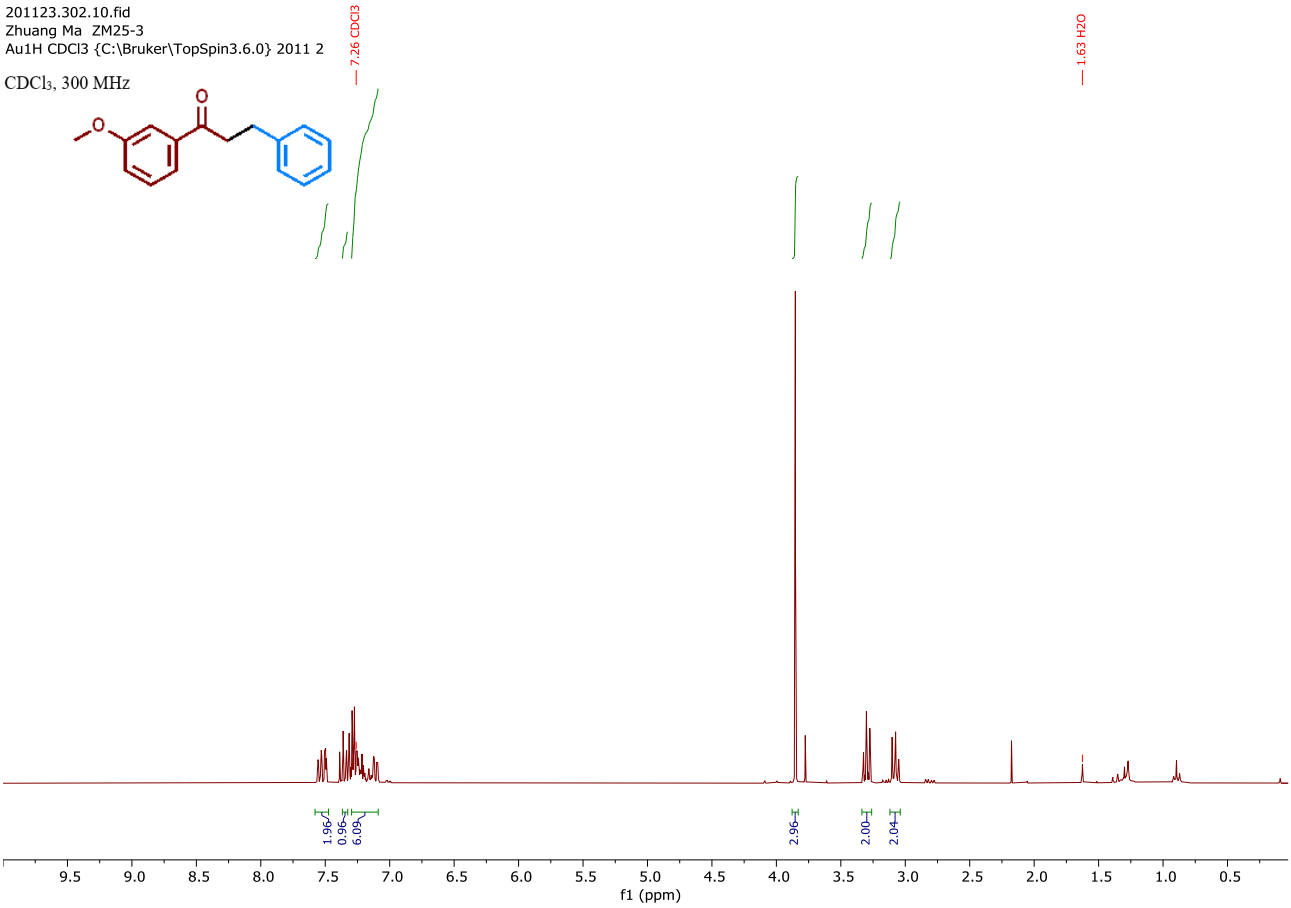
1103



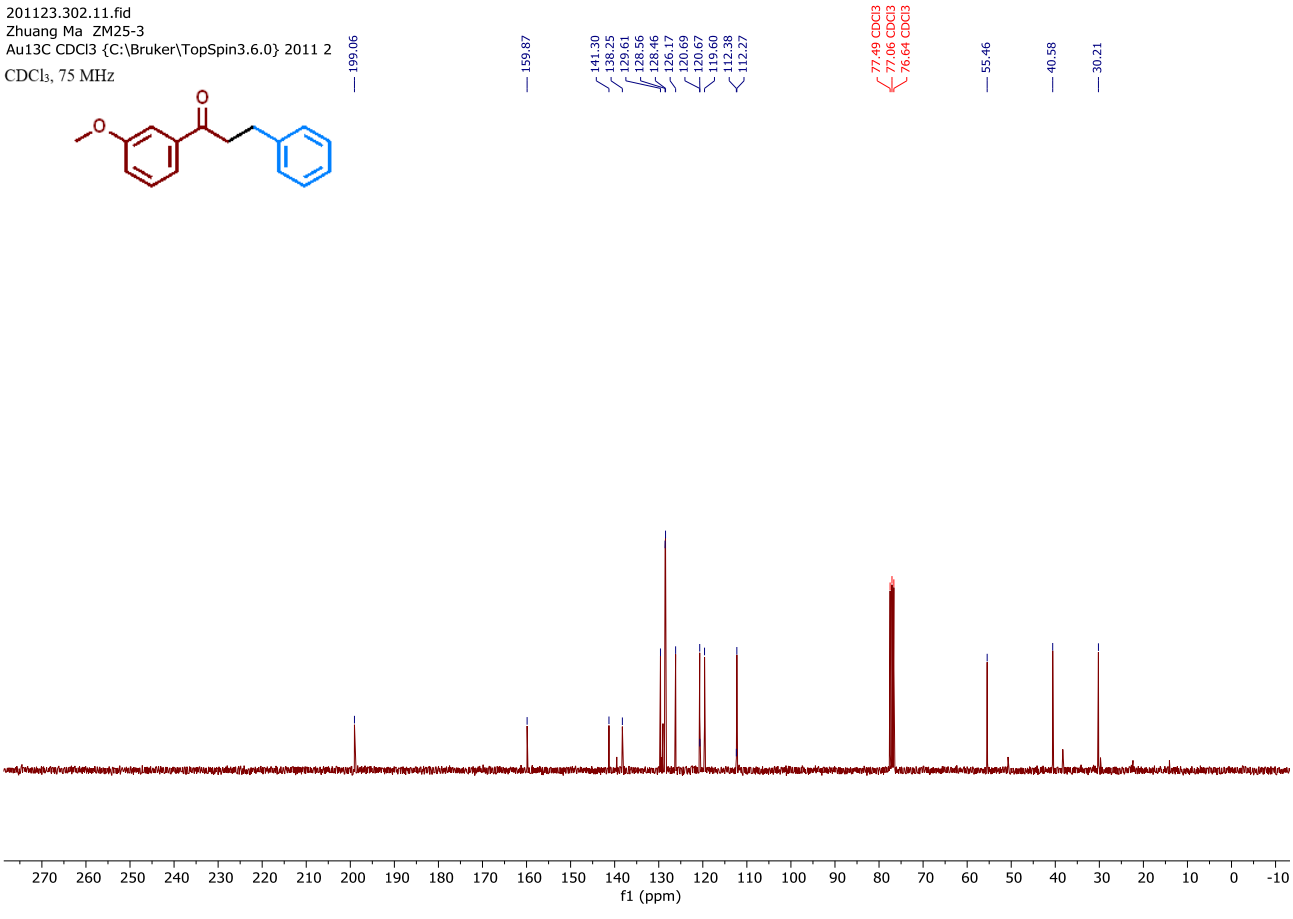
1104

1105

1106

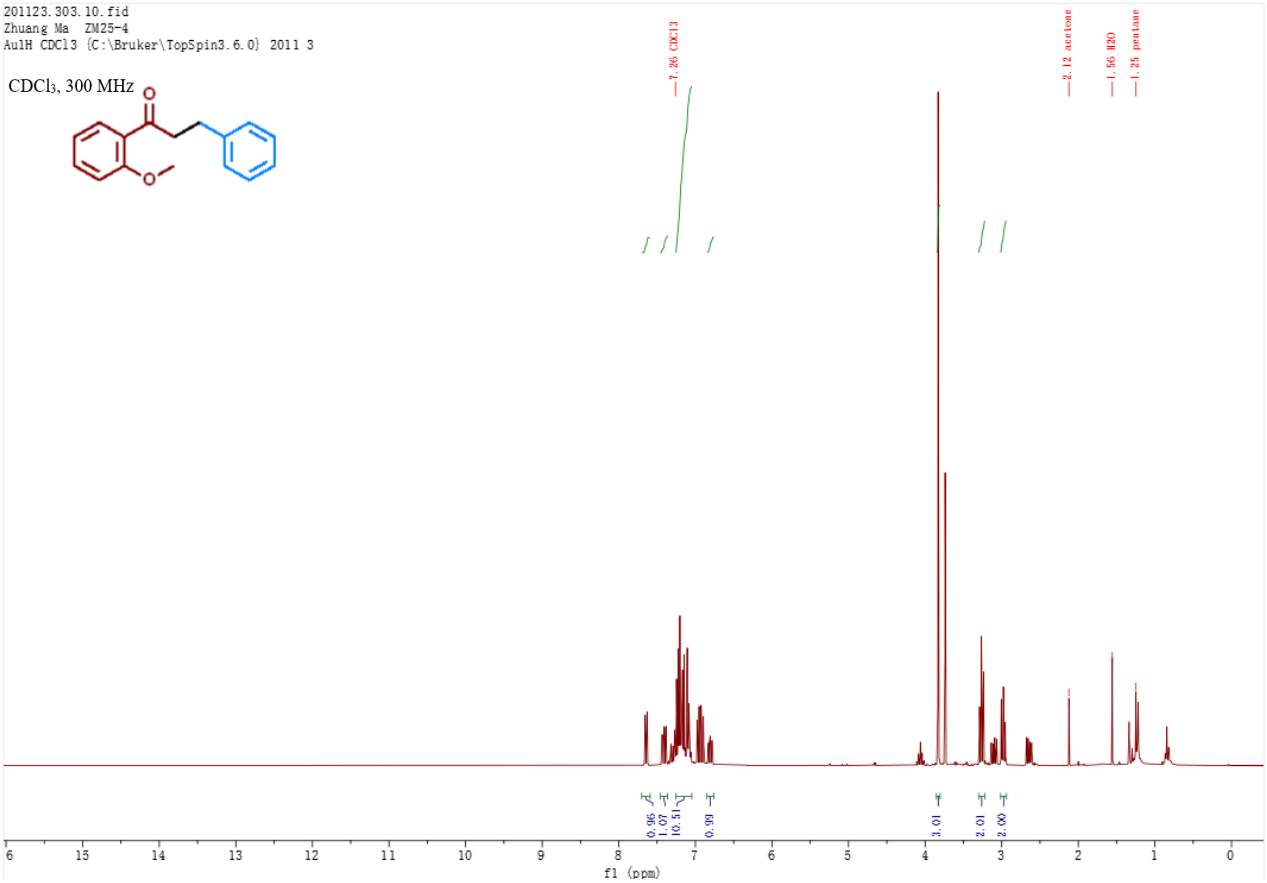


1107

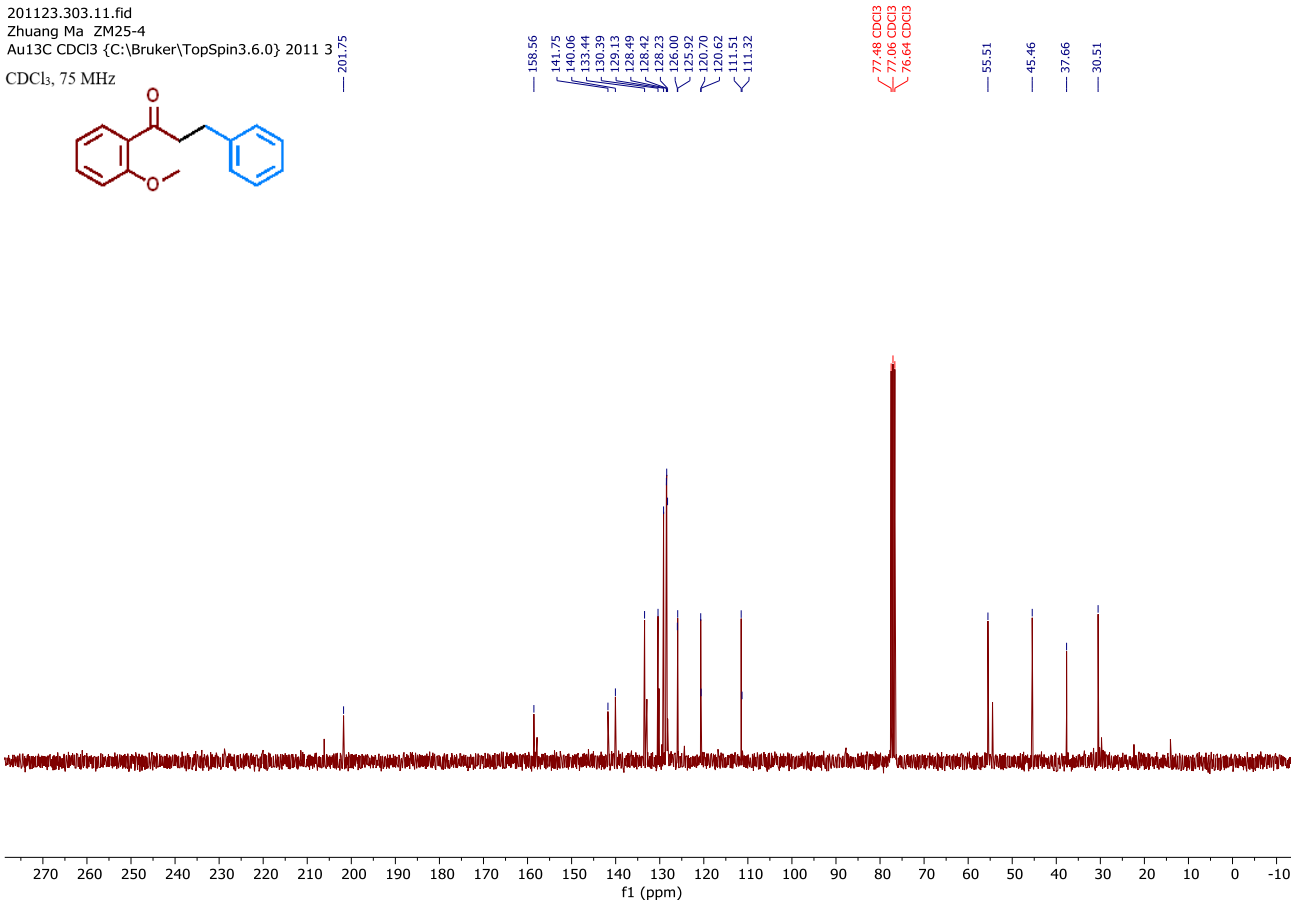


1108

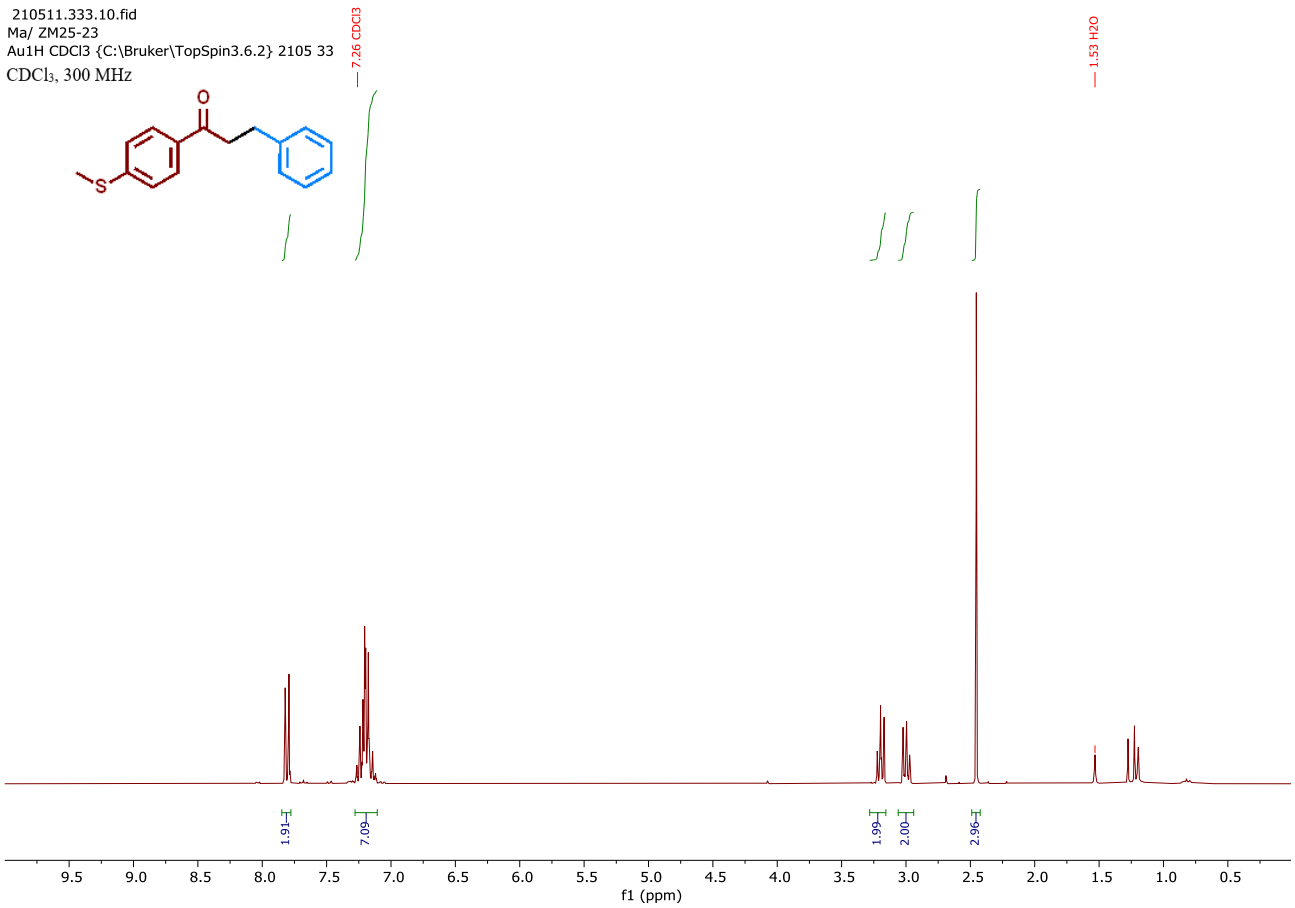
1109


201123.303.10.fid
Zhuang Ma ZM25-4
Au1H CDCl3 {C:\Bruker\TopSpin3.6.0} 2011 3
CDCl3, 300 MHz
7.26 CDCl3
2.12 acetone
1.56 H2O
1.25 pentane
0.96
1.07
10.51
0.99
3.01
2.01
2.00
f1 (ppm)

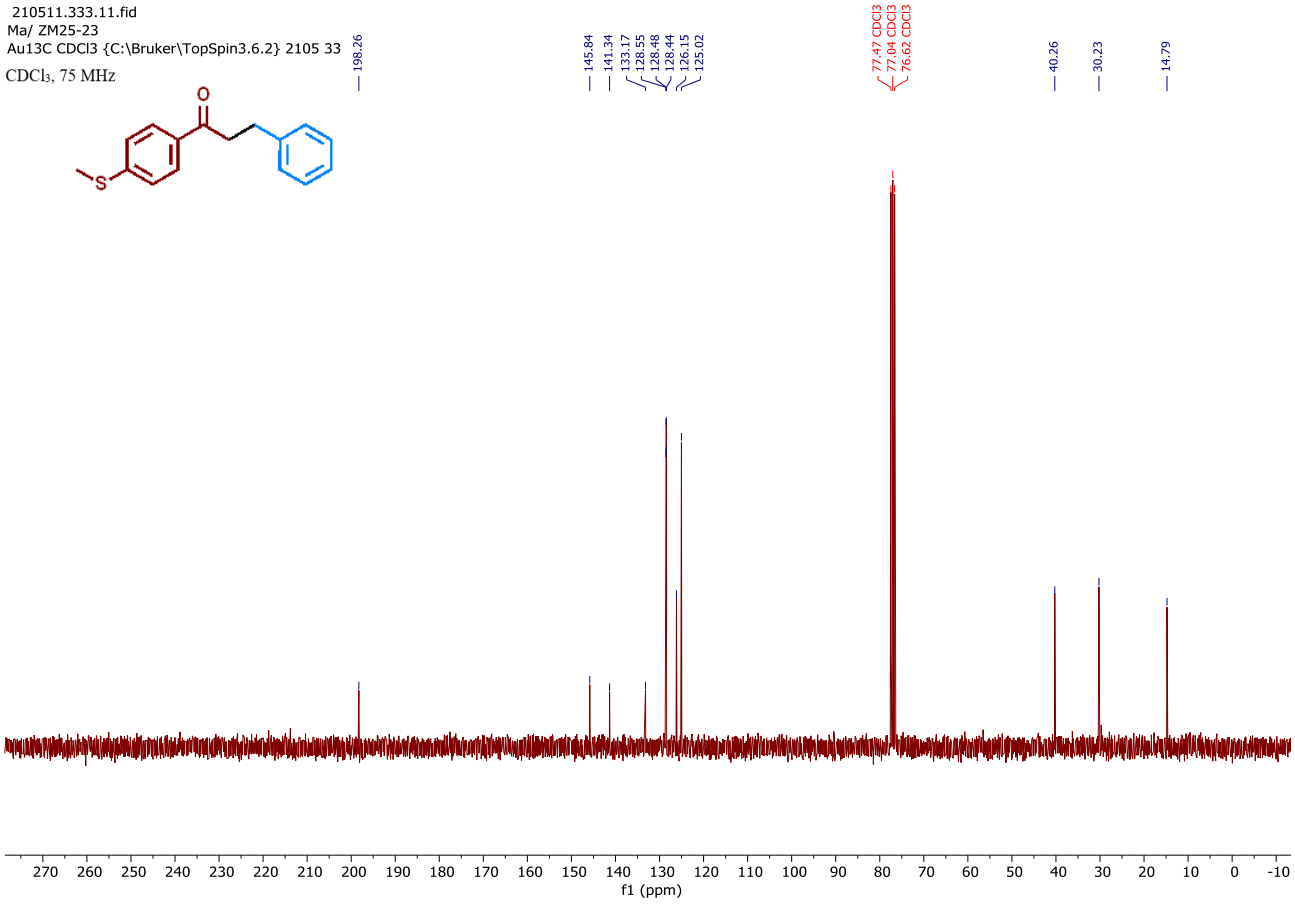
1110


201123.303.11.fid
Zhuang Ma ZM25-4
Au13C CDCl3 {C:\Bruker\TopSpin3.6.0} 2011 3
CDCl3, 75 MHz
201.75
158.56
141.75
140.06
133.44
130.39
129.13
128.49
128.42
128.23
126.00
125.92
120.70
120.62
111.51
111.32
77.48 CDCl3
77.06 CDCl3
76.64 CDCl3
55.51
45.46
37.66
30.51
f1 (ppm)

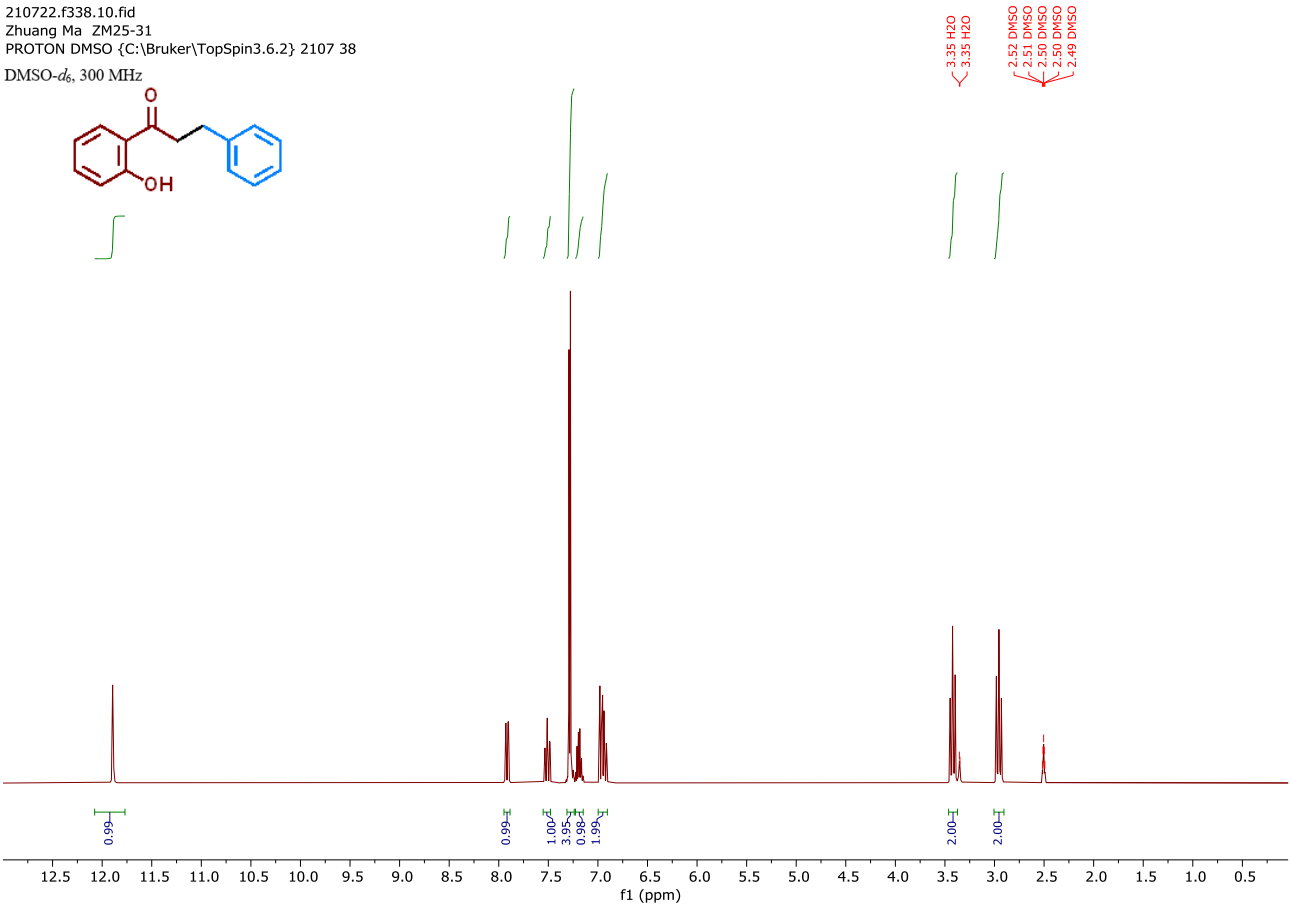
1111


210511.333.10.fid
Ma/ ZM25-23
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 33
CDCl3, 300 MHz
7.26 CDCl3
1.53 H2O
1.91
7.09
1.99
2.00
2.96
f1 (ppm)

