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Electronic Supplementary Information (ESI) for:

Nickel-Catalyzed Hydroalkylation and Hydroalkenylation of 1,3-Dienes with Hydrazones

Lei Cheng, Ming-Ming Li, Biao Wang, Li-Jun Xiao, Jian-Hua Xie, Qi-Lin Zhou*

State Key Laboratory and Institute of Elemento-Organic Chemistry, College of Chemistry, Nankai University, Tianjin 300071, China

CONTENTS:

1. General Information