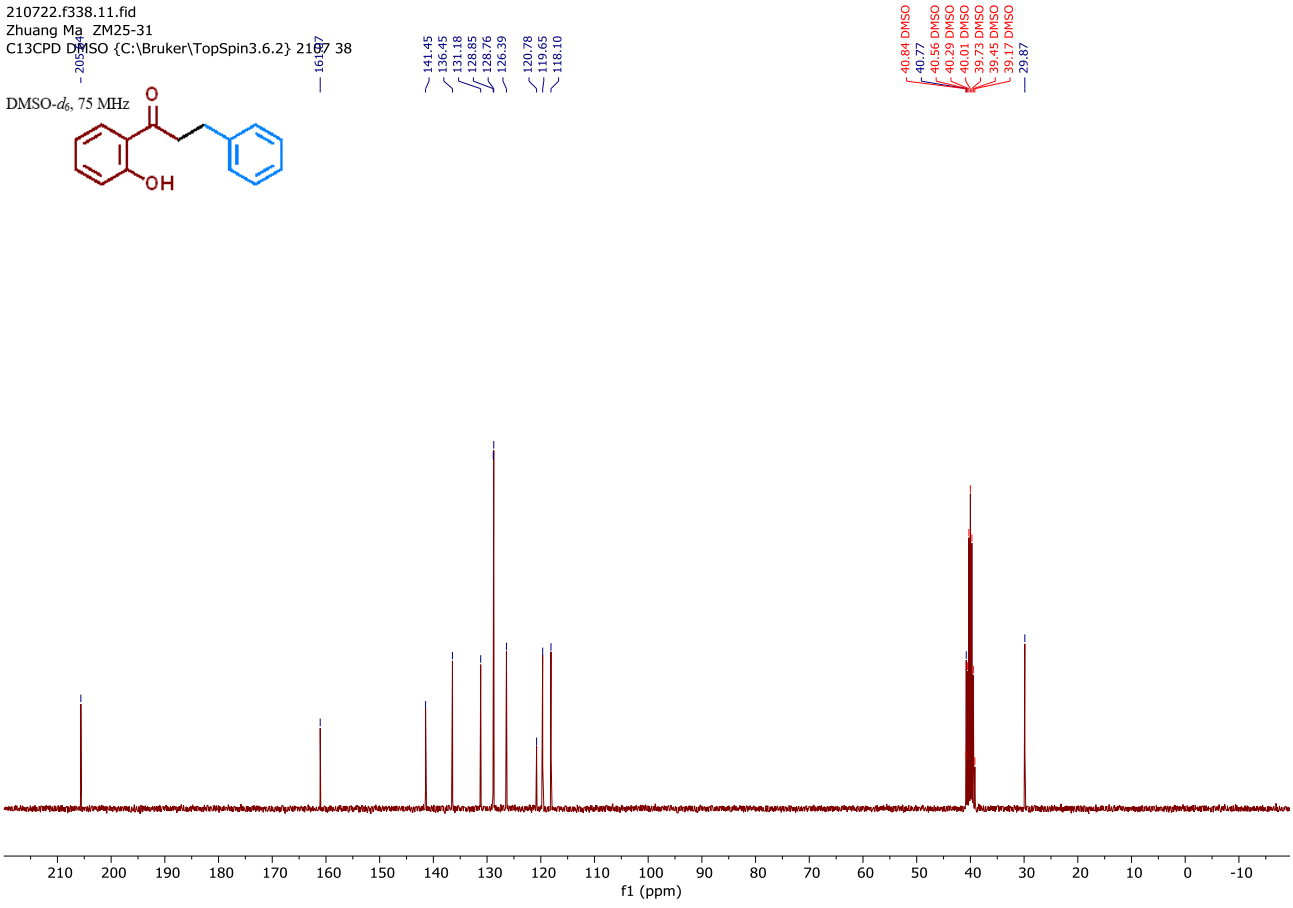
1112


210511.333.11.fid
Ma/ ZM25-23
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 33
CDCl3, 75 MHz
198.26
145.84
141.34
133.17
128.55
128.48
128.44
126.15
125.02
77.47 CDCl3
77.04 CDCl3
76.62 CDCl3
40.26
30.23
14.79
f1 (ppm)

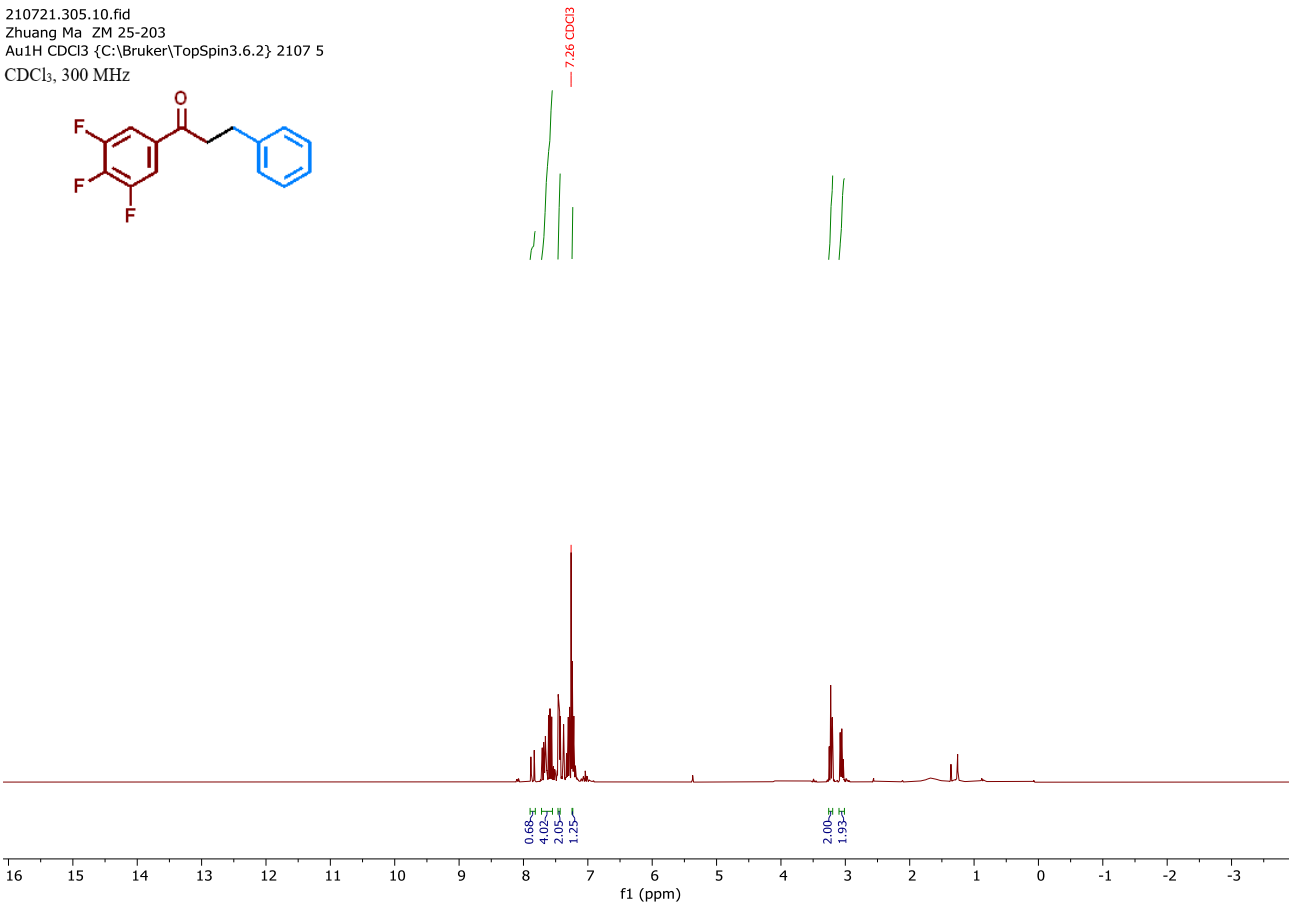
1113


210722.f338.10.fid
Zhuang Ma ZM25-31
PROTON DMSO {C:\Bruker\TopSpin3.6.2} 2107 38
DMSO-d_6, 300 MHz
3.35 H2O
3.35 H2O
2.52 DMSO
2.51 DMSO
2.50 DMSO
2.50 DMSO
2.49 DMSO
0.99
0.99
1.00
3.95
0.98
1.99
2.00
2.00
f1 (ppm)

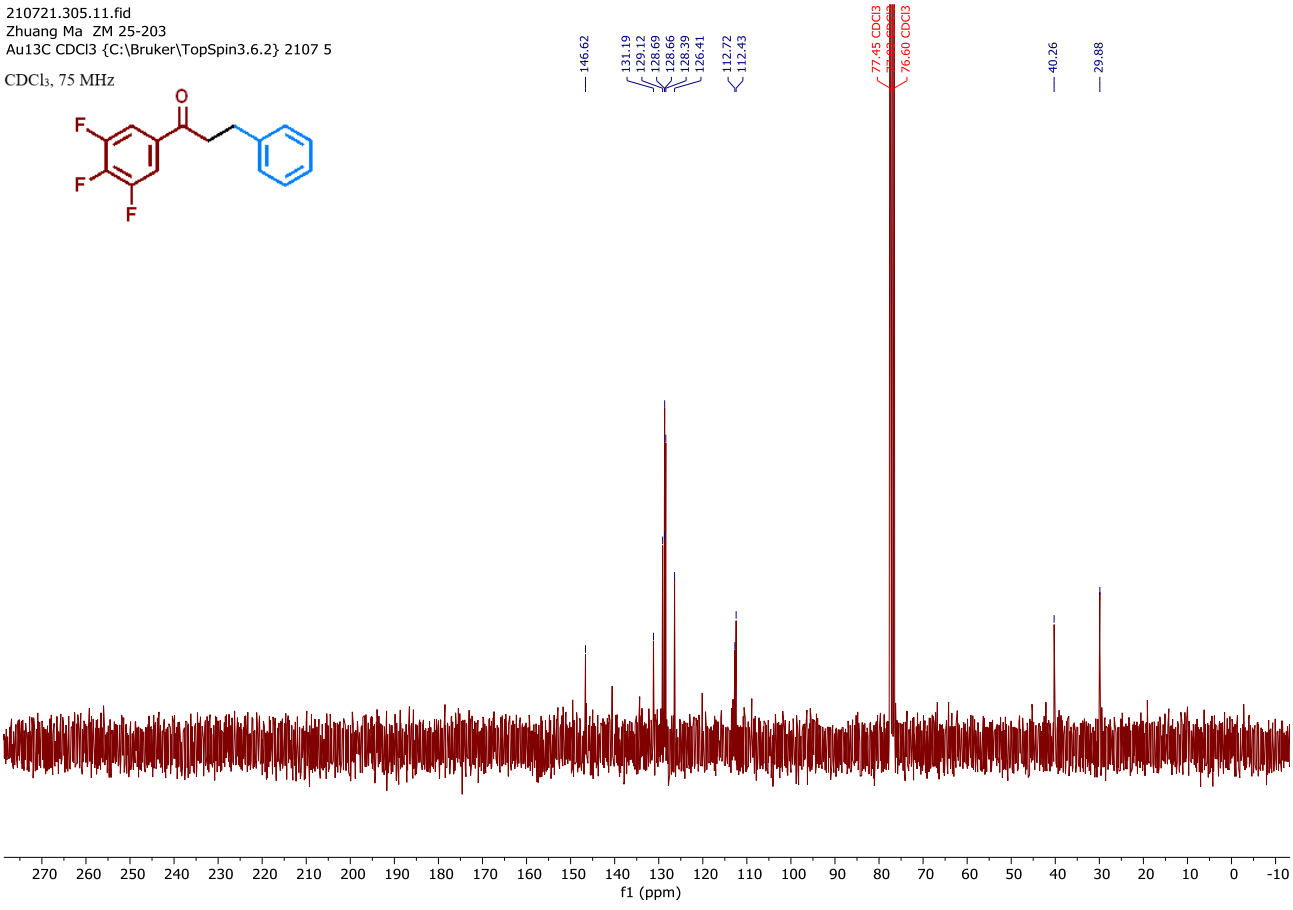
1114


210722.f338.11.fid
Zhuang Ma ZM25-31
C13CPD DMSO {C:\Bruker\TopSpin3.6.2} 2107 38
DMSO-d_6, 75 MHz
141.45
136.45
131.18
128.85
128.76
126.39
120.78
119.65
118.10
40.84 DMSO
40.77
40.56 DMSO
40.29 DMSO
40.01 DMSO
39.73 DMSO
39.45 DMSO
39.17 DMSO
29.87
f1 (ppm)

1115

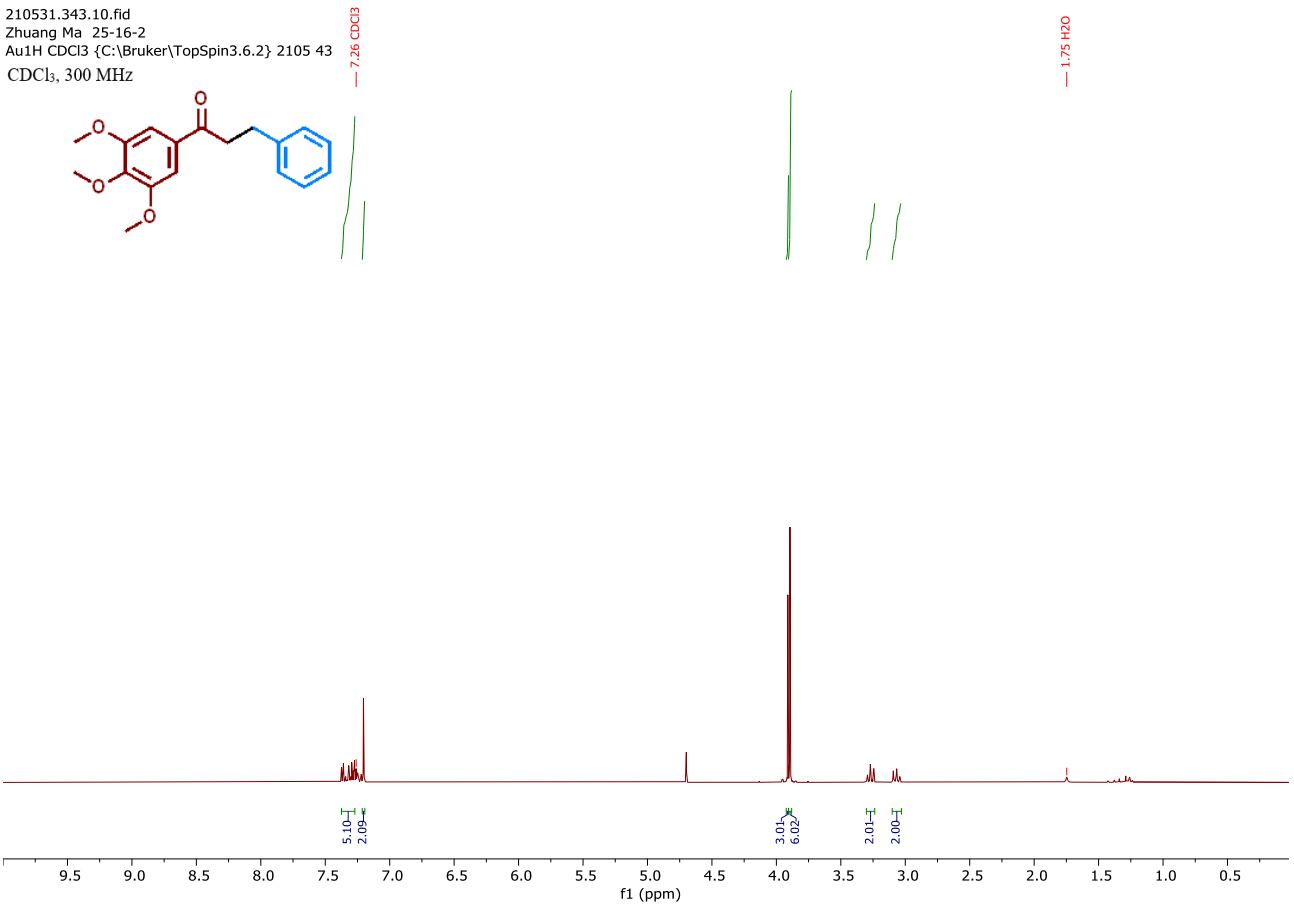


1116

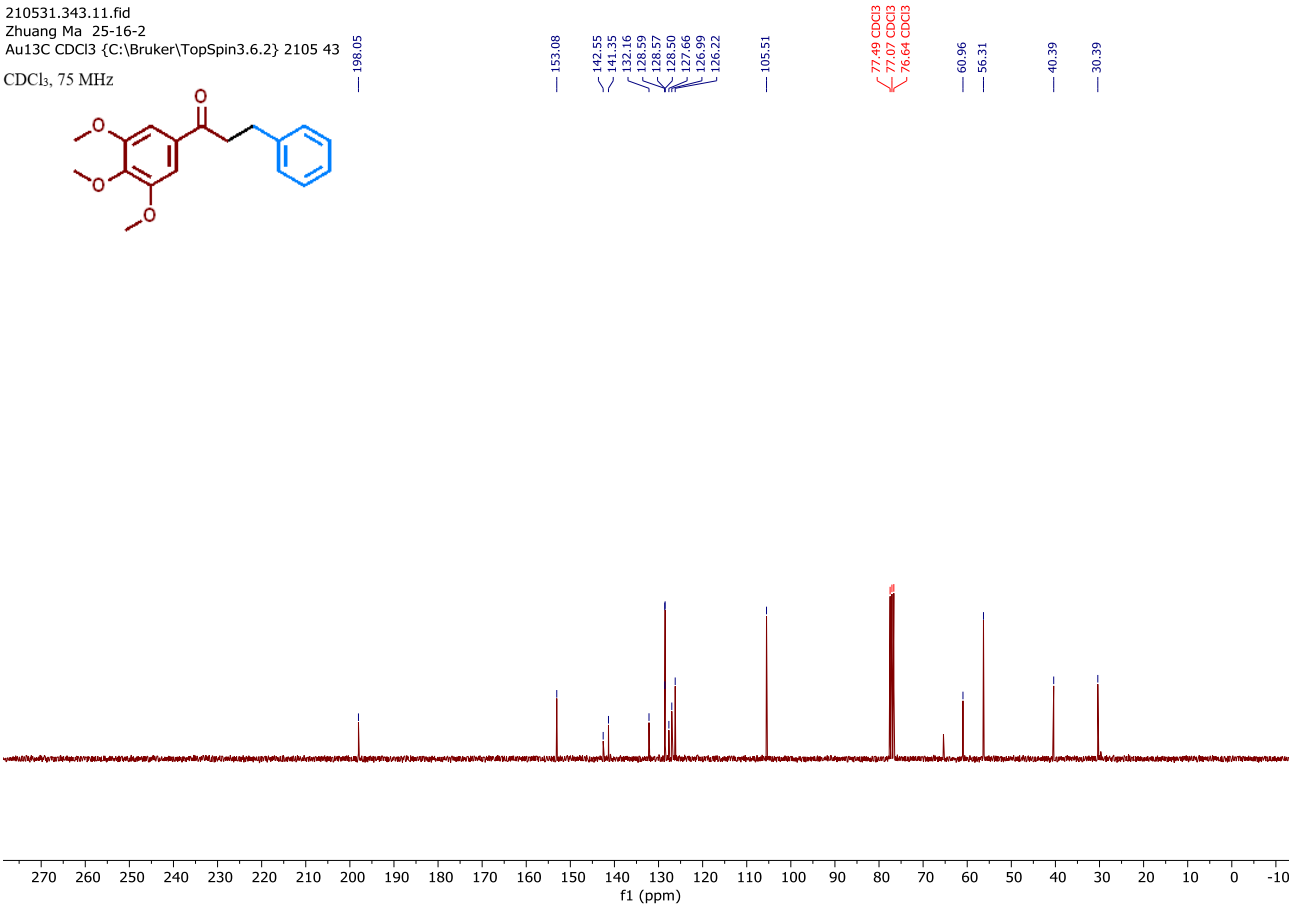


1117

1118

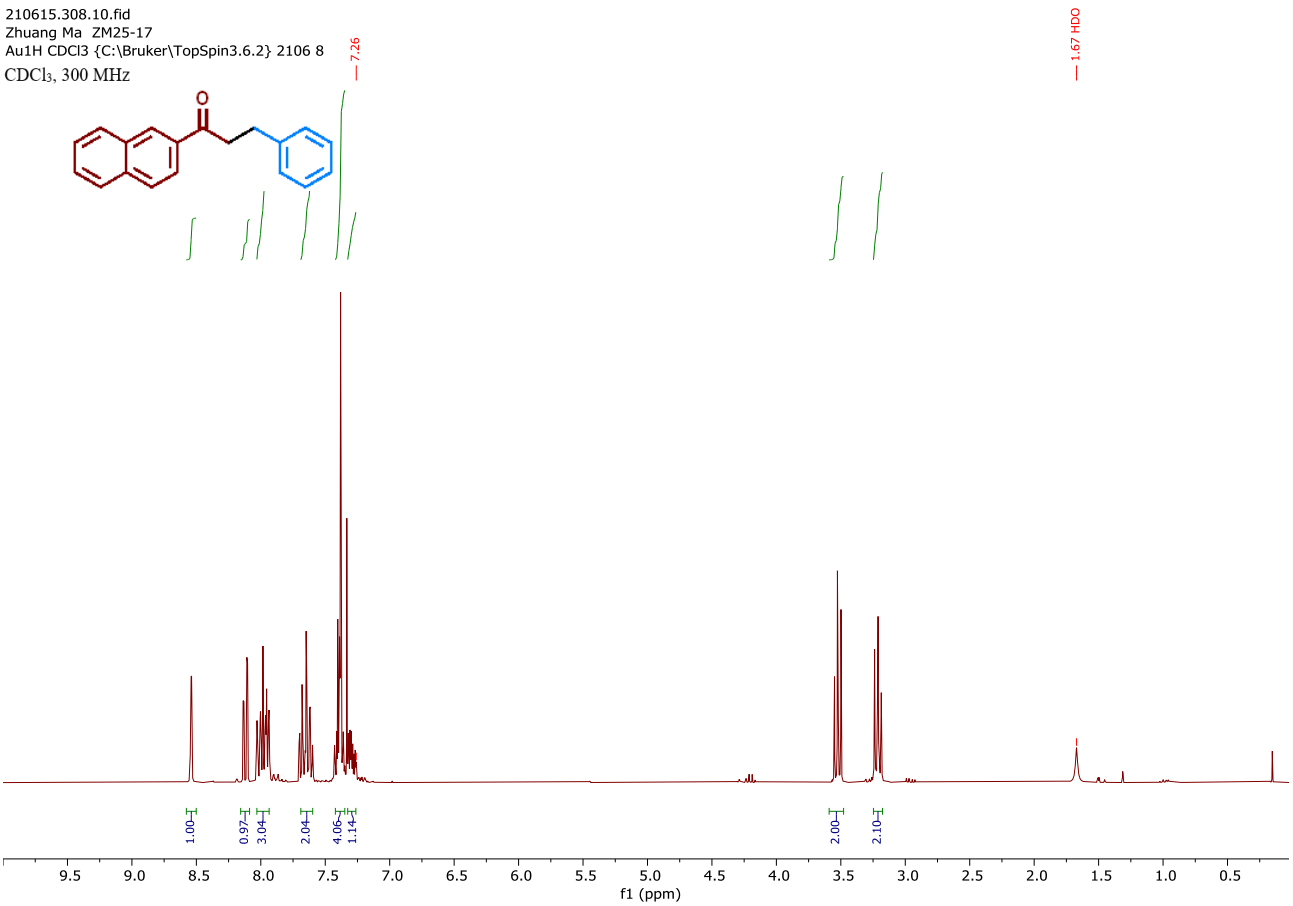


1119



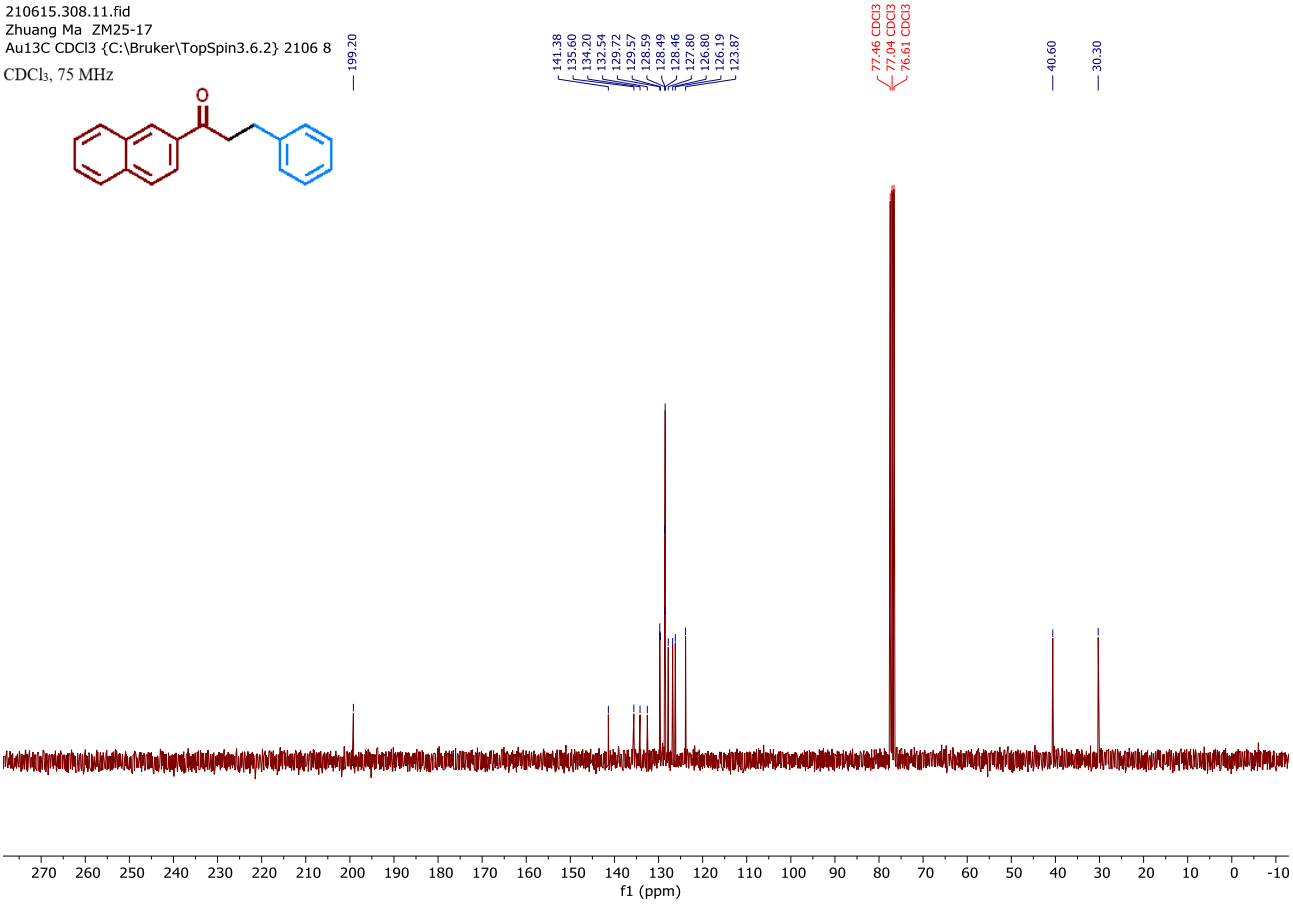
1120

1121

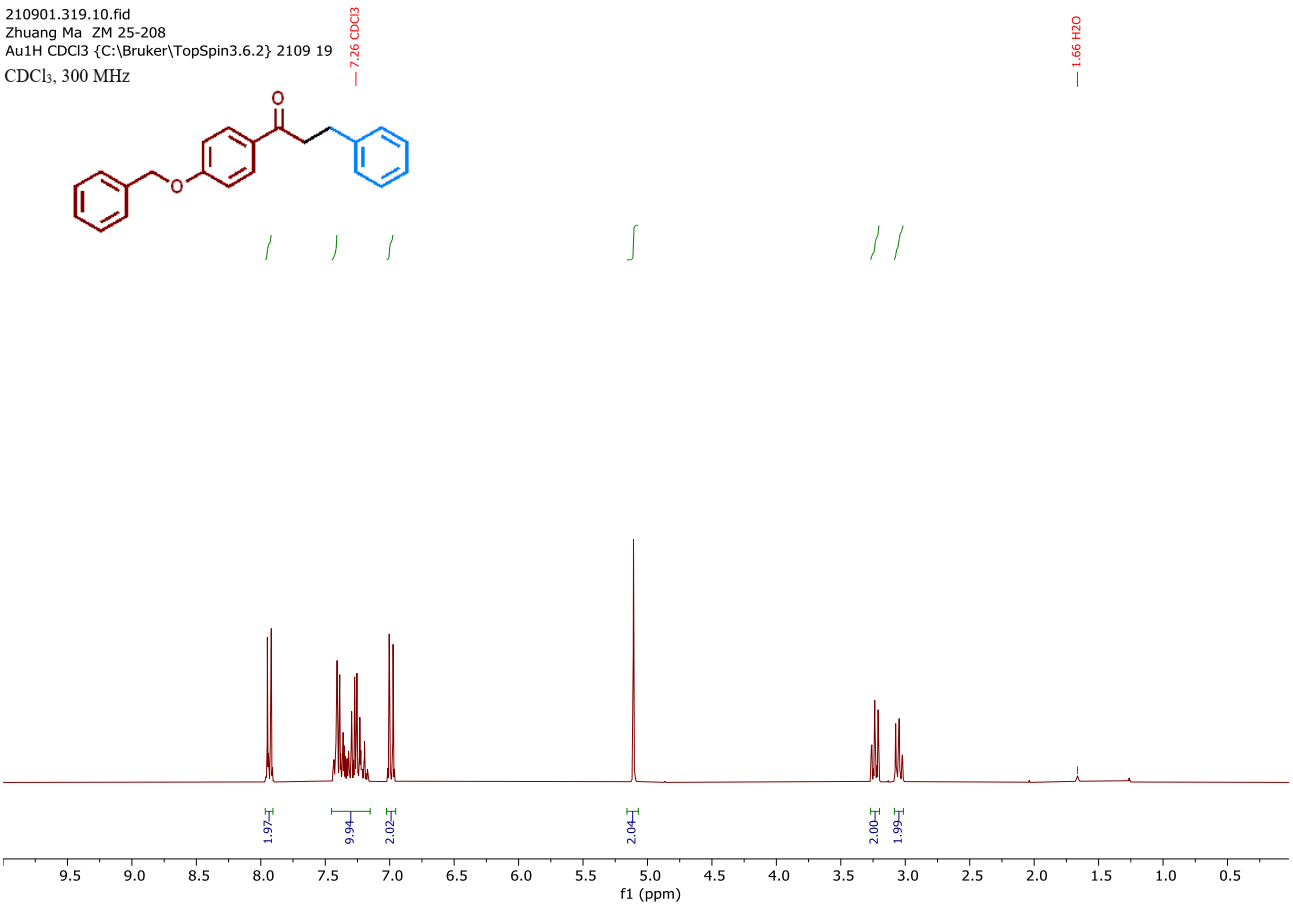


1122

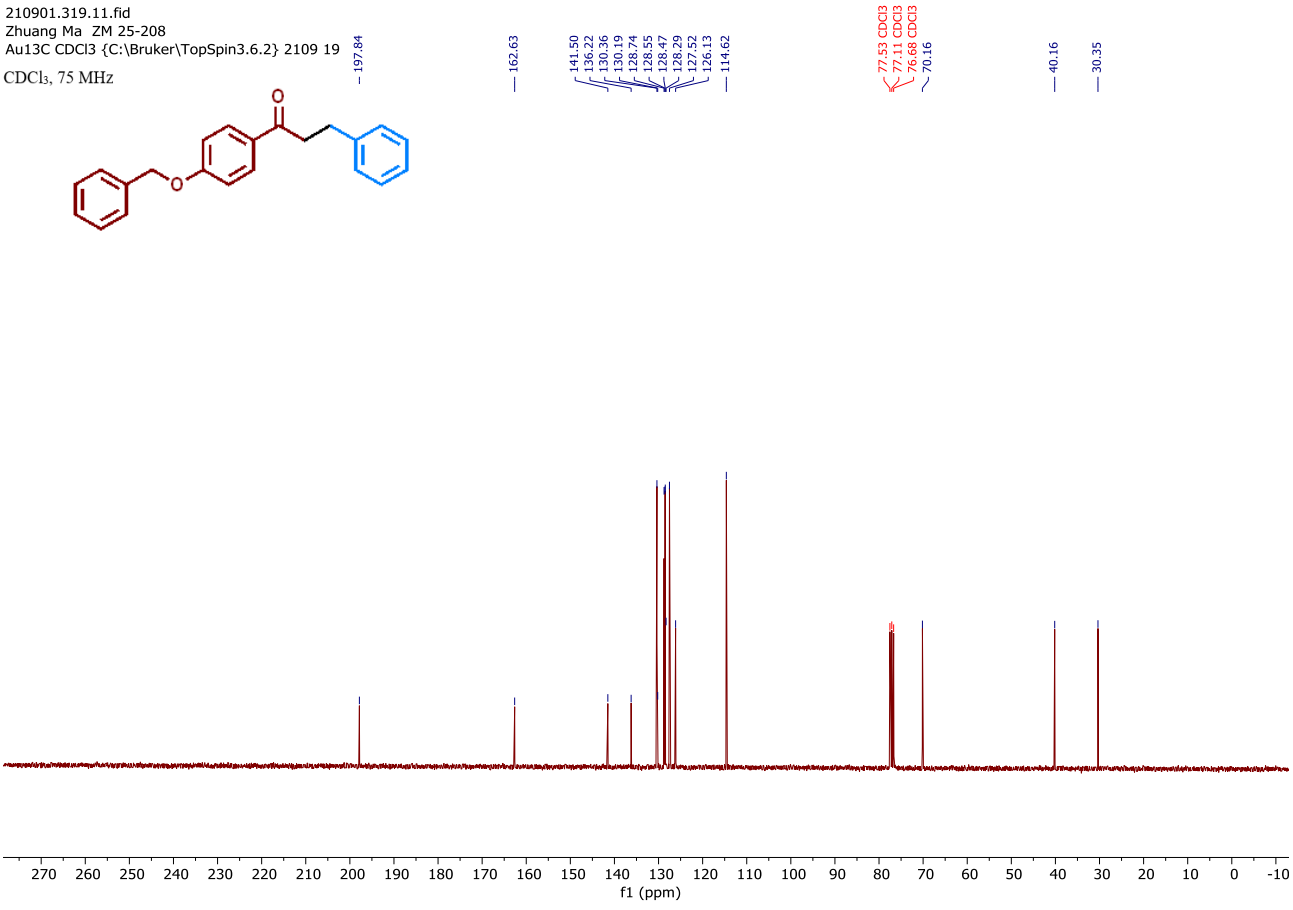
1123



1124

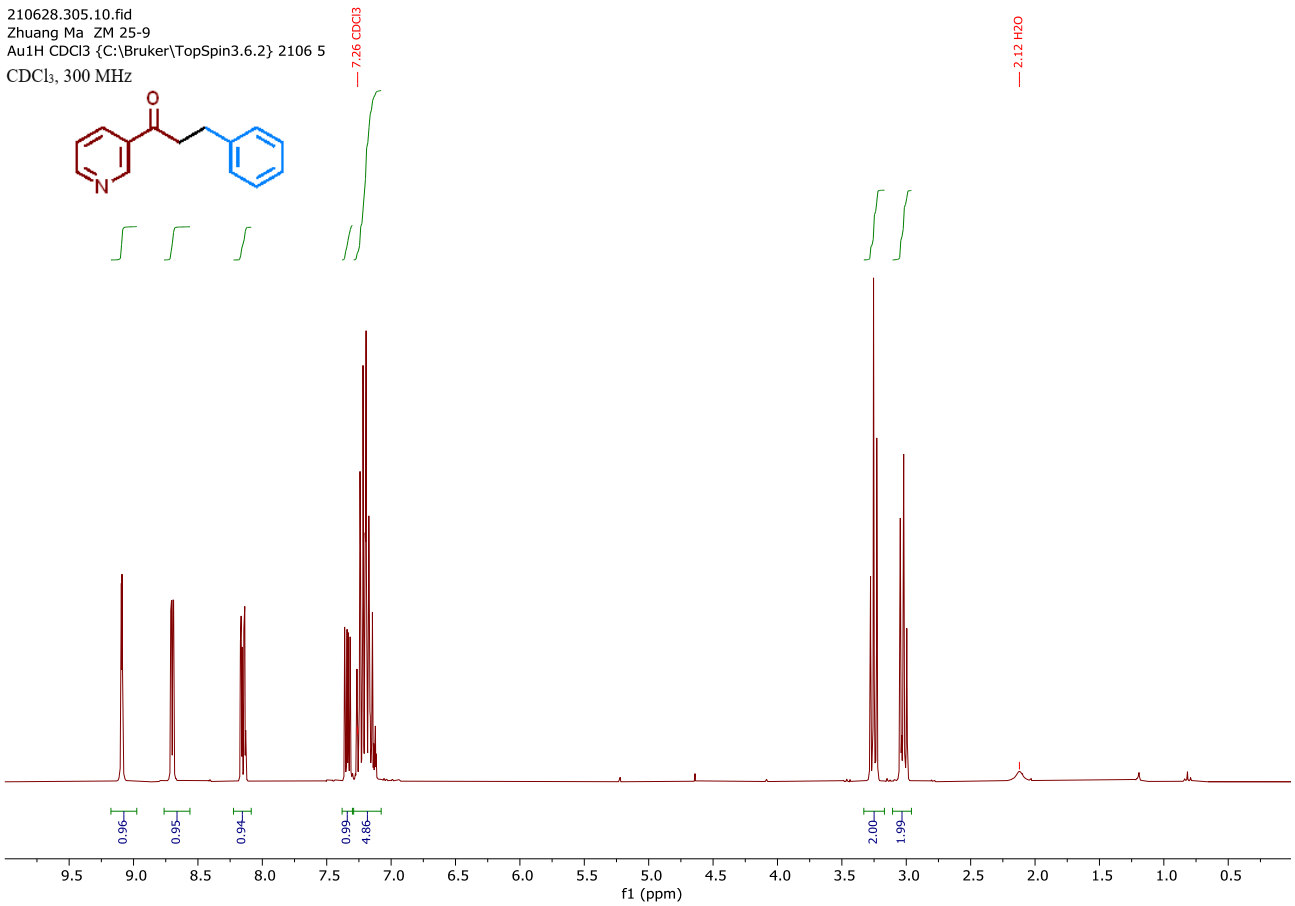


1125

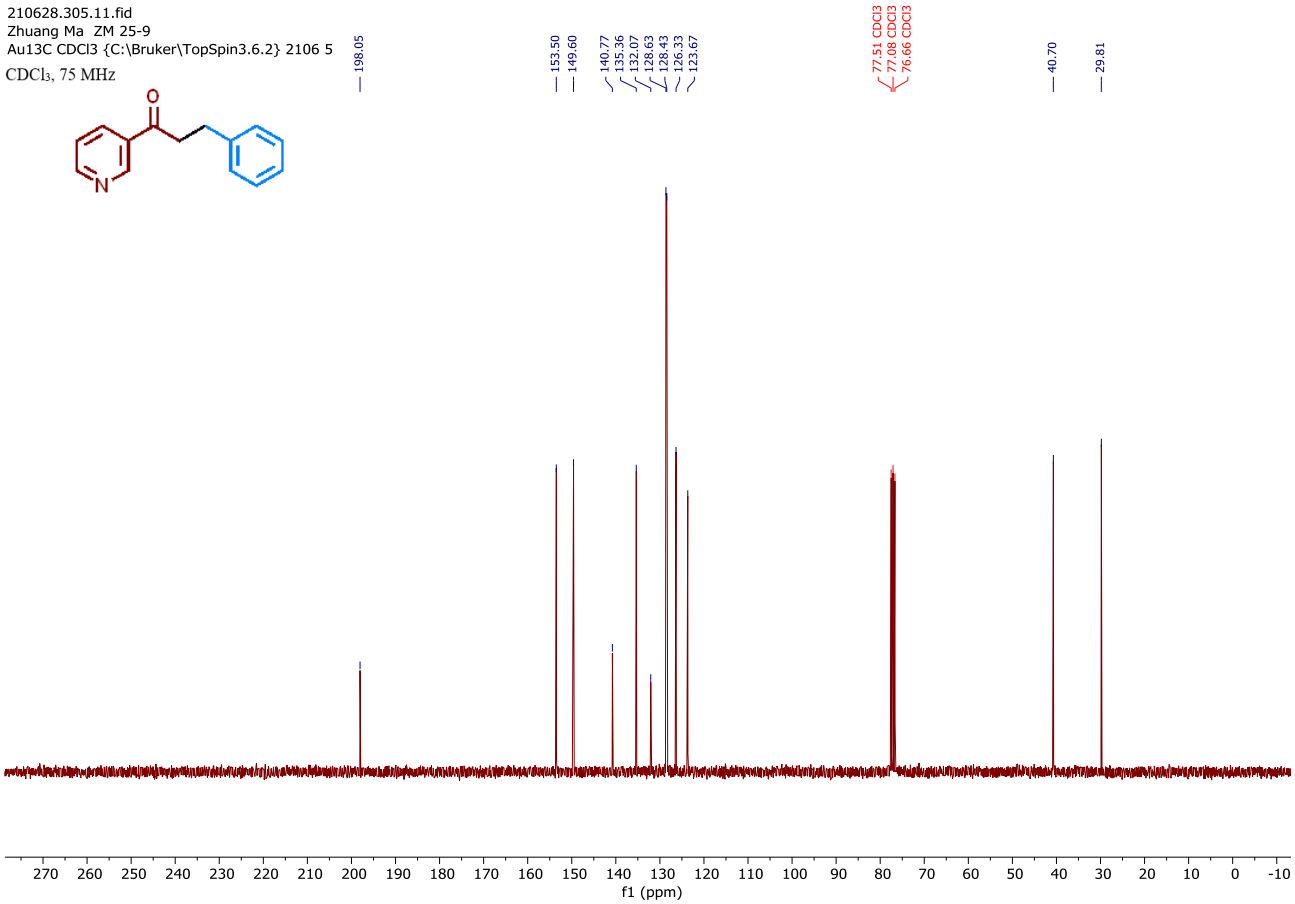


1126

1127

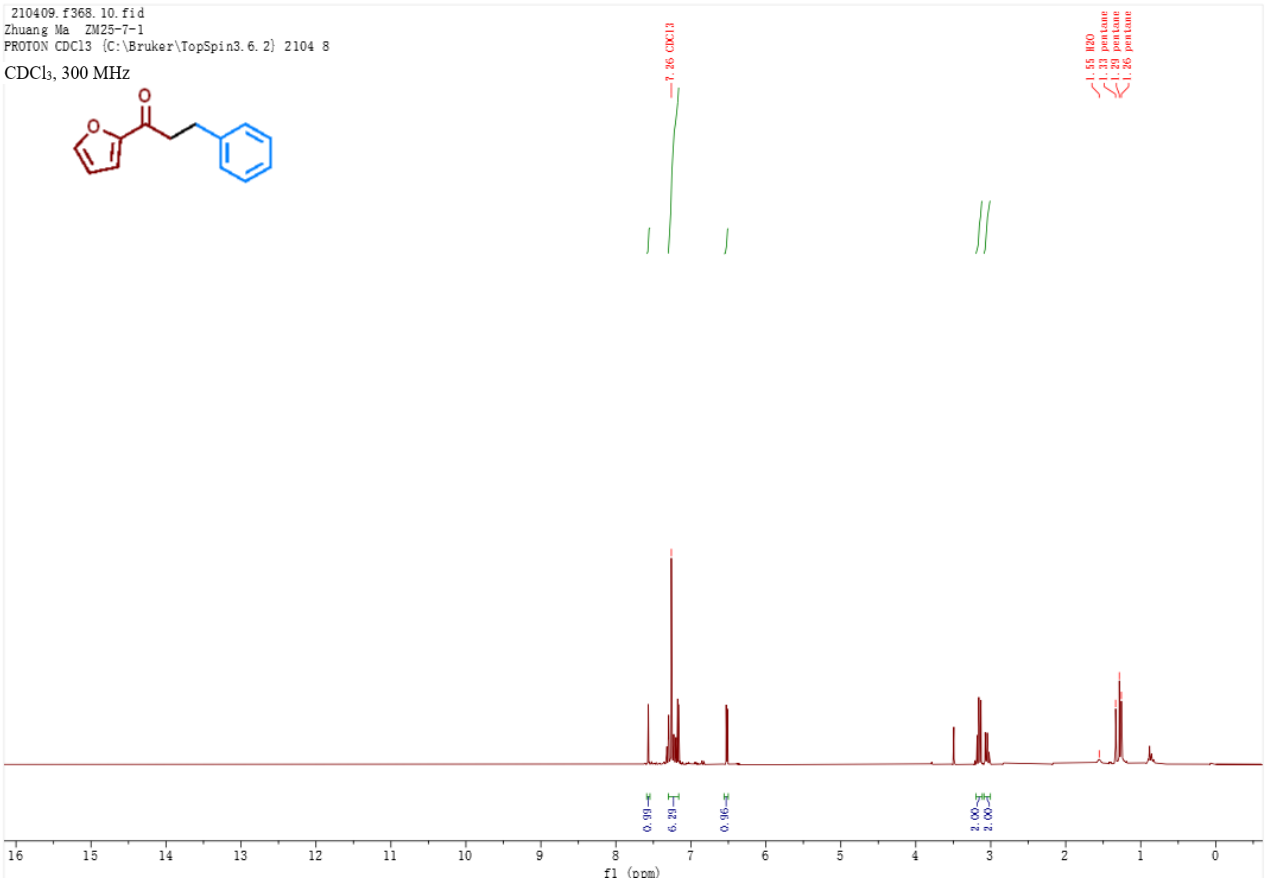


1128

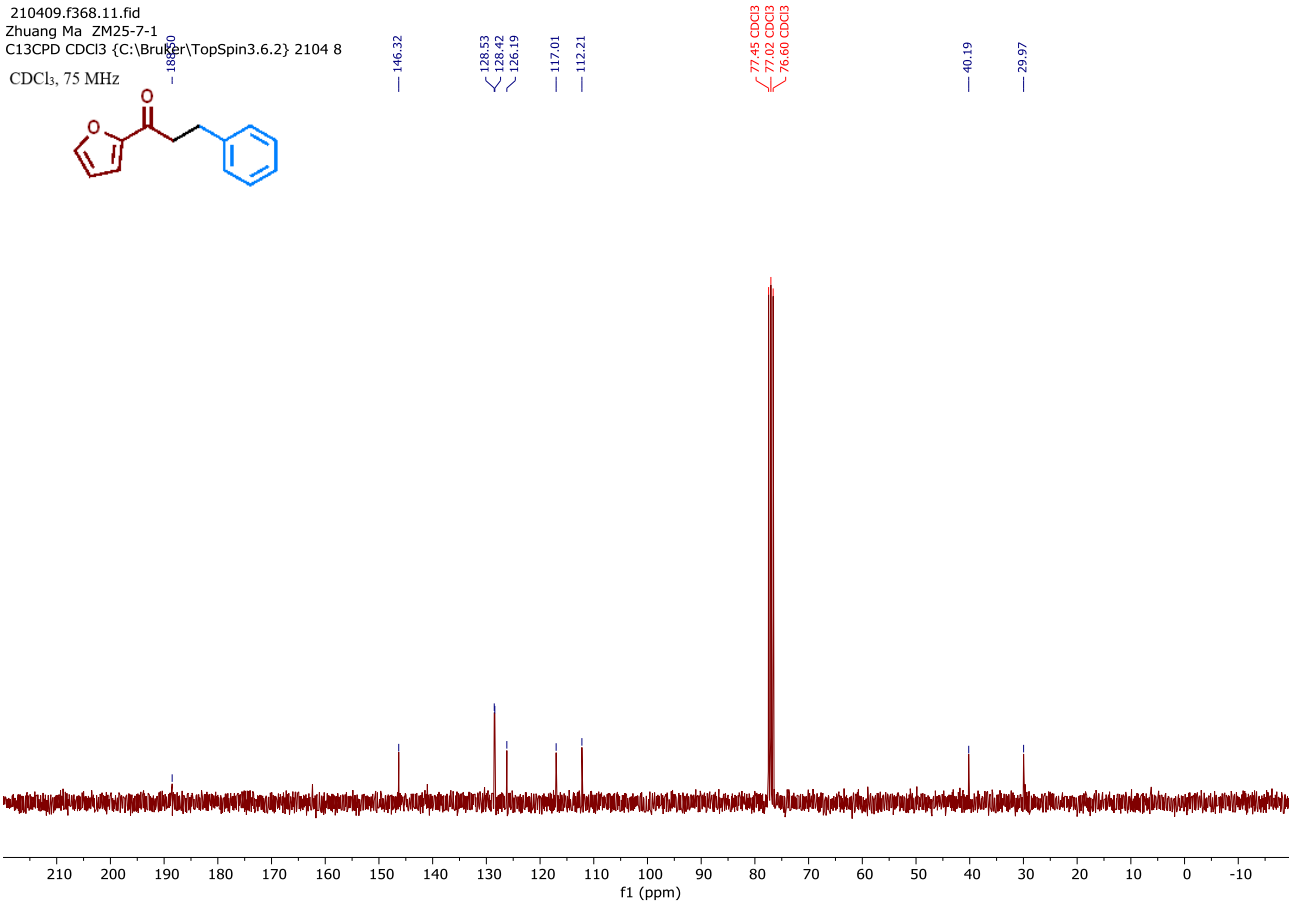


1129

1130

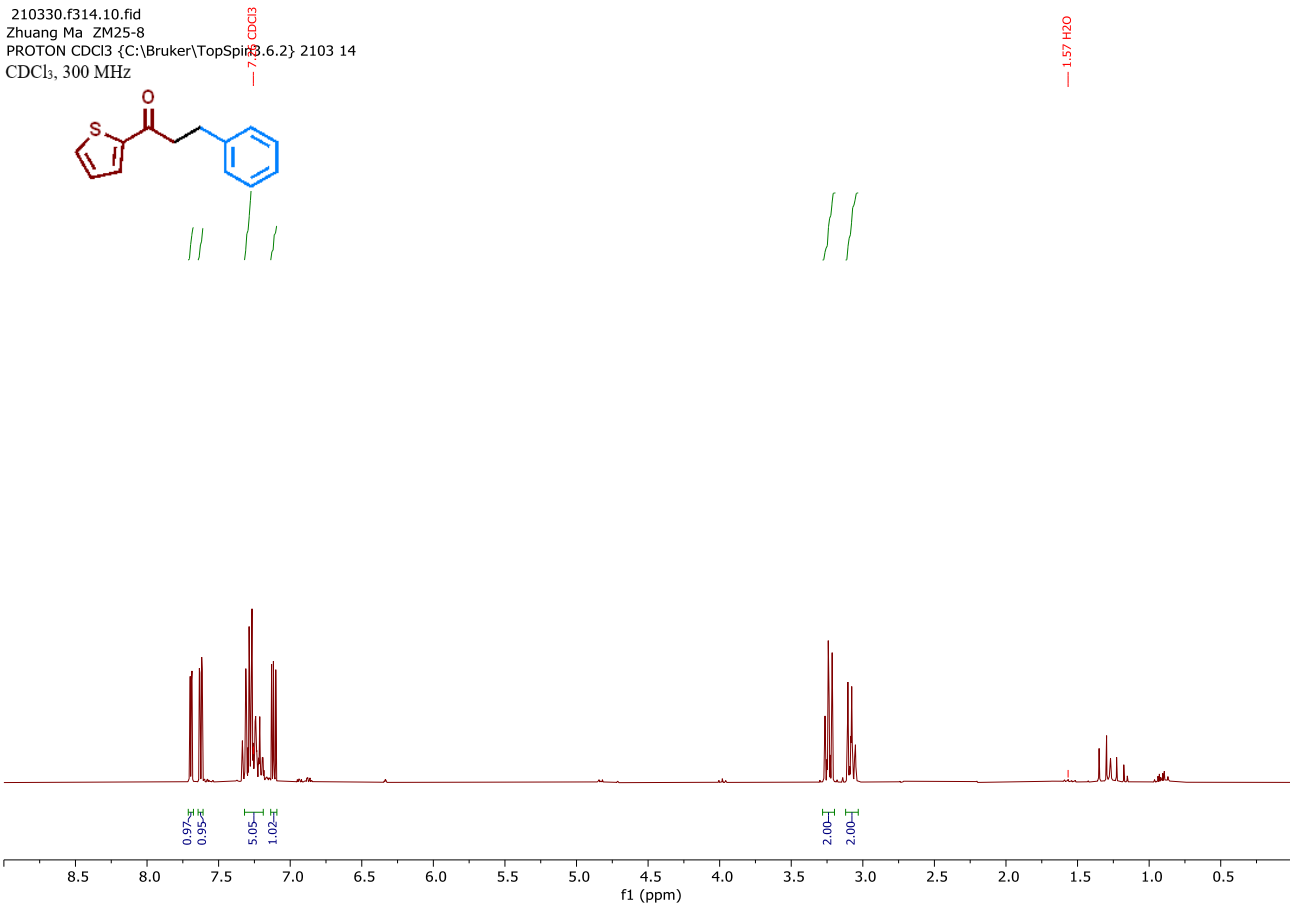


1131

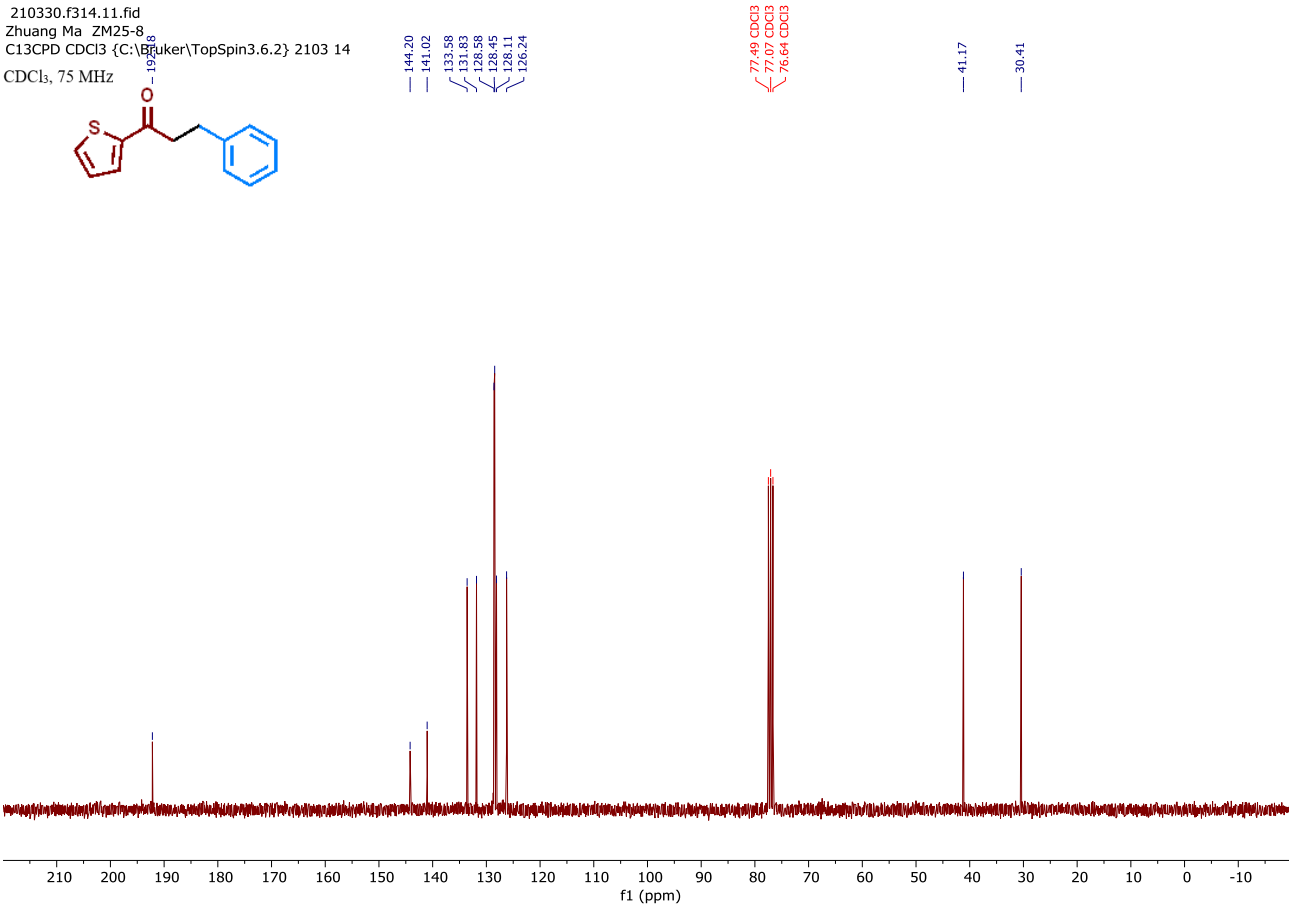


1132

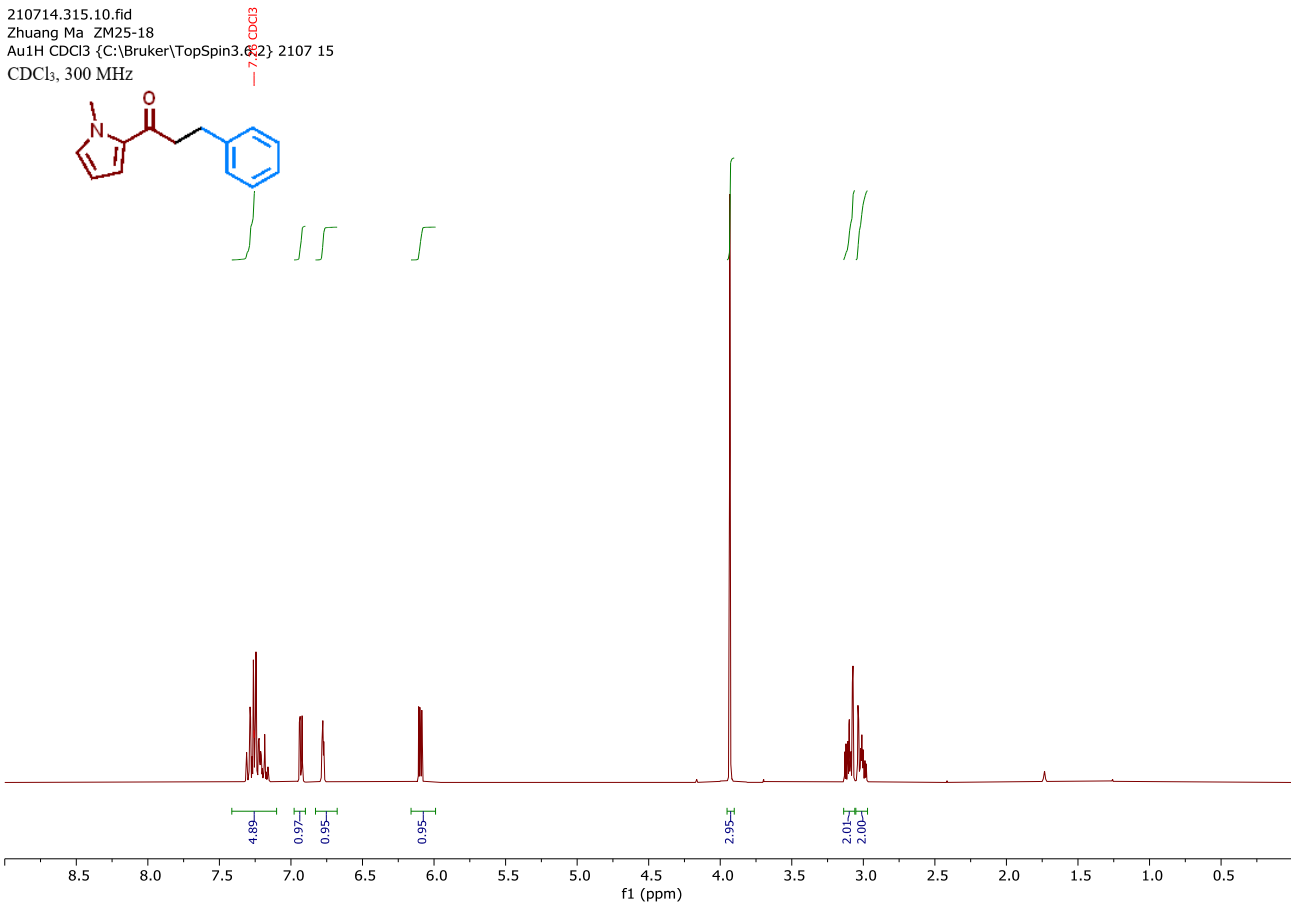
1133


210330.f314.10.fid
Zhuang Ma ZM25-8
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 14
CDCl3, 300 MHz
7.26 CDCl3
1.57 H2O
0.97
0.95
5.05
1.02
2.00
2.00
f1 (ppm)

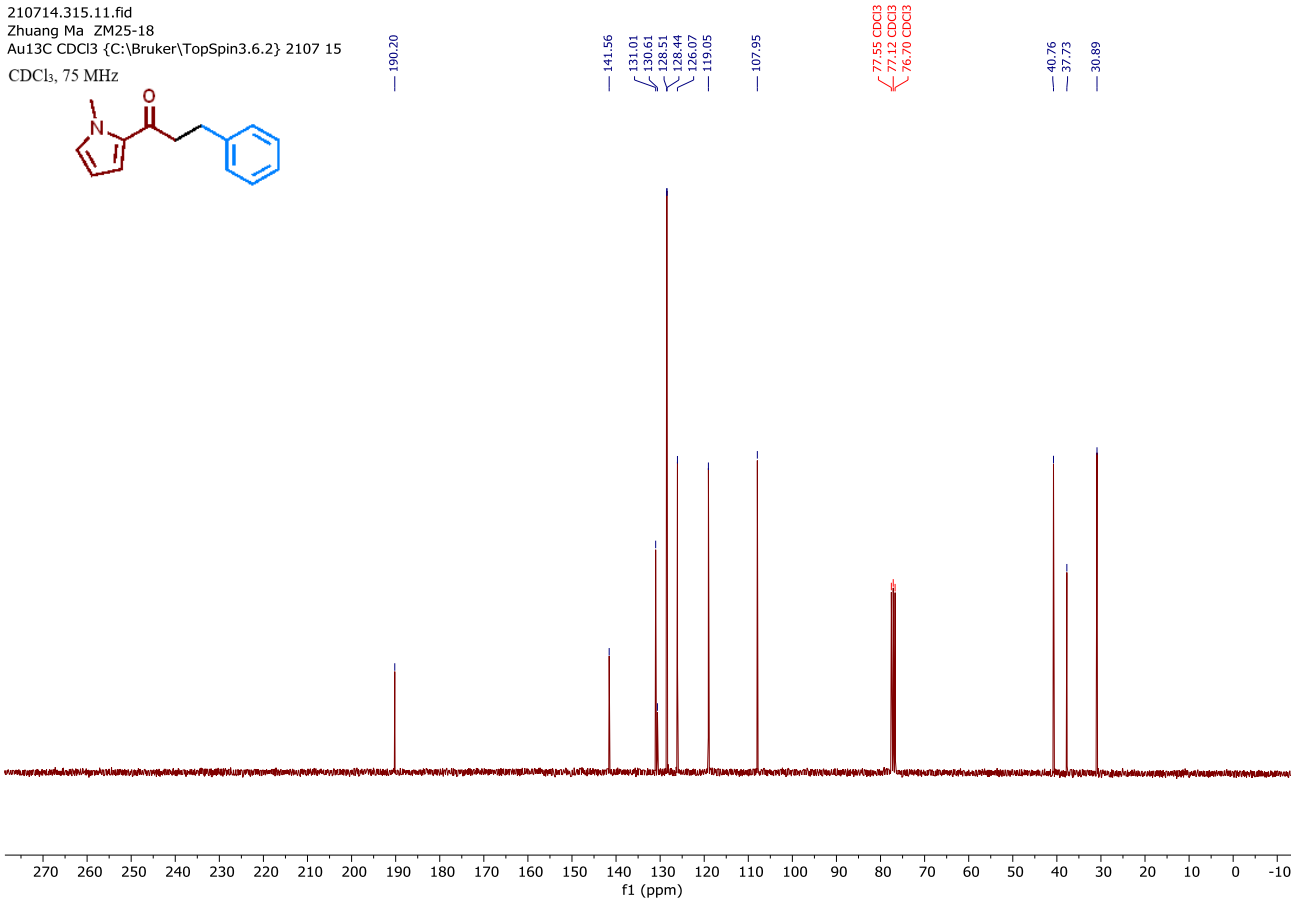
1134


210330.f314.11.fid
Zhuang Ma ZM25-8
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2103 14
CDCl3, 75 MHz
197.88
144.20
141.02
133.58
131.83
128.58
128.45
128.11
126.24
77.49 CDCl3
77.07 CDCl3
76.64 CDCl3
41.17
30.41
f1 (ppm)

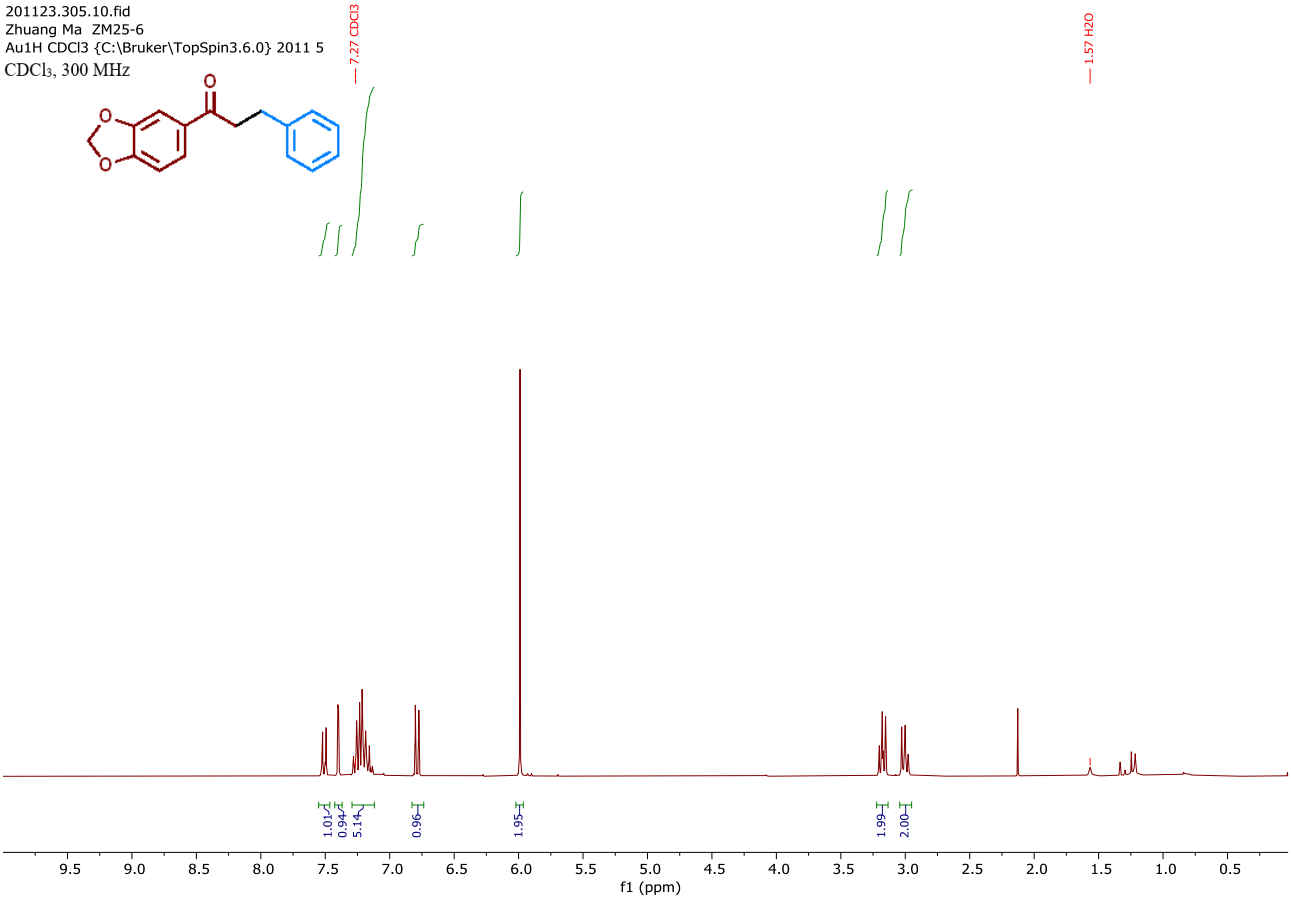
1135


210714.315.10.fid
Zhuang Ma ZM25-18
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 15
CDCl3, 300 MHz
7.26 CDCl3
4.89
0.97
0.95
0.95
2.95
2.01
2.00
f1 (ppm)

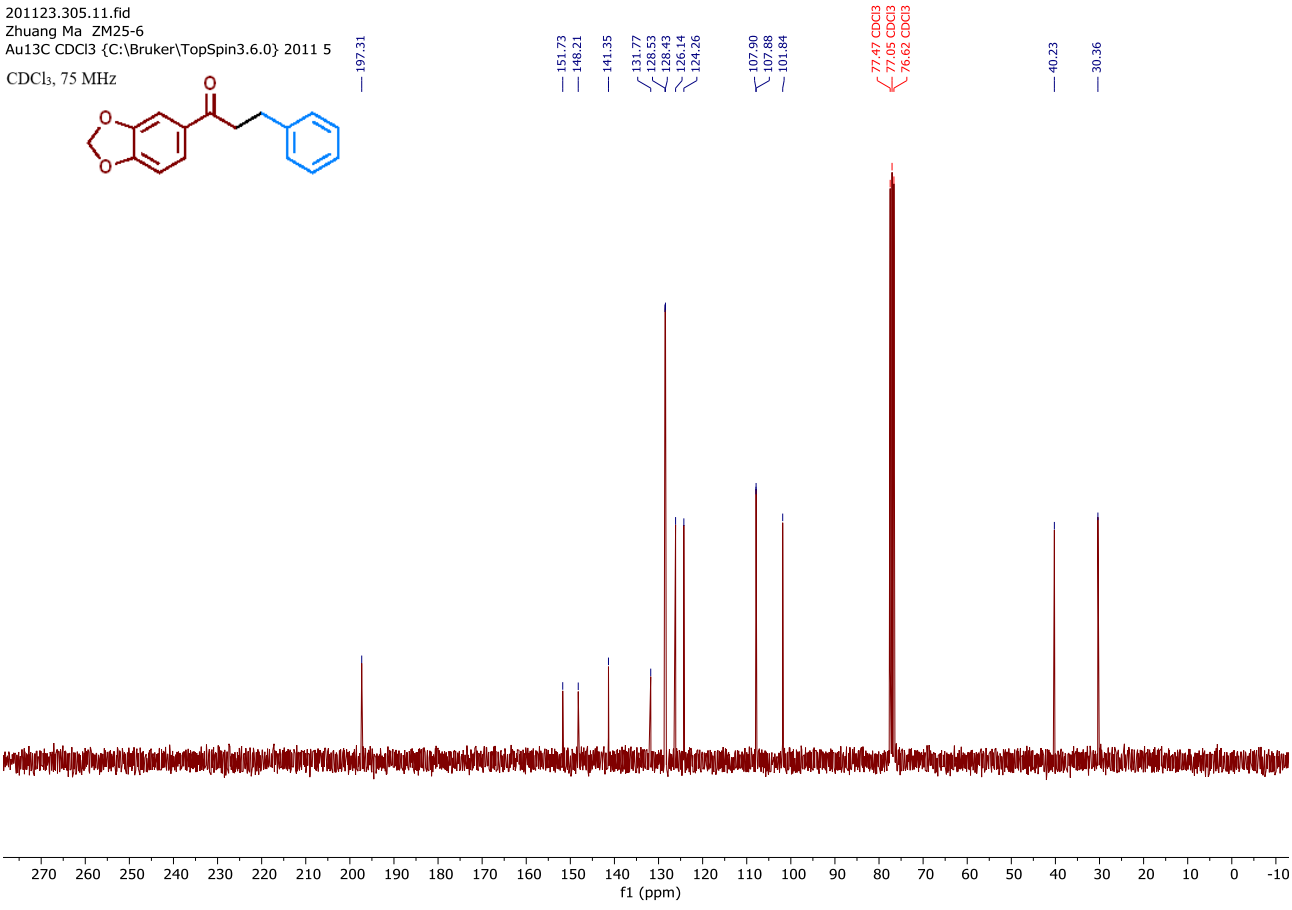
1136


210714.315.11.fid
Zhuang Ma ZM25-18
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 15
CDCl3, 75 MHz
190.20
141.56
131.01
130.61
128.51
128.44
126.07
119.05
107.95
77.55 CDCl3
77.12 CDCl3
76.70 CDCl3
40.76
37.73
30.89
f1 (ppm)

1137

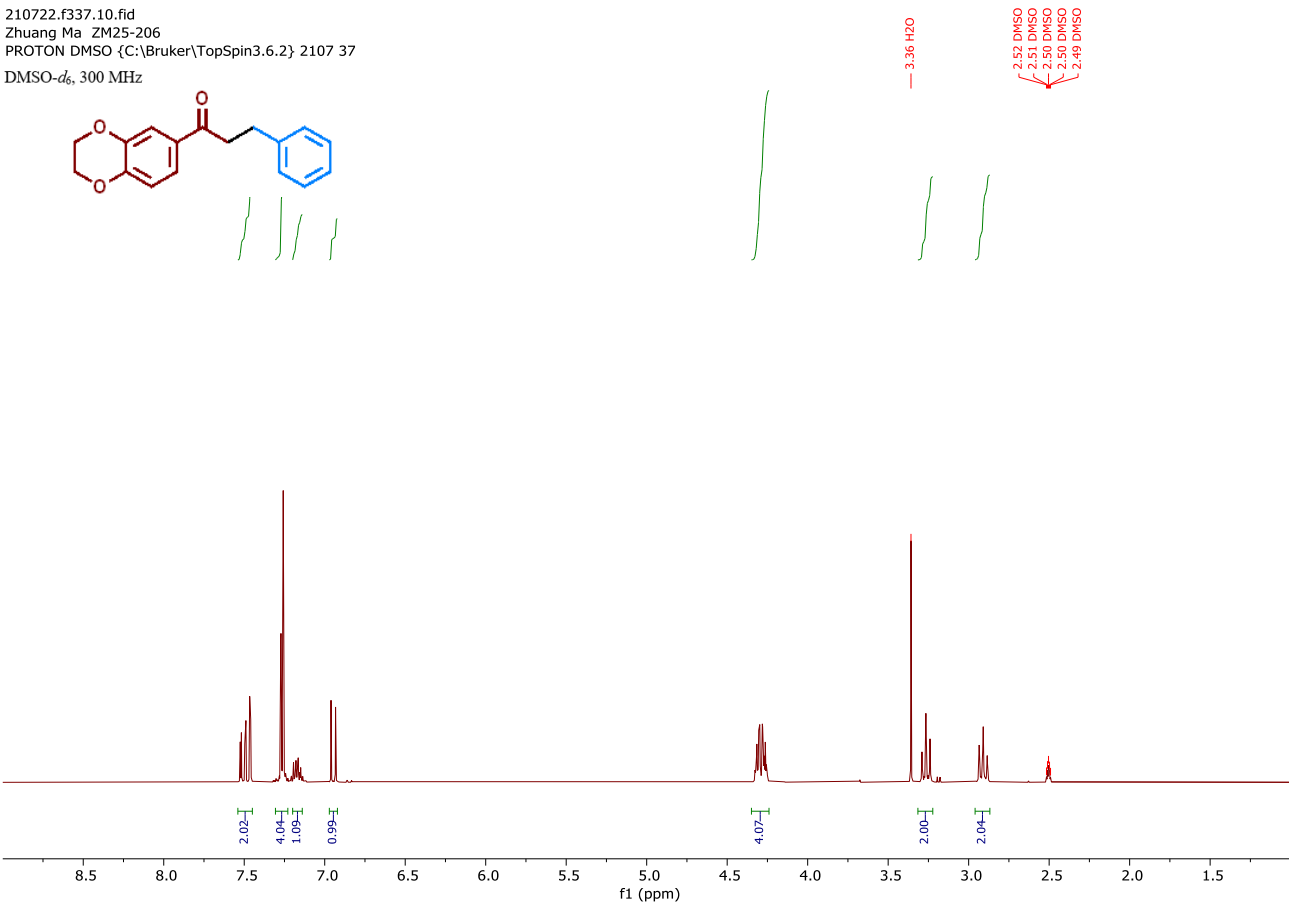


1138

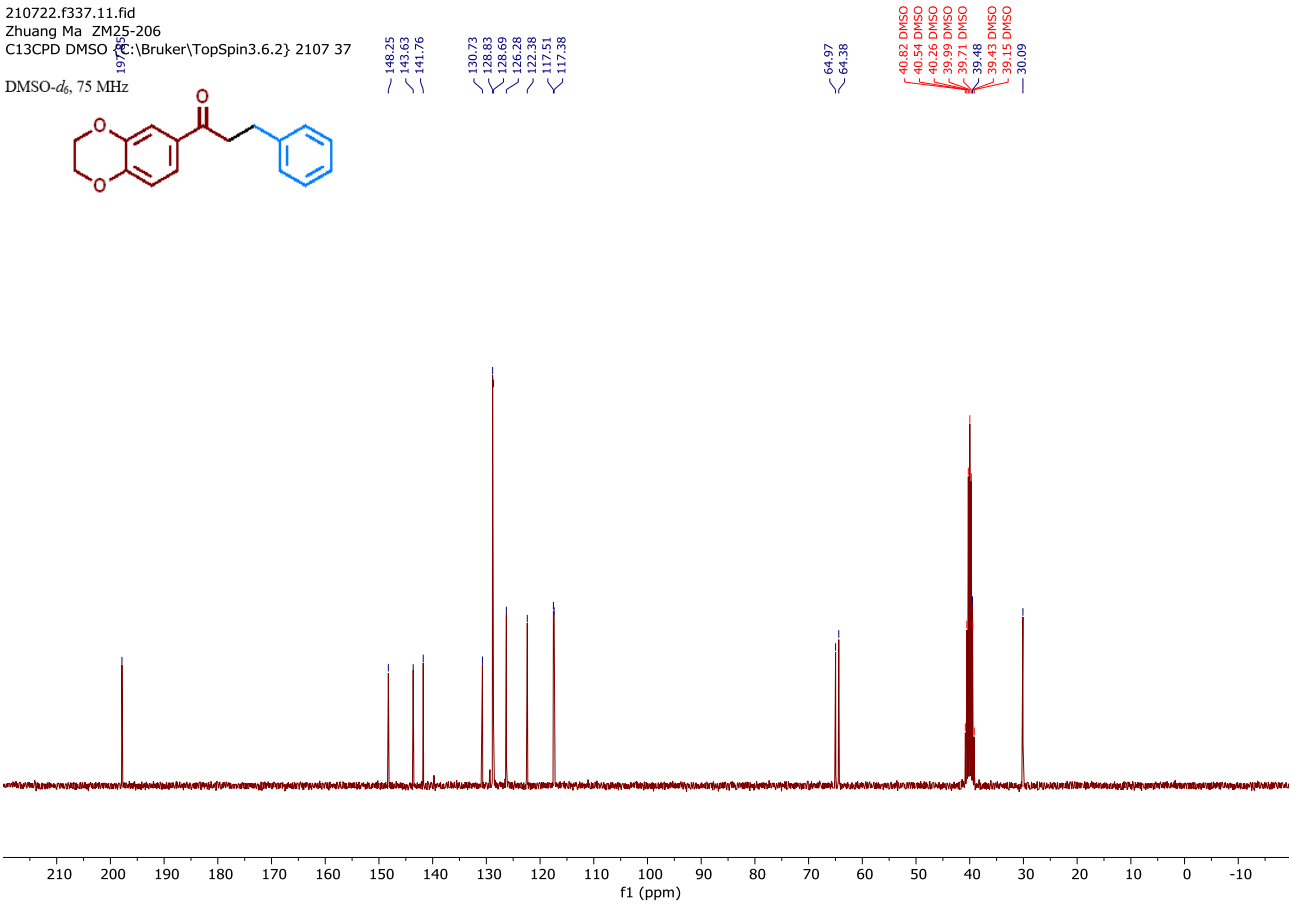


1139

1140

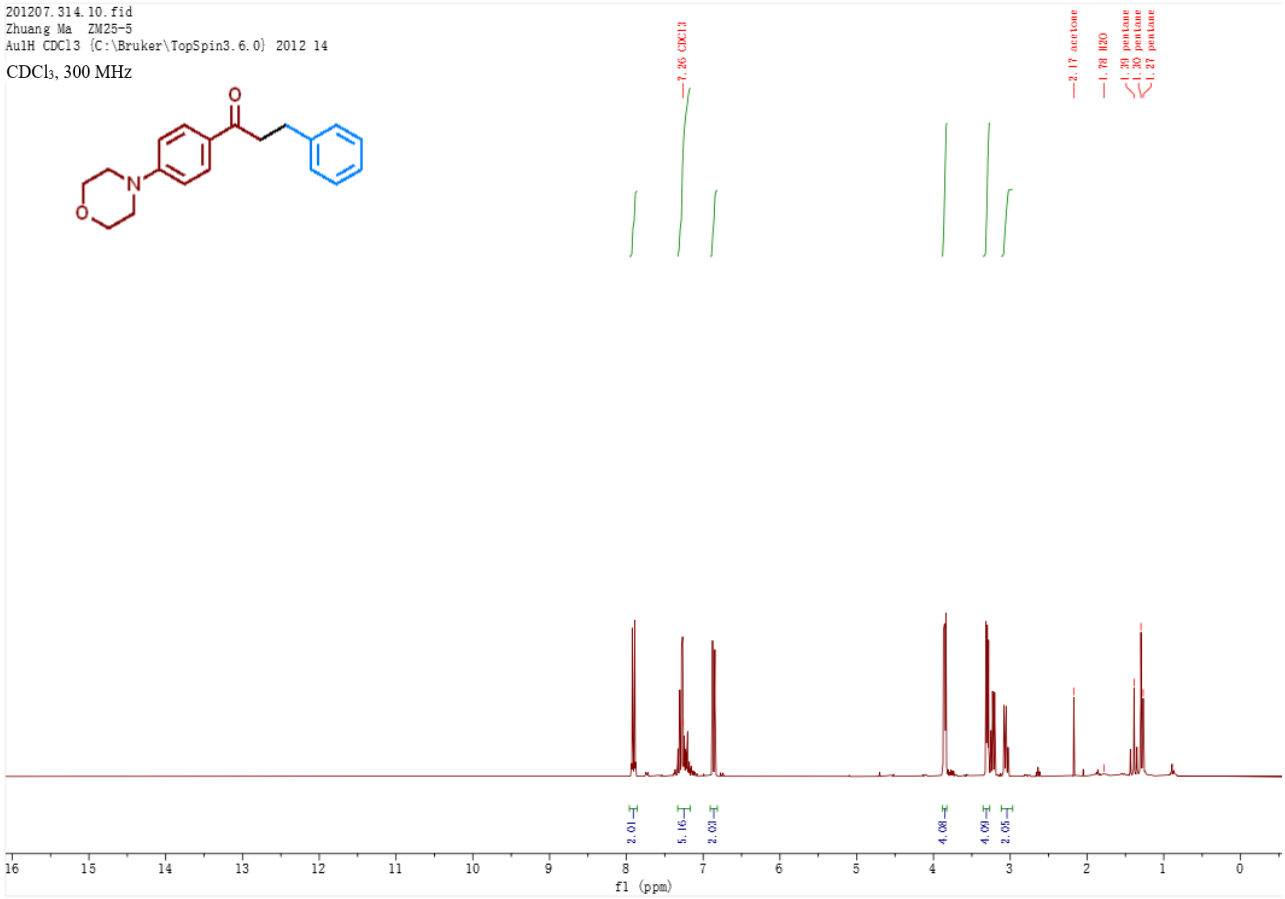


1141

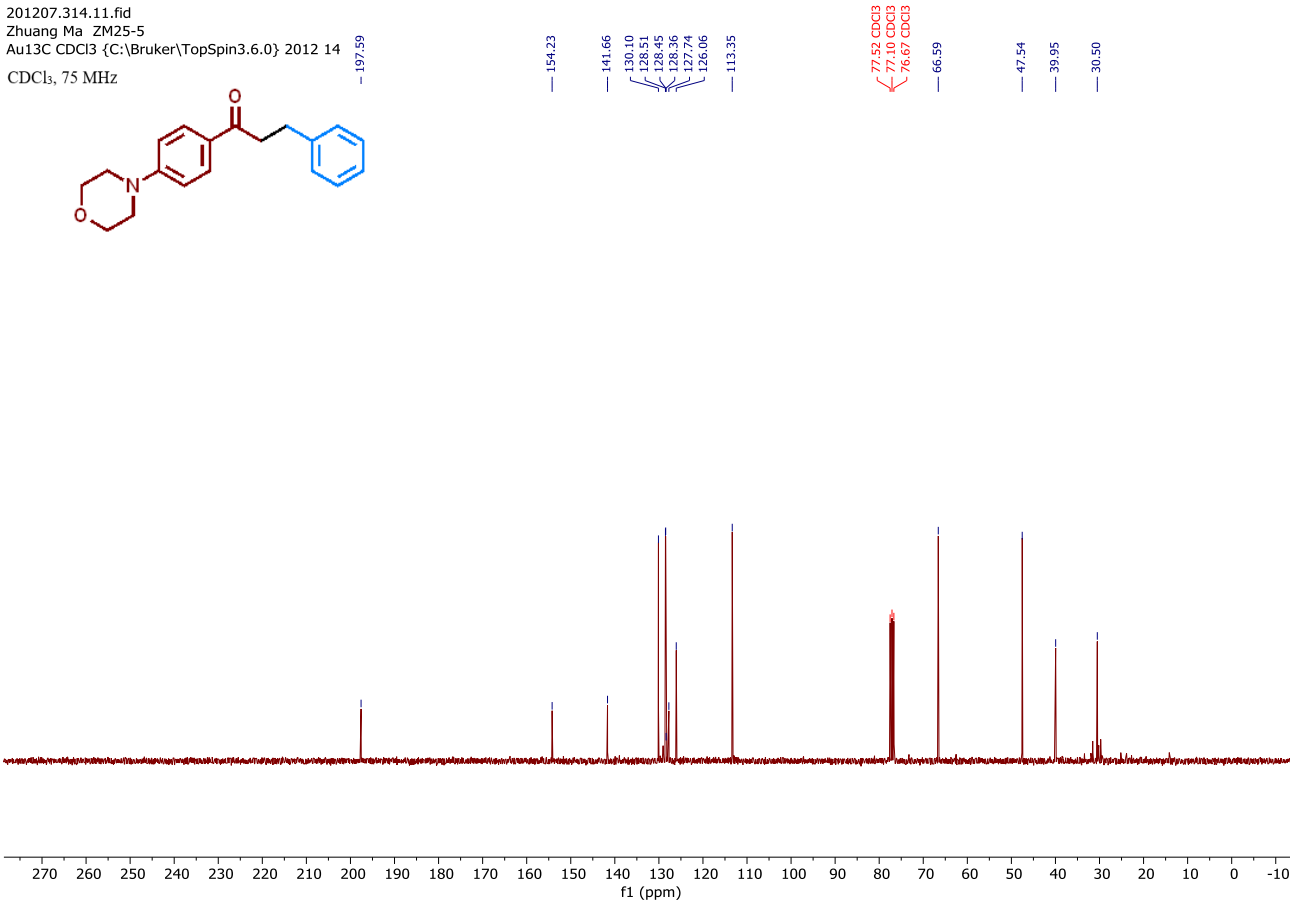


1142

1143



1144

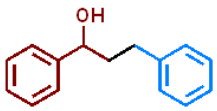


1145

1146

220509.f348.10.fid
Zhuang Ma ZM 9-K9
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2205 48

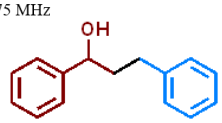
$CDCl_3$, 300 MHz



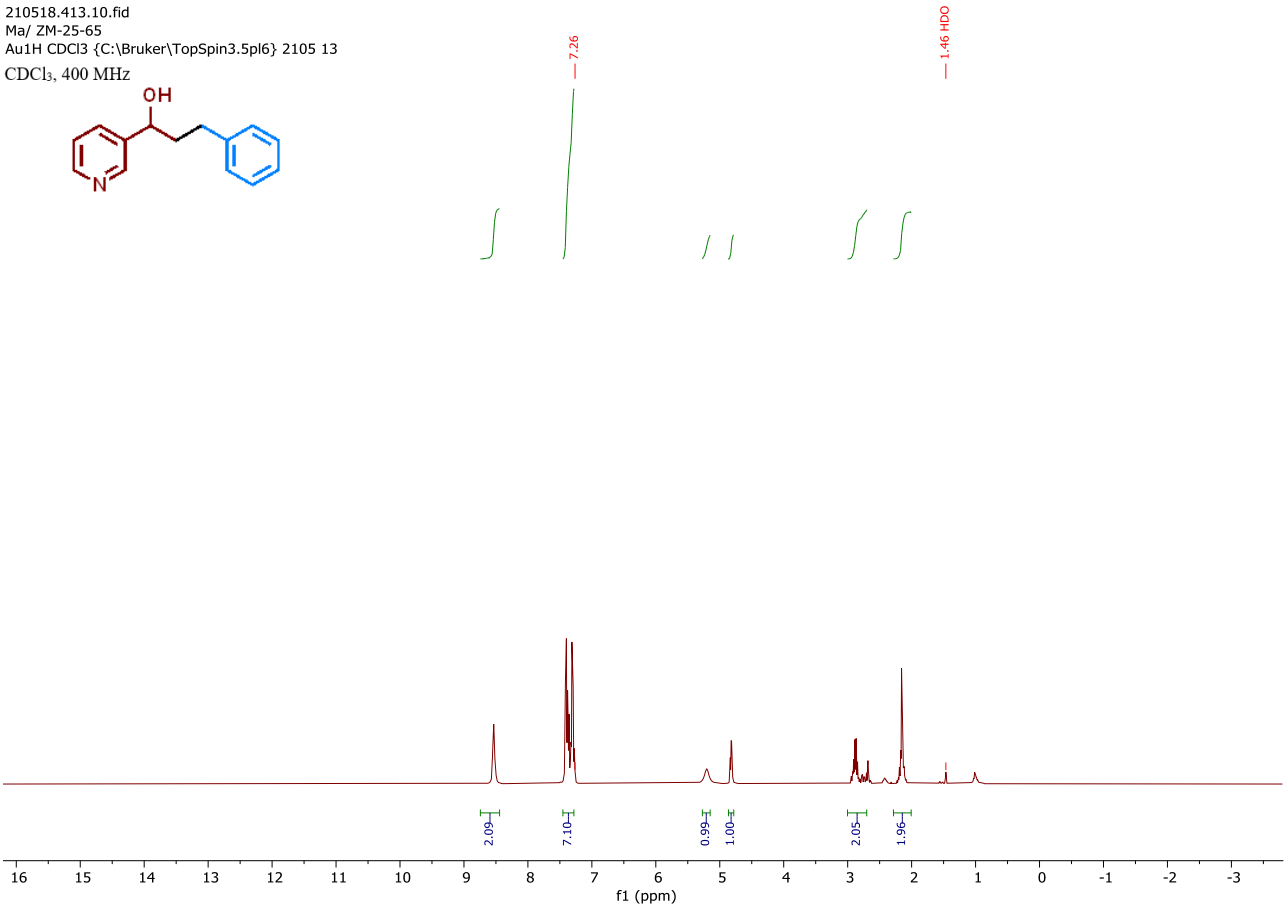
1147

220509.f348.11.fid
Zhuang Ma ZM 9-K9
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2205 48

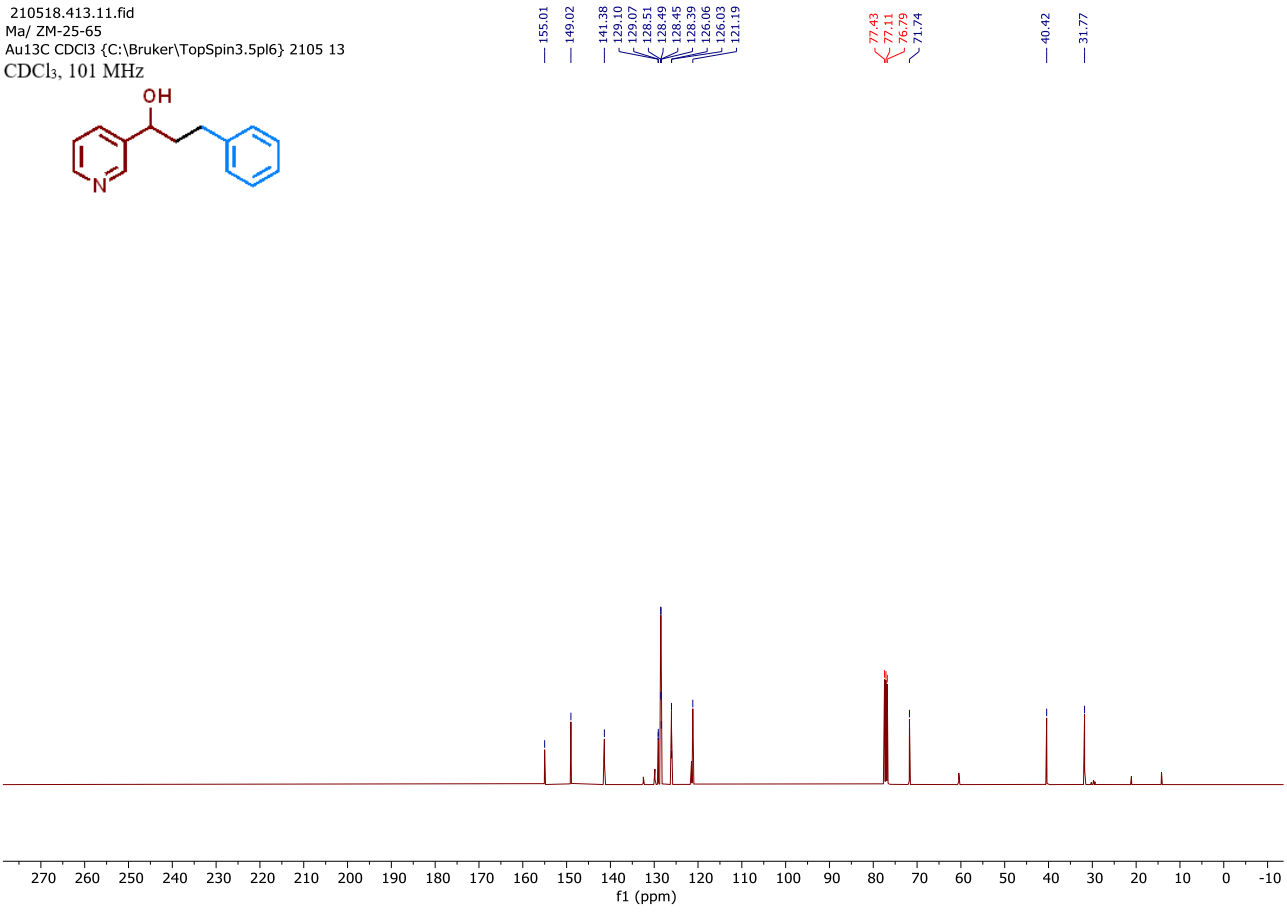
$CDCl_3$, 75 MHz



1148



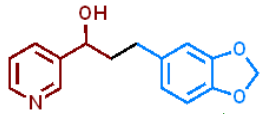
1149



1150

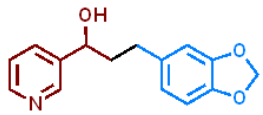
1151

210527.443.10.fid
Zhuang Ma ZM25-69
Au1H CDCl3 {C:\Bruker\TopSpin3.5pl6} 2105 43
$CDCl_3$, 400 MHz



1152

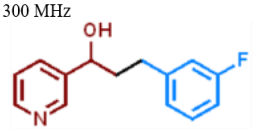
210527.443.11.fid
Zhuang Ma ZM25-69
Au13C CDCl3 {C:\Bruker\TopSpin3.5pl6} 2105 43
$CDCl_3$, 101 MHz



1153

210526.341.10.fid
Zhuang Ma ZM25-68
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 41

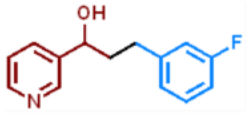
$CDCl_3$, 300 MHz



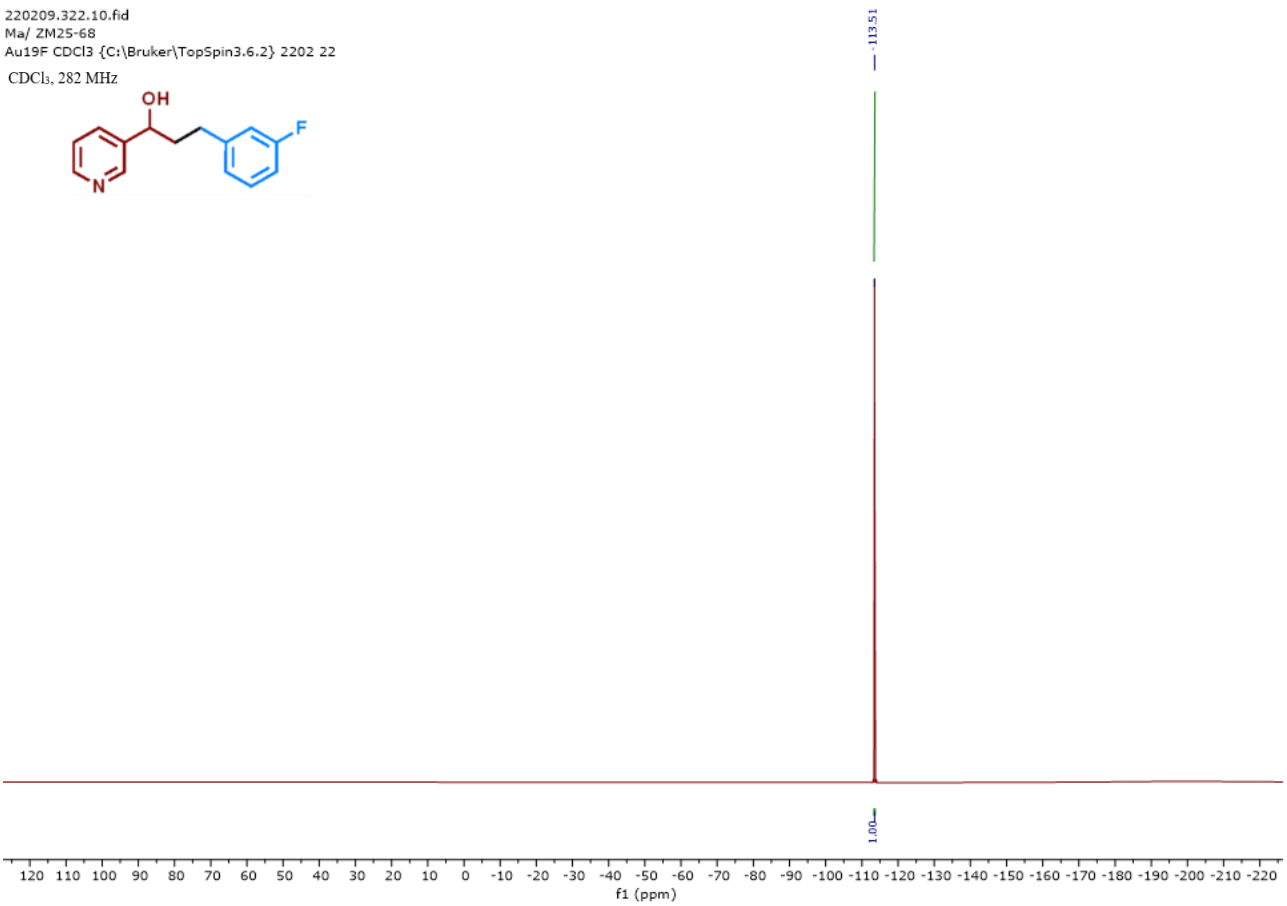
1154

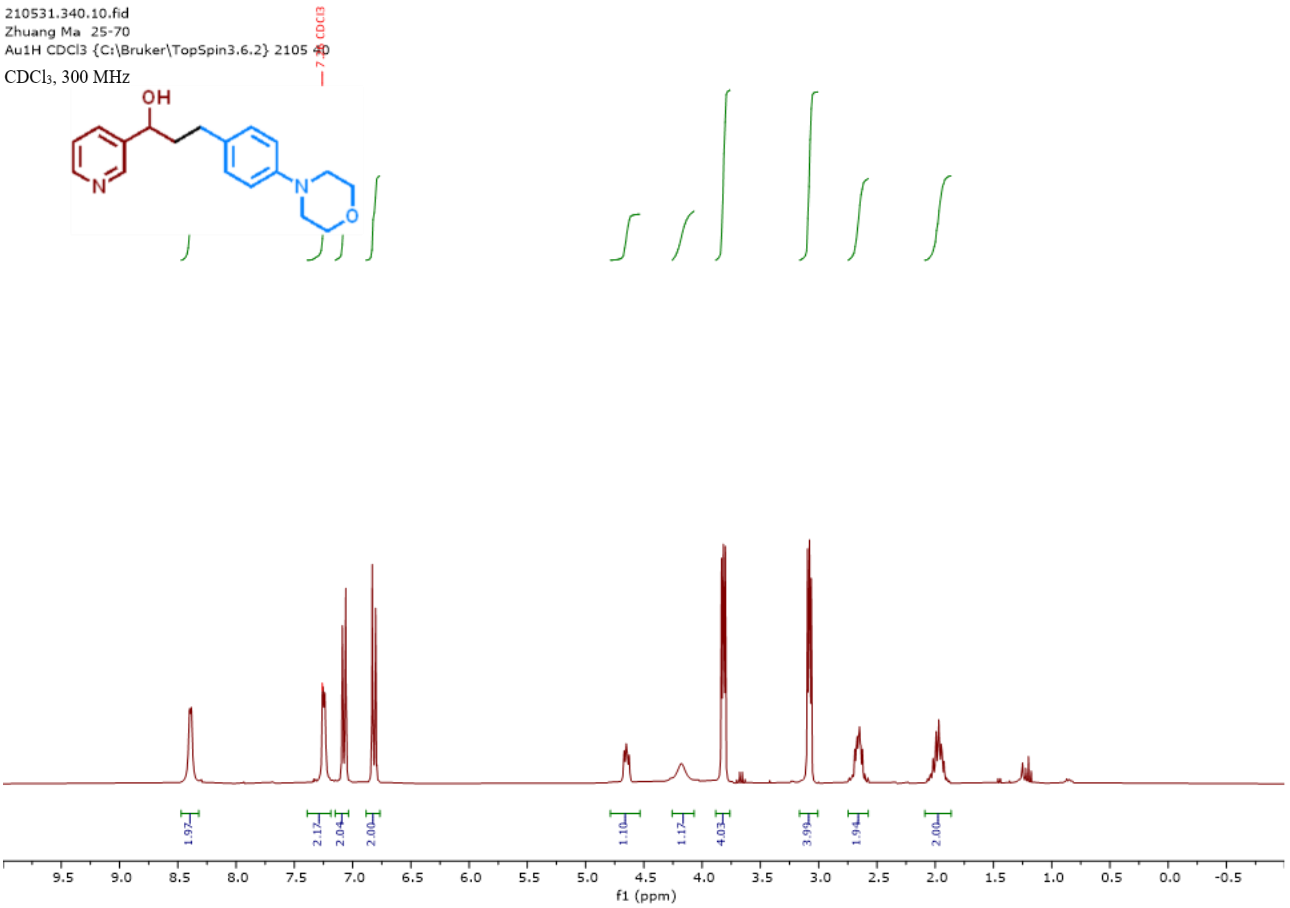
210526.341.11.fid
Zhuang Ma ZM25-68
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2105 41

$CDCl_3$, 75 MHz

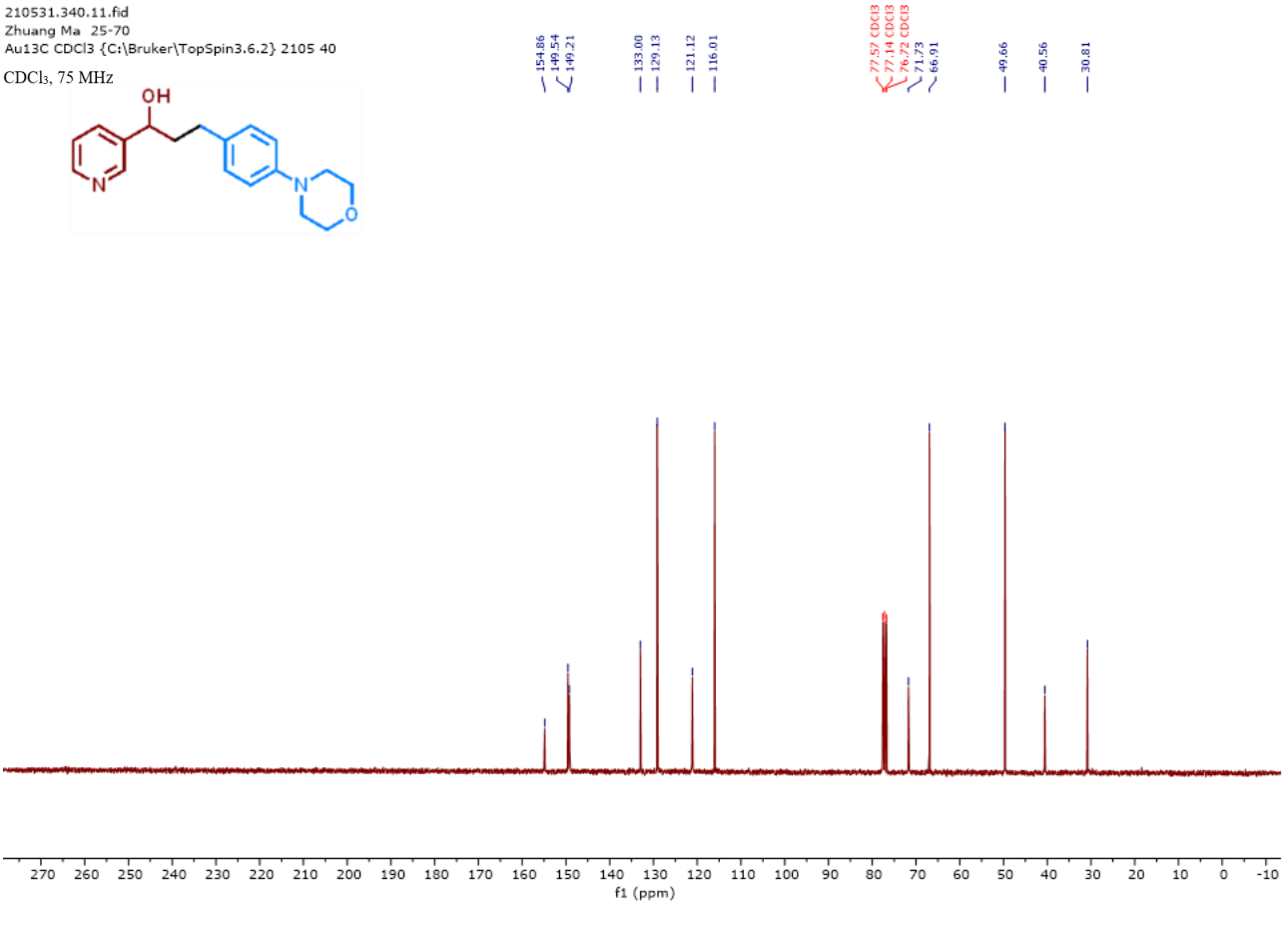


1155


220209.322.10.fid
Ma/ ZM25-68
Au19F CDCl3 {C:\Bruker\TopSpin3.6.2} 2202 22
CDCl3, 282 MHz
OH
F
N
-113.51
1.00
120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)

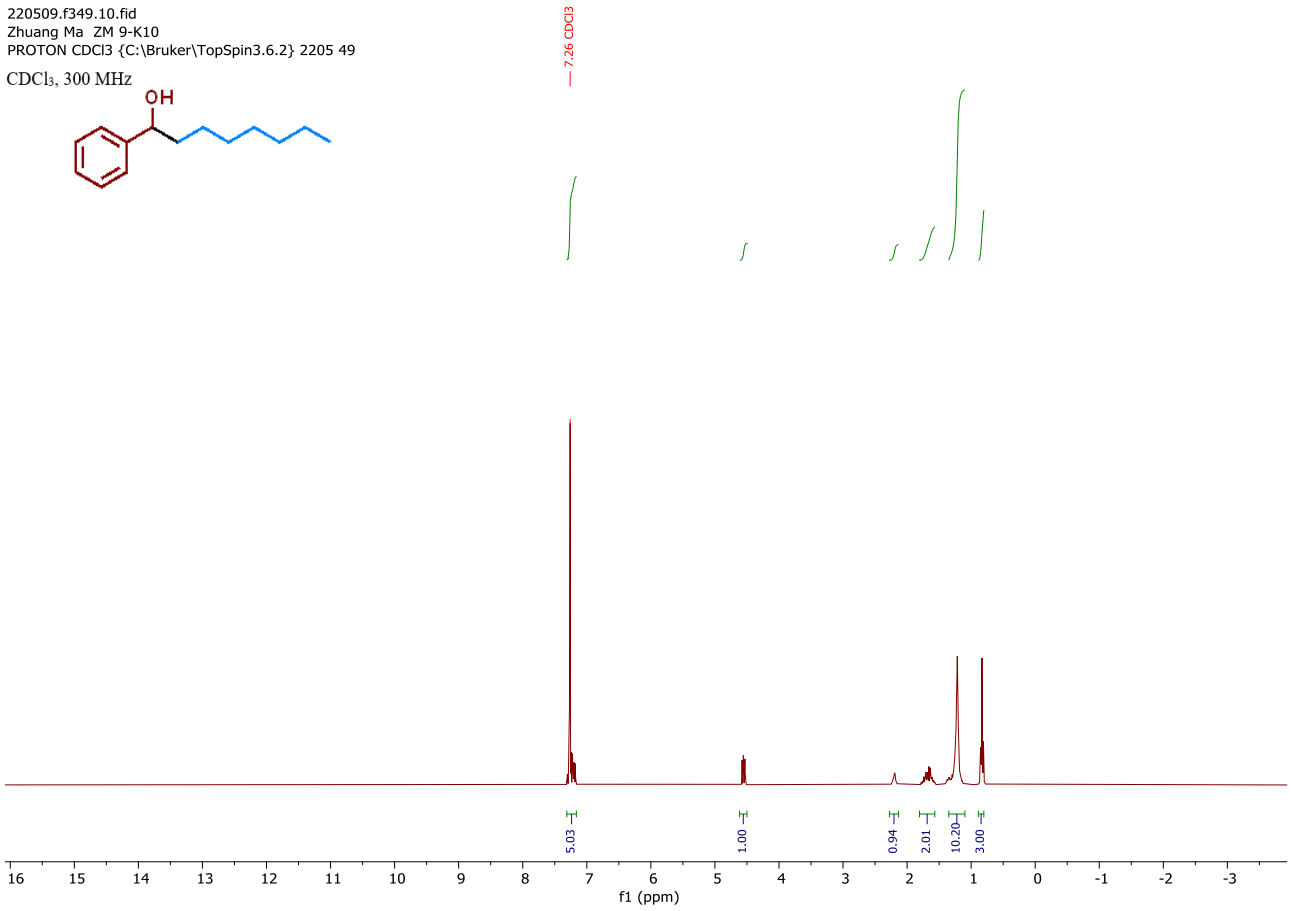


1159

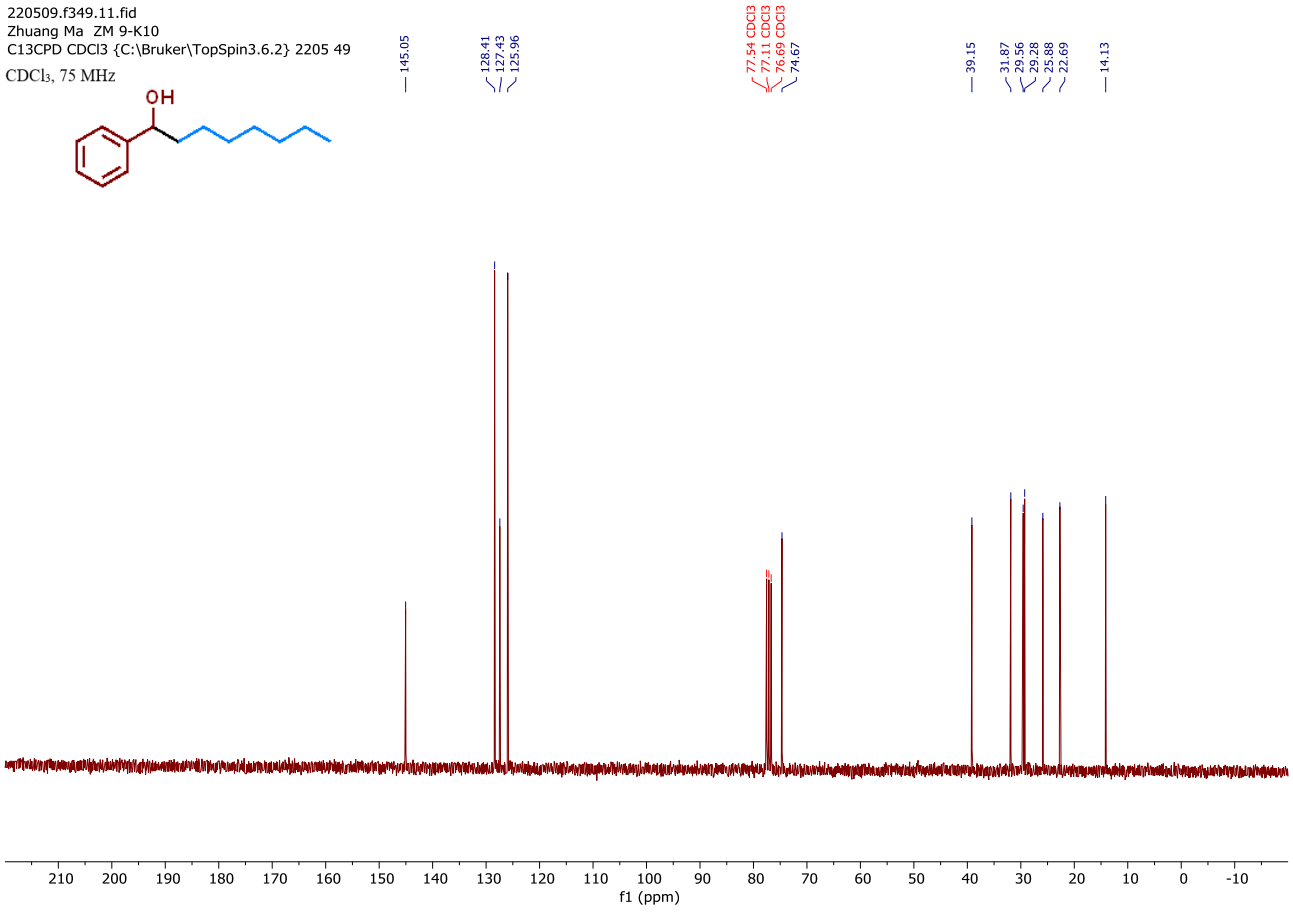


1160

1161

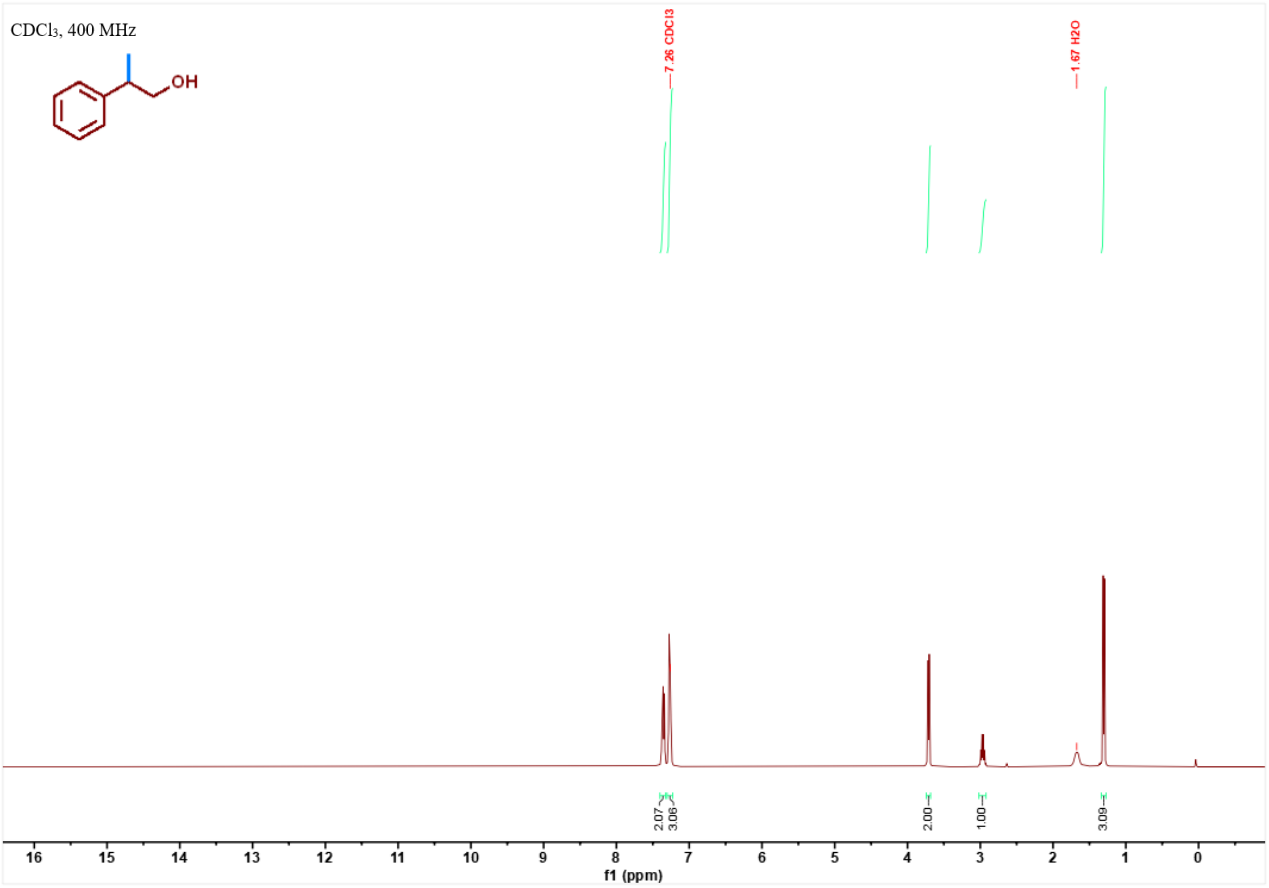


1162



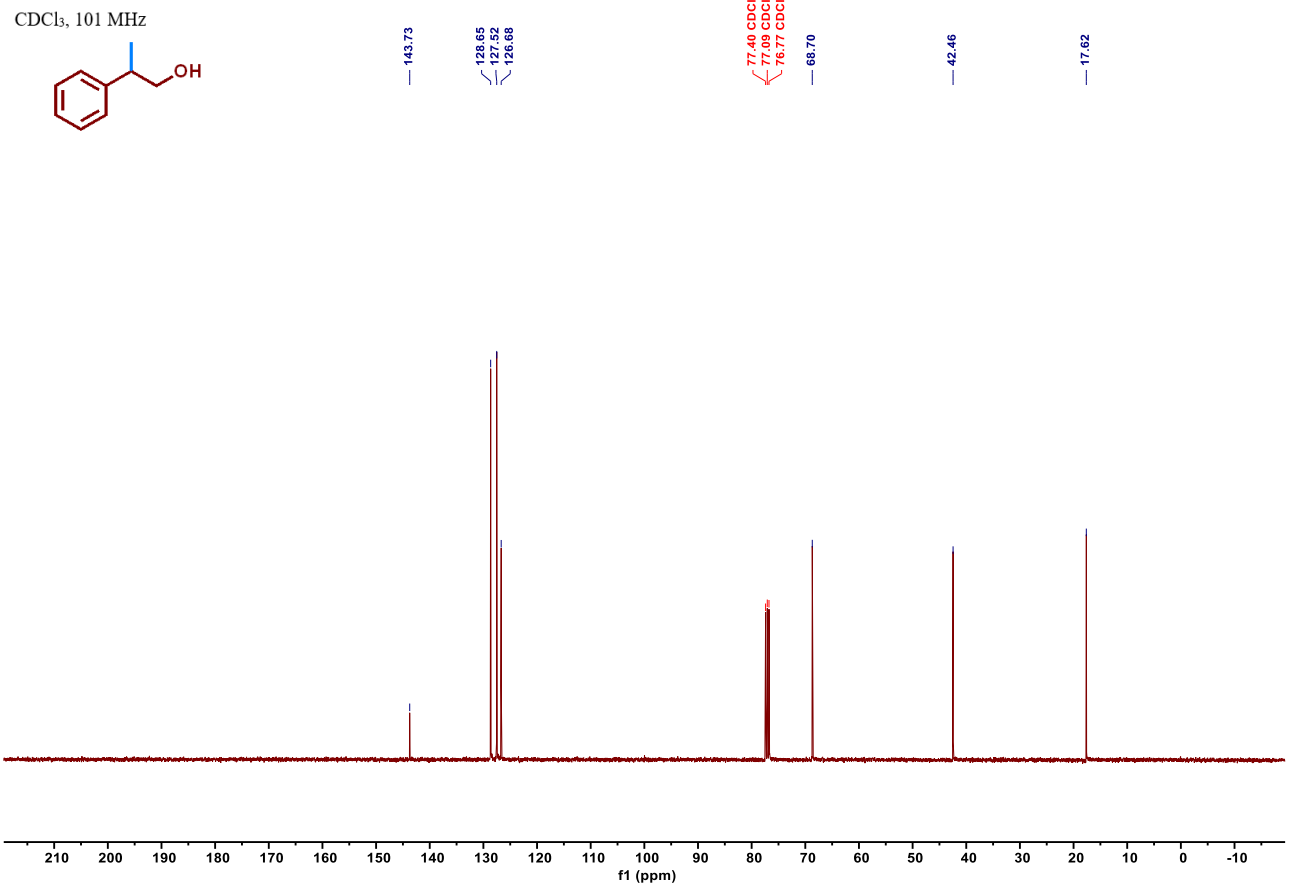
1163

1164

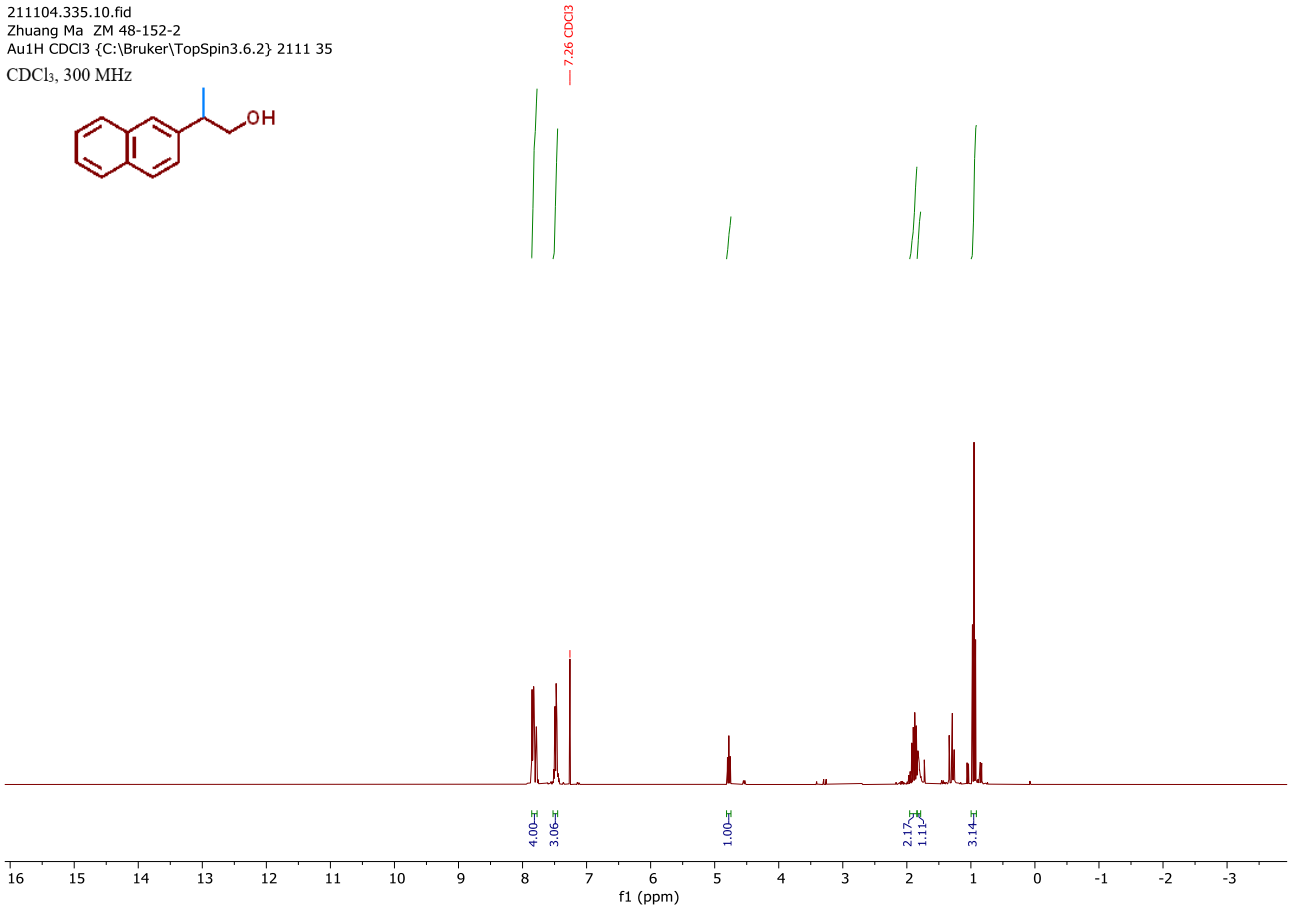


1165

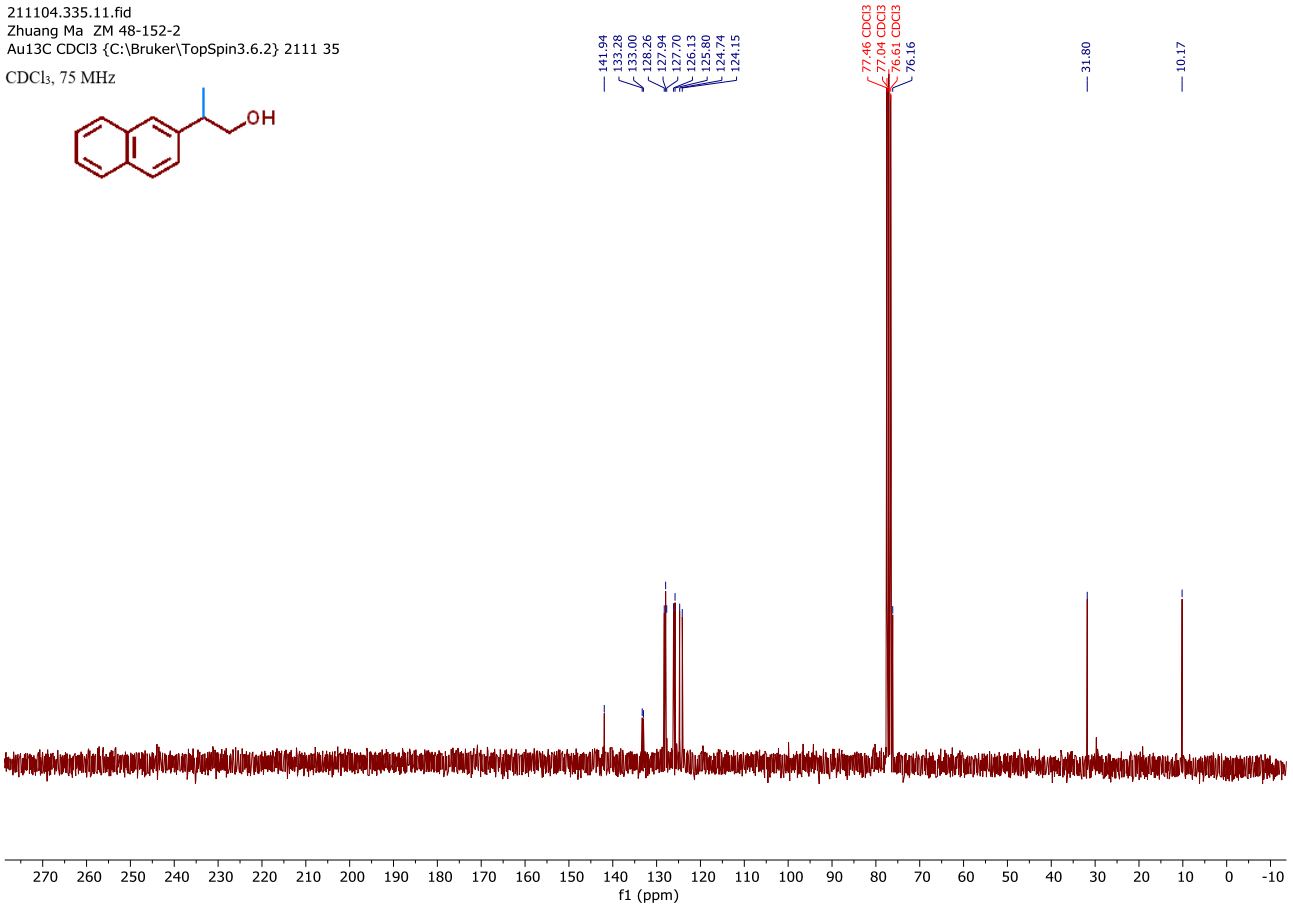
1166



1167

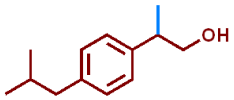

211104.335.10.fid
Zhuang Ma ZM 48-152-2
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 35
CDCl3, 300 MHz
OH
7.26 CDCl3
4.00
3.06
1.00
2.17
1.11
3.14
f1 (ppm)

1168


211104.335.11.fid
Zhuang Ma ZM 48-152-2
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 35
CDCl3, 75 MHz
OH
141.94
133.28
133.00
128.26
127.94
127.70
126.13
125.80
124.74
124.15
77.46 CDCl3
77.04 CDCl3
76.61 CDCl3
76.16
31.80
10.17
f1 (ppm)

1169

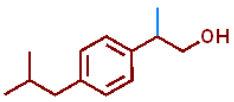
CDCl3, 400 MHz



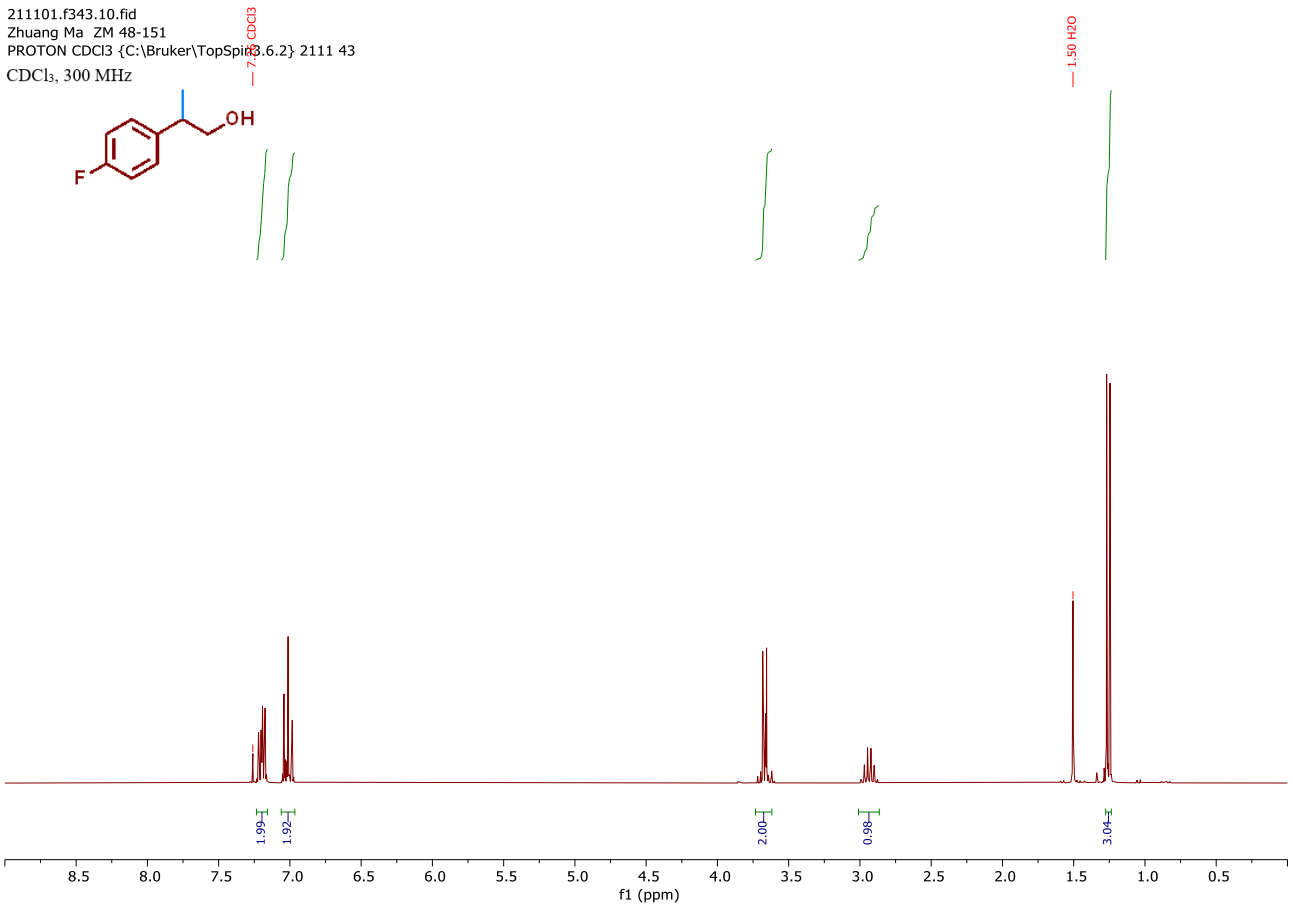
1170

1171

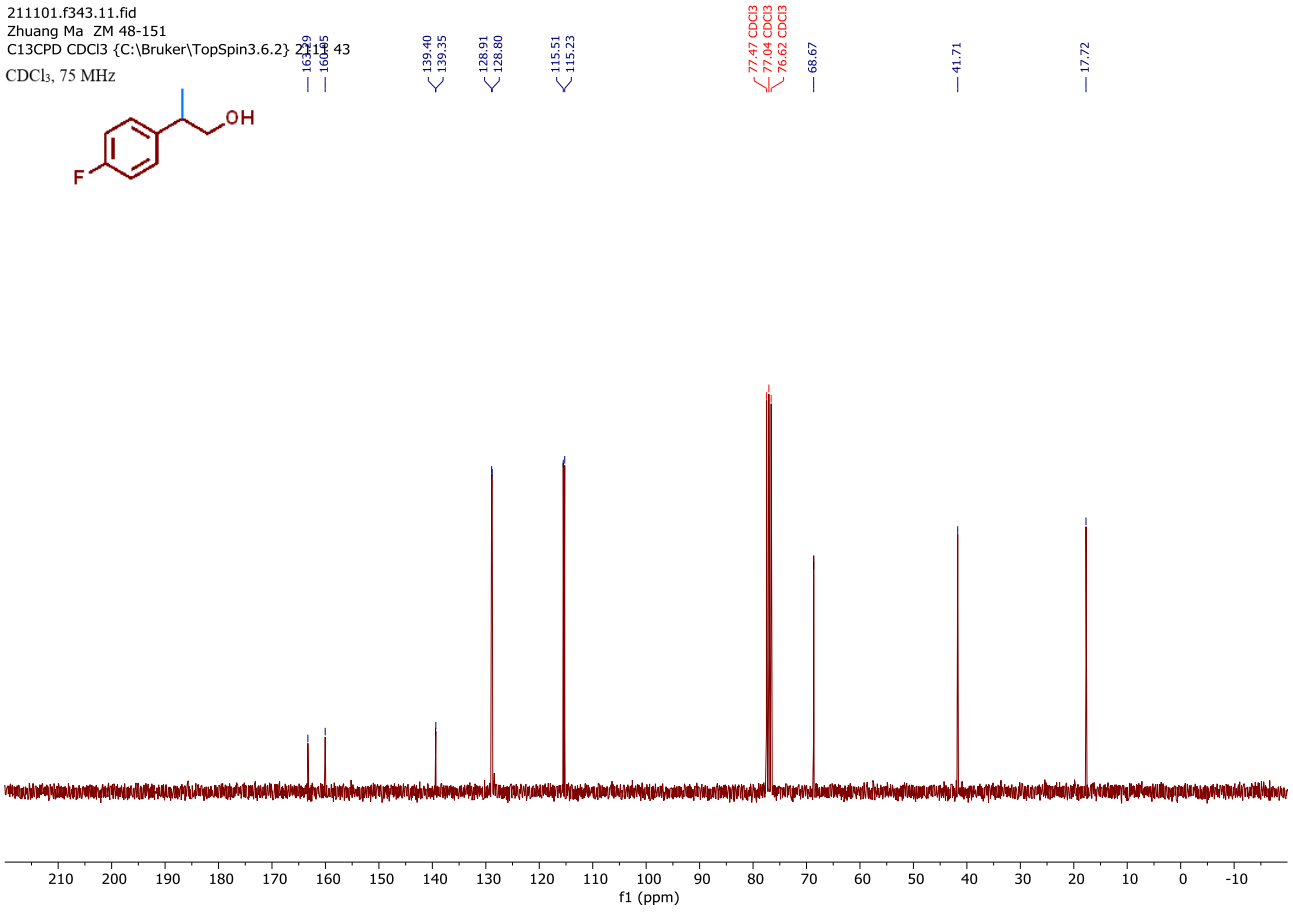
CDCl3, 101 MHz



1172

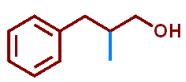

211101.f343.10.fid
Zhuang Ma ZM 48-151
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 43
CDCl3, 300 MHz
OH
F
7.26 CDCl3
1.50 H2O
1.99
1.92
2.00
0.98
3.04
f1 (ppm)

1173


211101.f343.11.fid
Zhuang Ma ZM 48-151
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2111 43
CDCl3, 75 MHz
OH
F
163.59
160.45
139.40
139.35
128.91
128.80
115.51
115.23
77.47 CDCl3
77.04 CDCl3
76.62 CDCl3
68.67
41.71
17.72
f1 (ppm)

1174

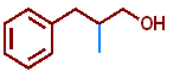
$CDCl_3$, 400 MHz



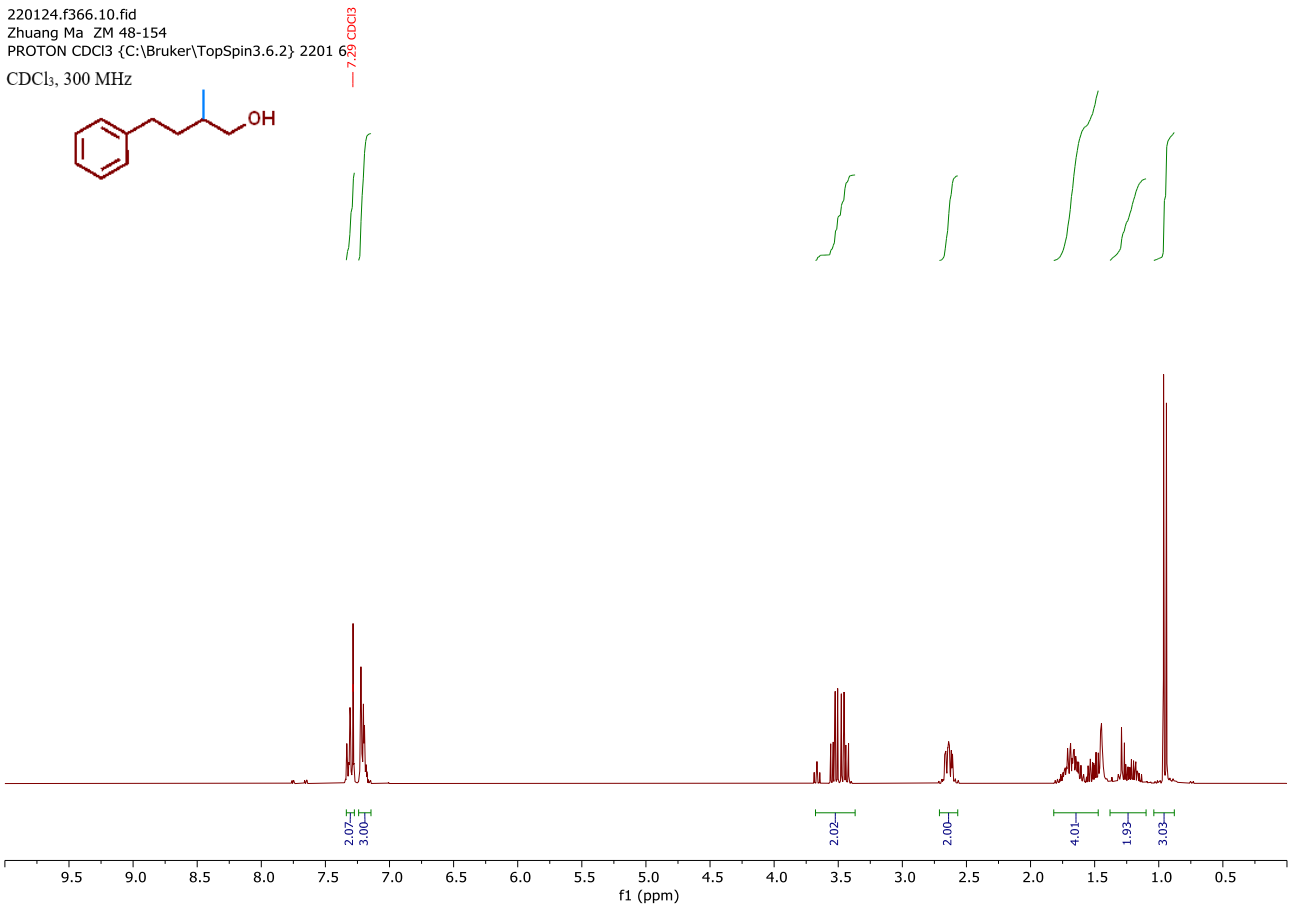
1175

1176

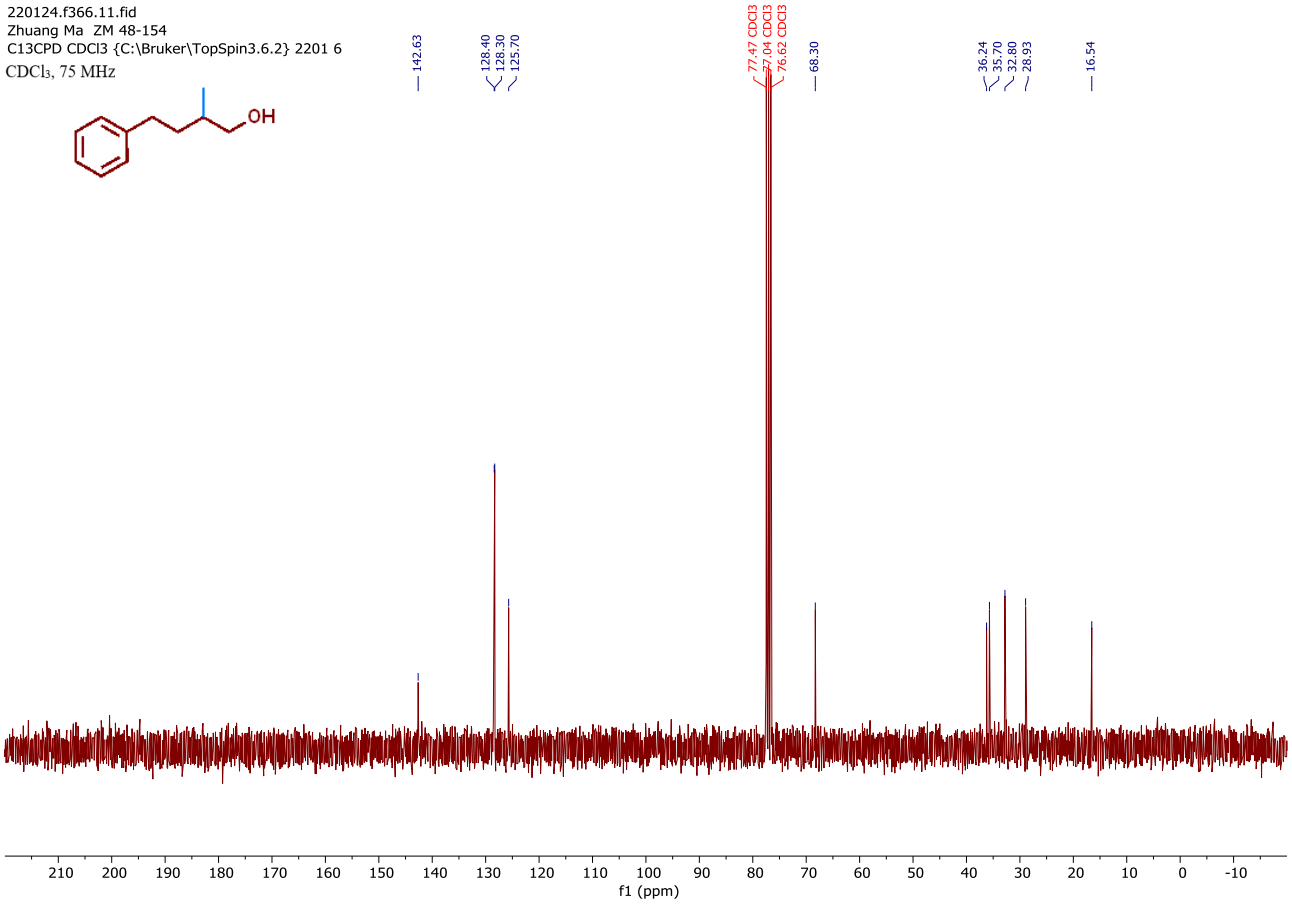
$CDCl_3$, 101 MHz



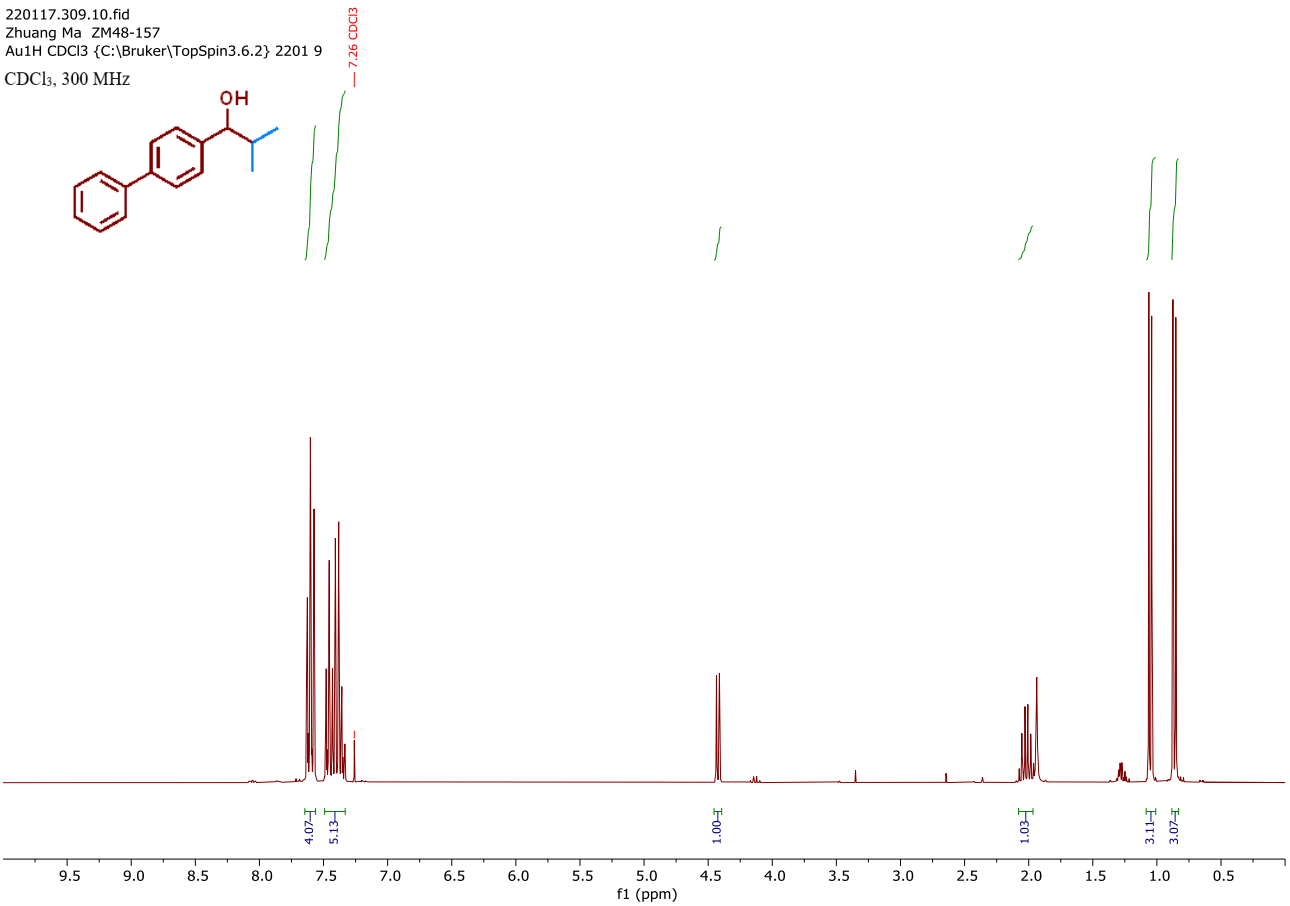
1177


220124.f366.10.fid
Zhuang Ma ZM 48-154
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2201 6
CDCl3, 300 MHz
OH
7.29 CDCl3
2.07
3.00
2.02
2.00
4.01
1.93
3.03
f1 (ppm)

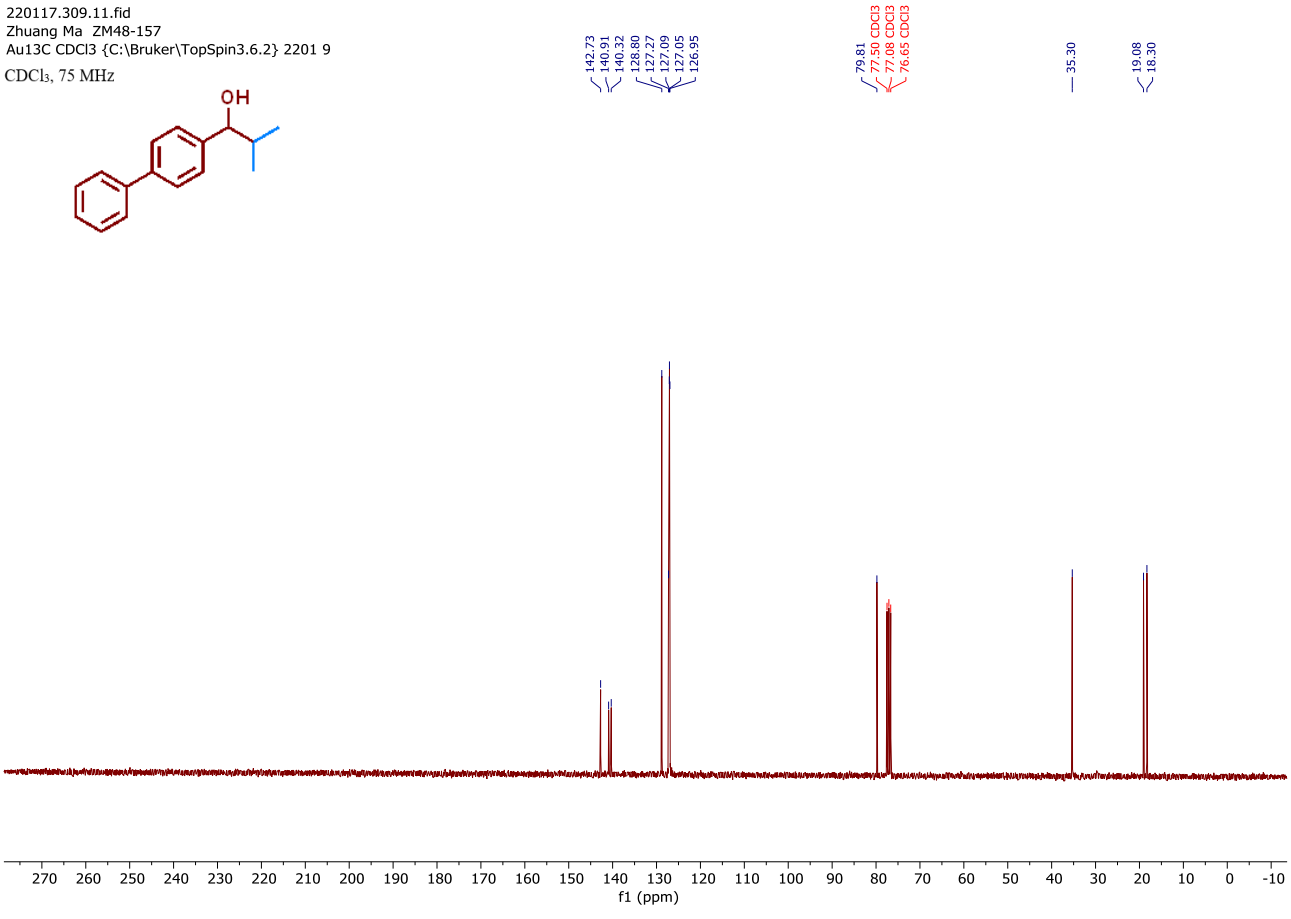
1178


220124.f366.11.fid
Zhuang Ma ZM 48-154
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2201 6
CDCl3, 75 MHz
OH
142.63
128.40
128.30
125.70
77.47 CDCl3
77.04 CDCl3
76.62 CDCl3
68.30
36.24
35.70
32.80
28.93
16.54
f1 (ppm)

1179



1180

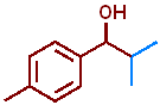


1181

1182

220203.326.10.fid
Ma/ ZM48-171
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2202 26

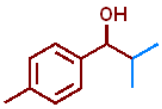
$CDCl_3$, 300 MHz



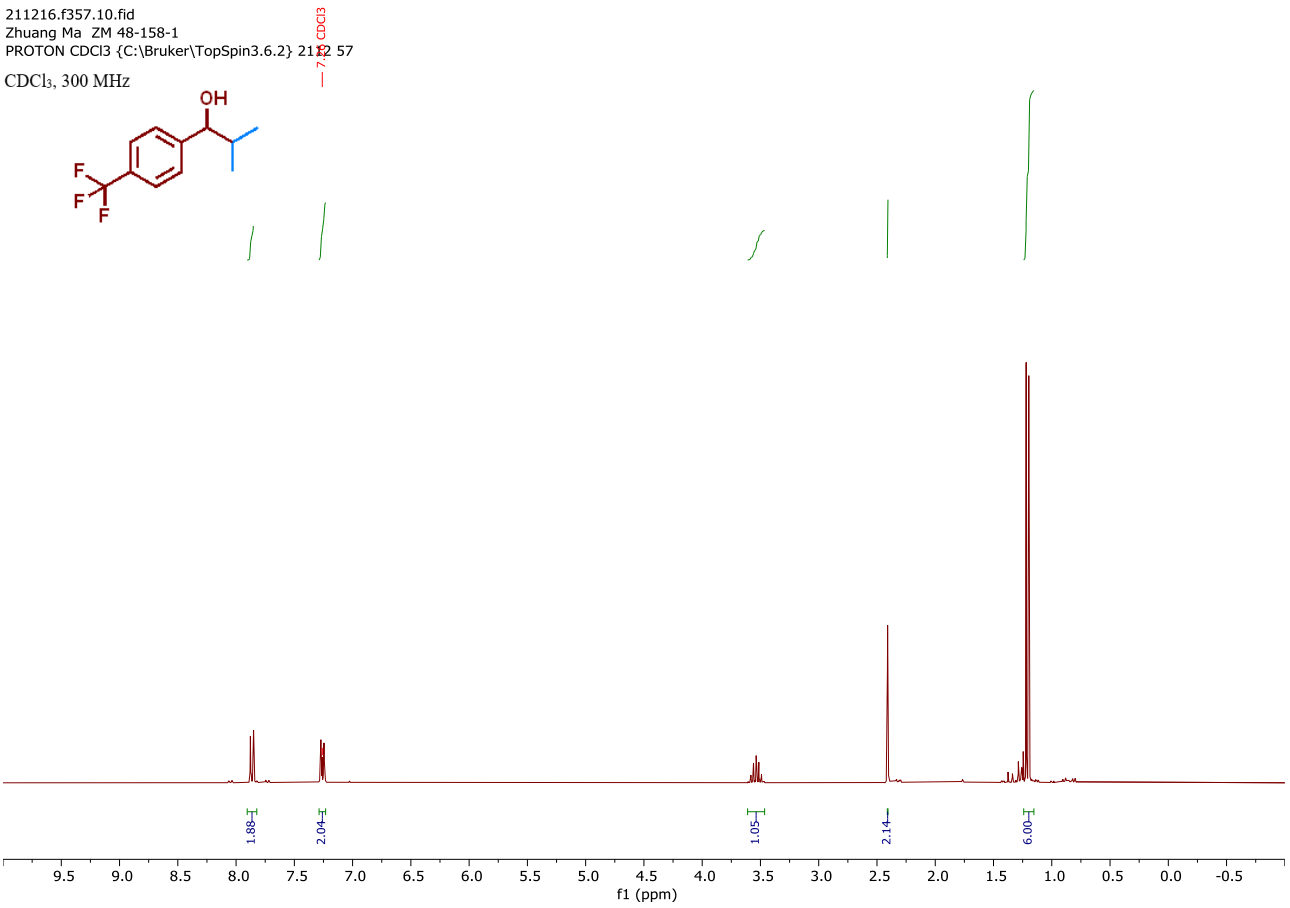
1183

220203.326.11.fid
Ma/ ZM48-171
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2202 26

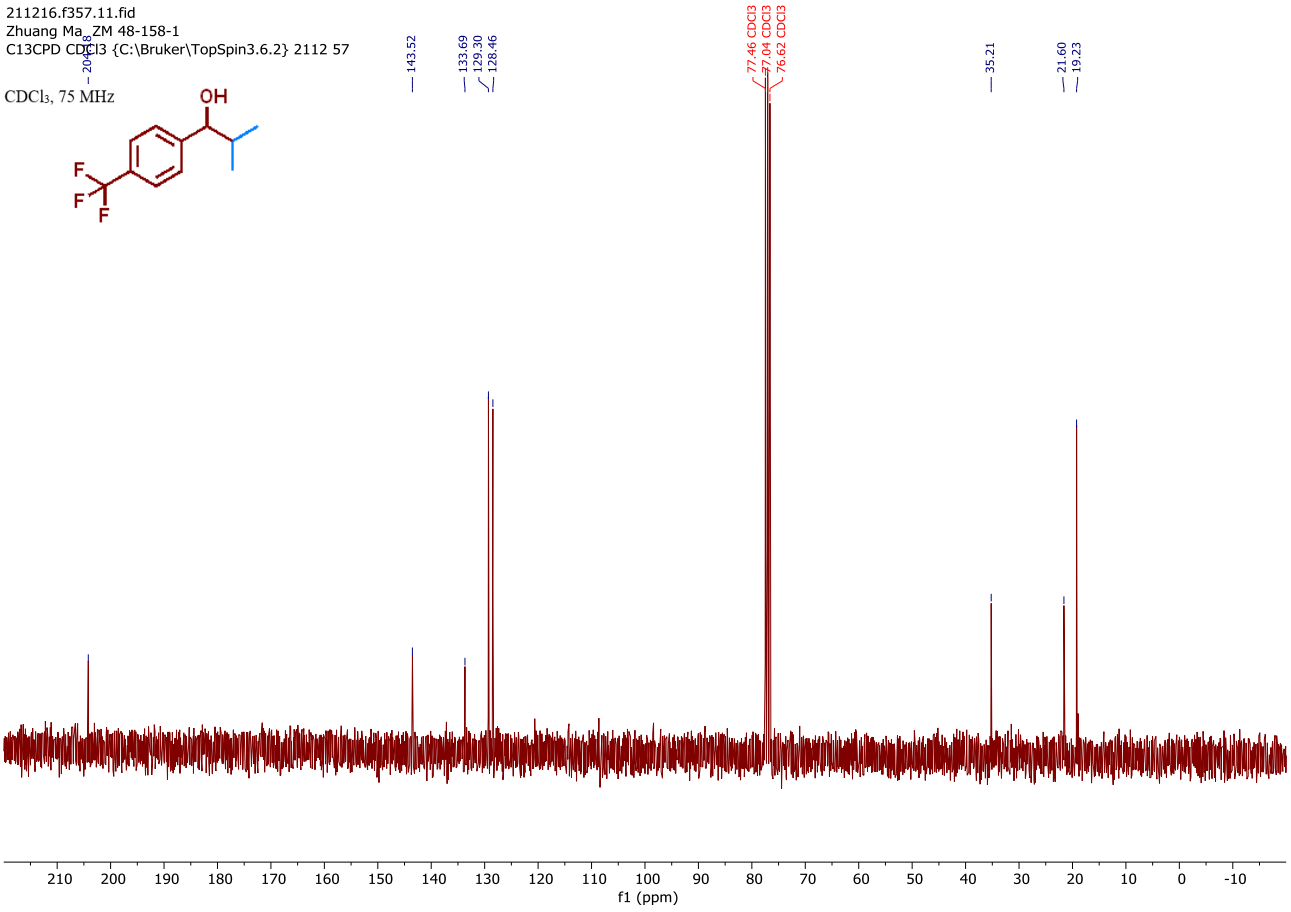
$CDCl_3$, 75 MHz



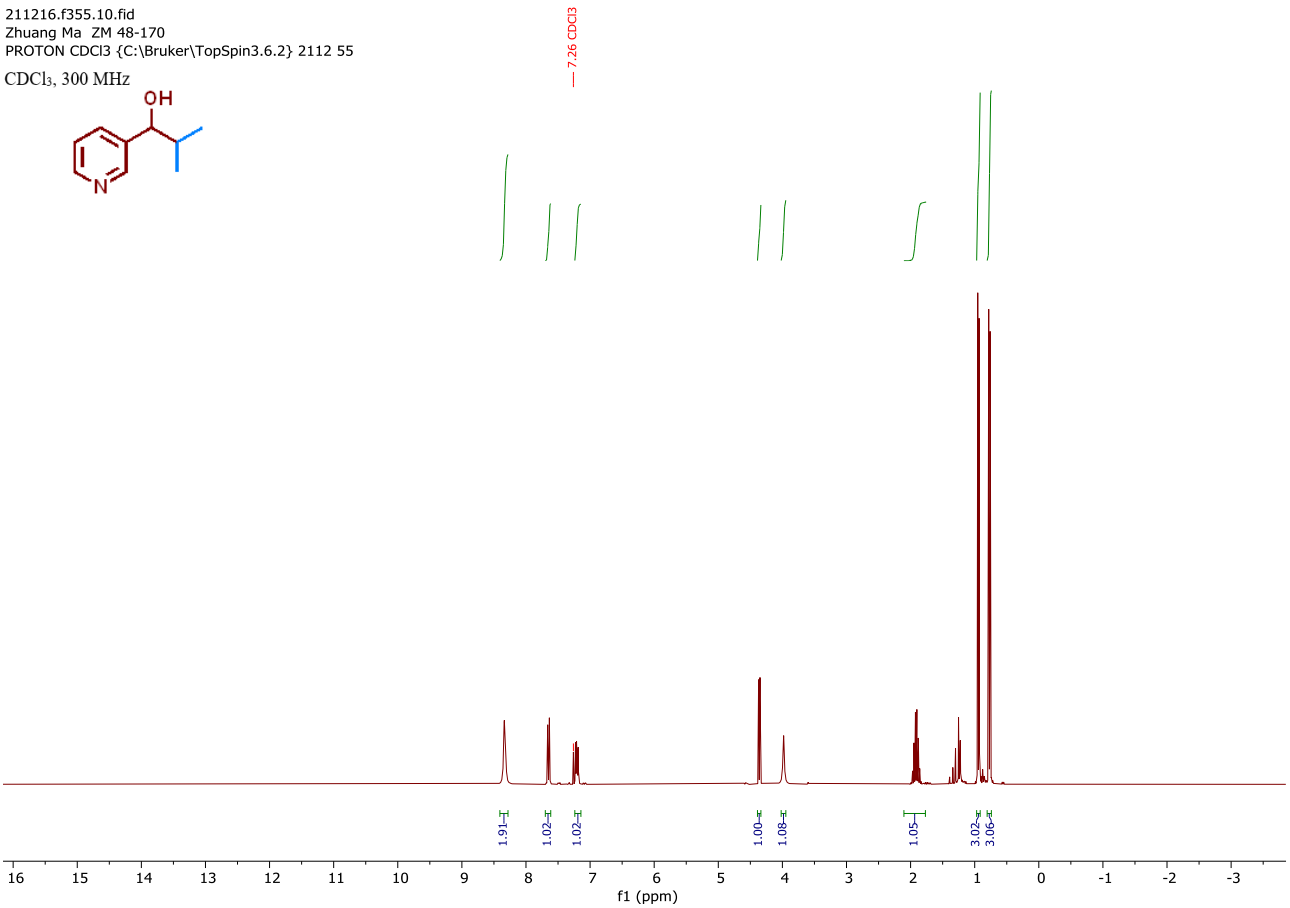
1184


211216.f357.10.fid
Zhuang Ma ZM 48-158-1
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2112 57
CDCl3, 300 MHz
OH
F
F
F
7.26 CDCl3
1.88
2.04
1.05
2.14
6.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

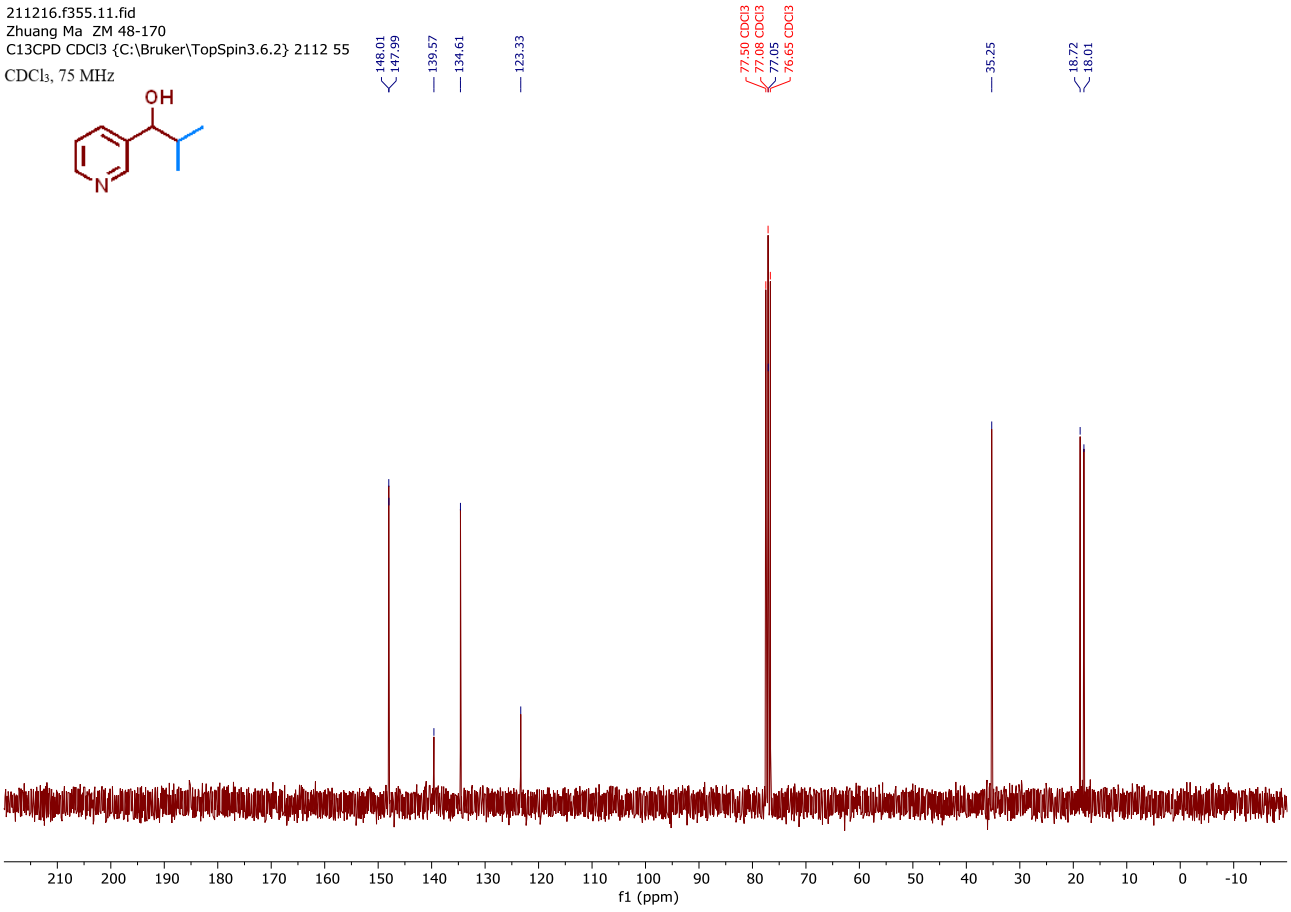
1185


211216.f357.11.fid
Zhuang Ma ZM 48-158-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2112 57
CDCl3, 75 MHz
OH
F
F
F
20.48
143.52
133.69
129.30
128.46
77.46 CDCl3
77.04 CDCl3
76.62 CDCl3
35.21
21.60
19.23
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

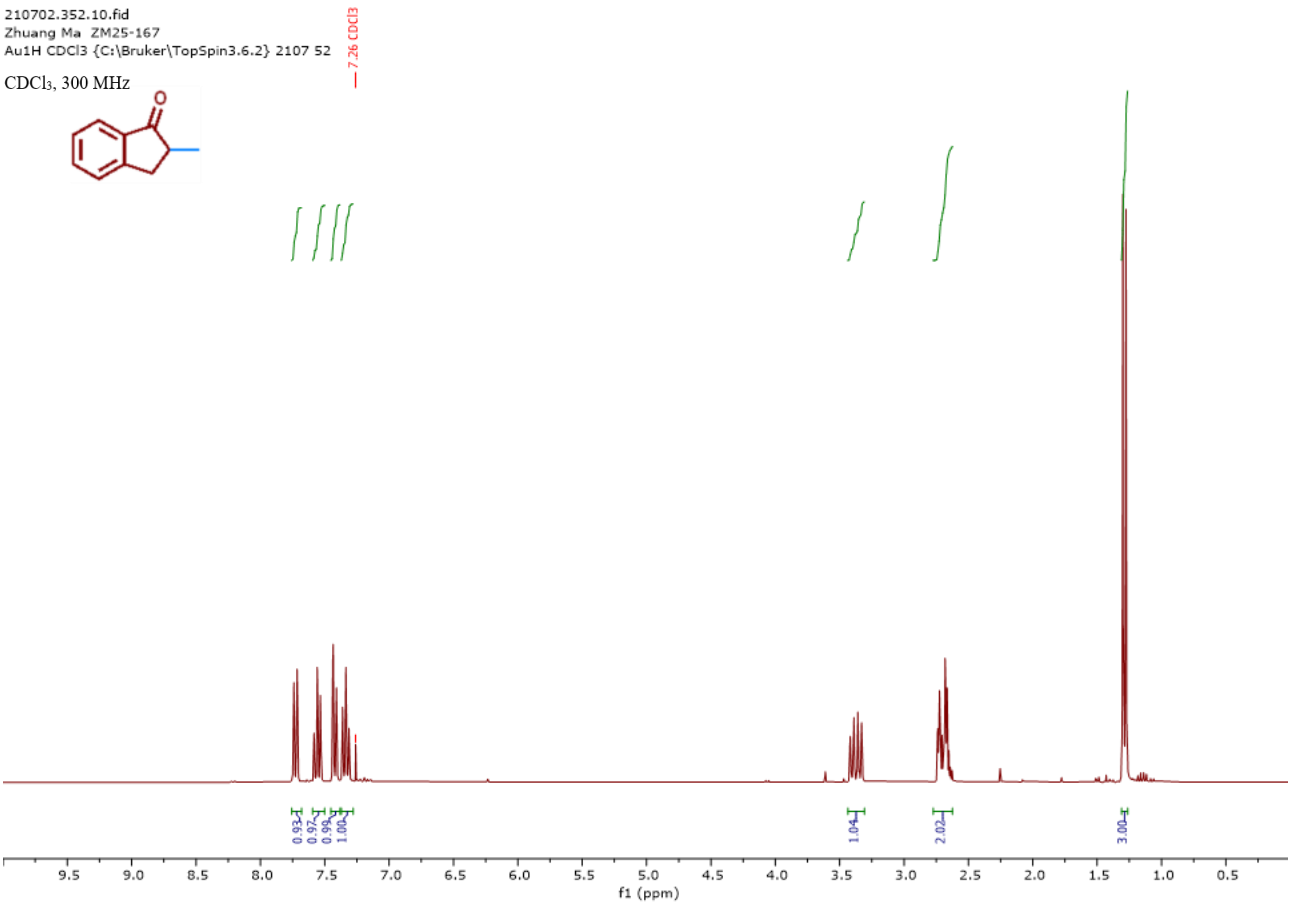
1186


211216.f355.10.fid
Zhuang Ma ZM 48-170
PROTON CDCl3 {C:\Bruker\TopSpin3.6.2} 2112 55
CDCl3, 300 MHz
OH
N
7.26 CDCl3
1.91
1.02
1.02
1.00
1.08
1.05
3.02
3.06
f1 (ppm)

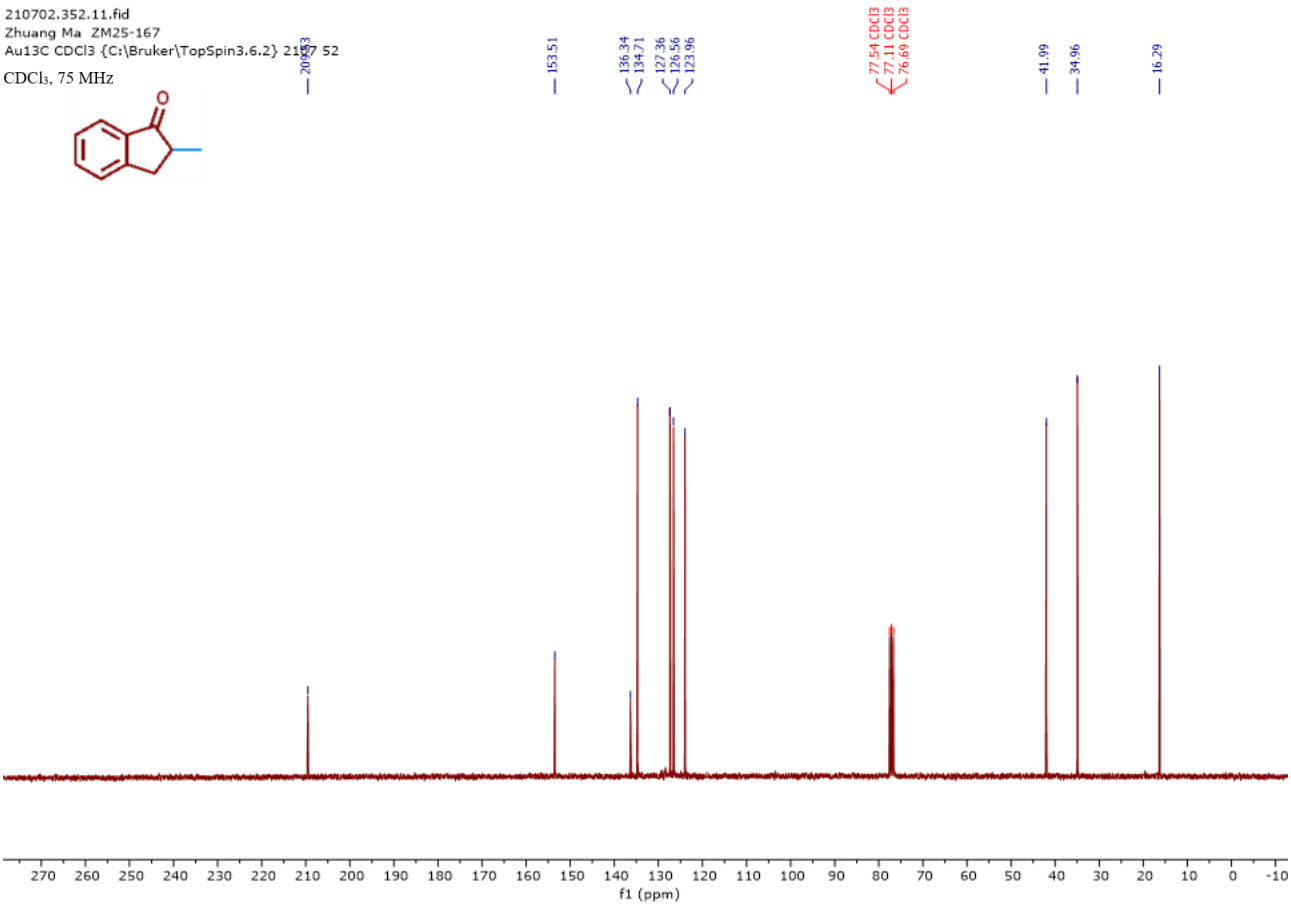
1187


211216.f355.11.fid
Zhuang Ma ZM 48-170
C13CPD CDCl3 {C:\Bruker\TopSpin3.6.2} 2112 55
CDCl3, 75 MHz
OH
N
148.01
147.99
139.57
134.61
123.33
77.50 CDCl3
77.08 CDCl3
77.05
76.65 CDCl3
35.25
18.72
18.01
f1 (ppm)

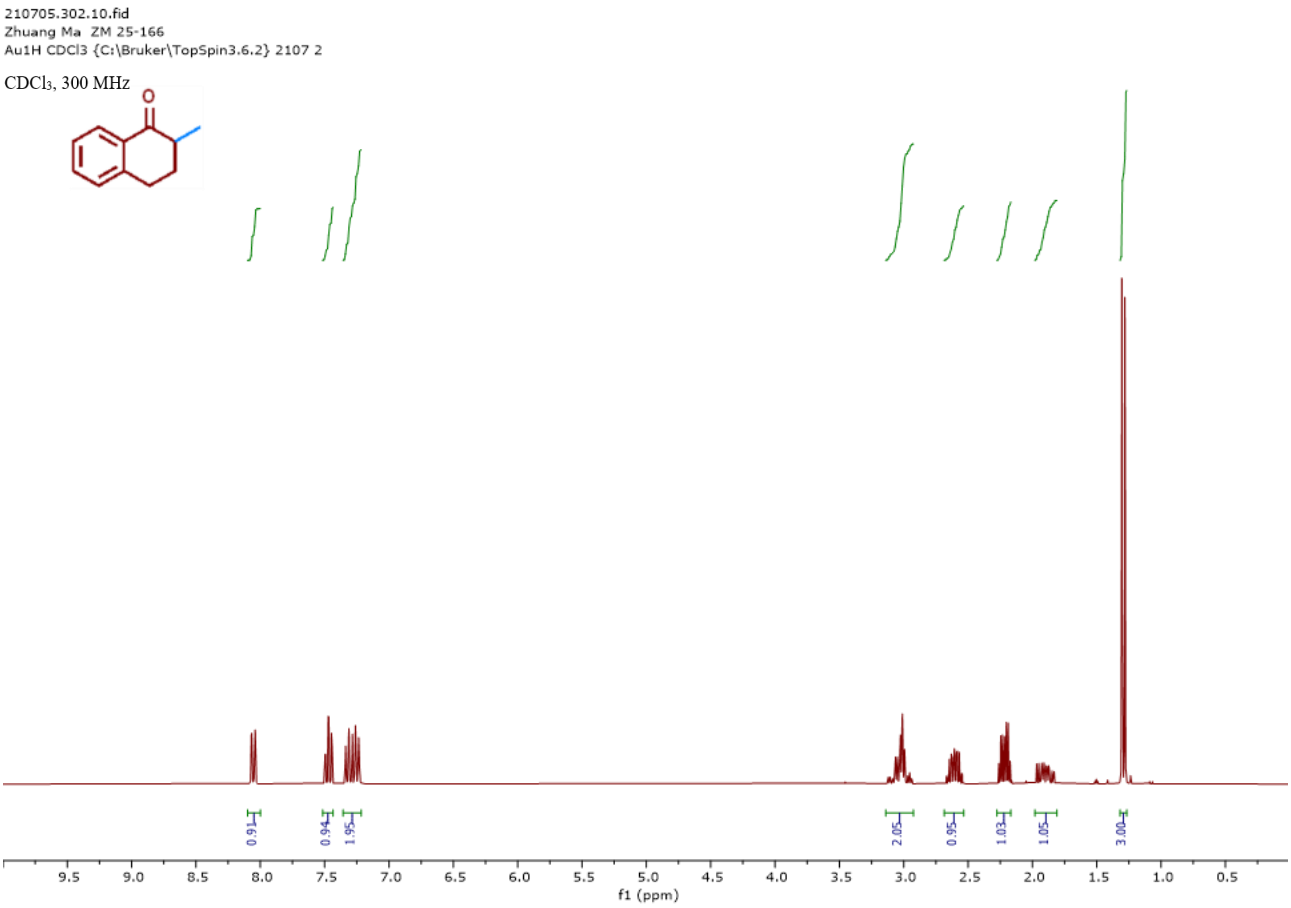
1188


210702.352.10.fid
Zhuang Ma ZM25-167
Au1H CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 52
CDCl3, 300 MHz
7.26 CDCl3
0.93
0.97
0.98
1.00
1.04
2.02
3.00
f1 (ppm)

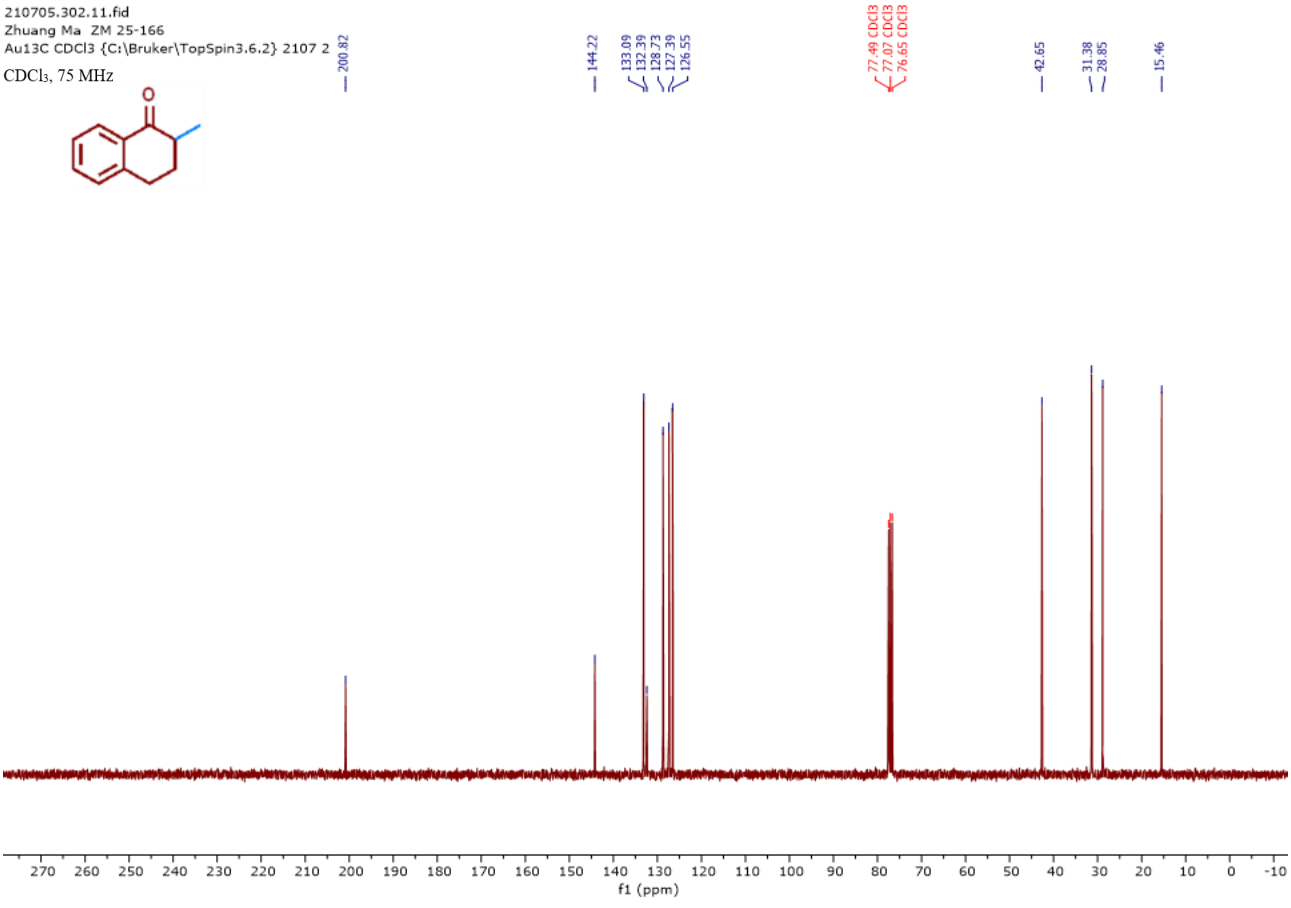
1189


210702.352.11.fid
Zhuang Ma ZM25-167
Au13C CDCl3 {C:\Bruker\TopSpin3.6.2} 2107 52
CDCl3, 75 MHz
153.51
136.34
134.71
127.36
126.56
123.96
77.54 CDCl3
77.11 CDCl3
76.69 CDCl3
41.99
34.96
16.29
f1 (ppm)

1190



1191



1192

1193

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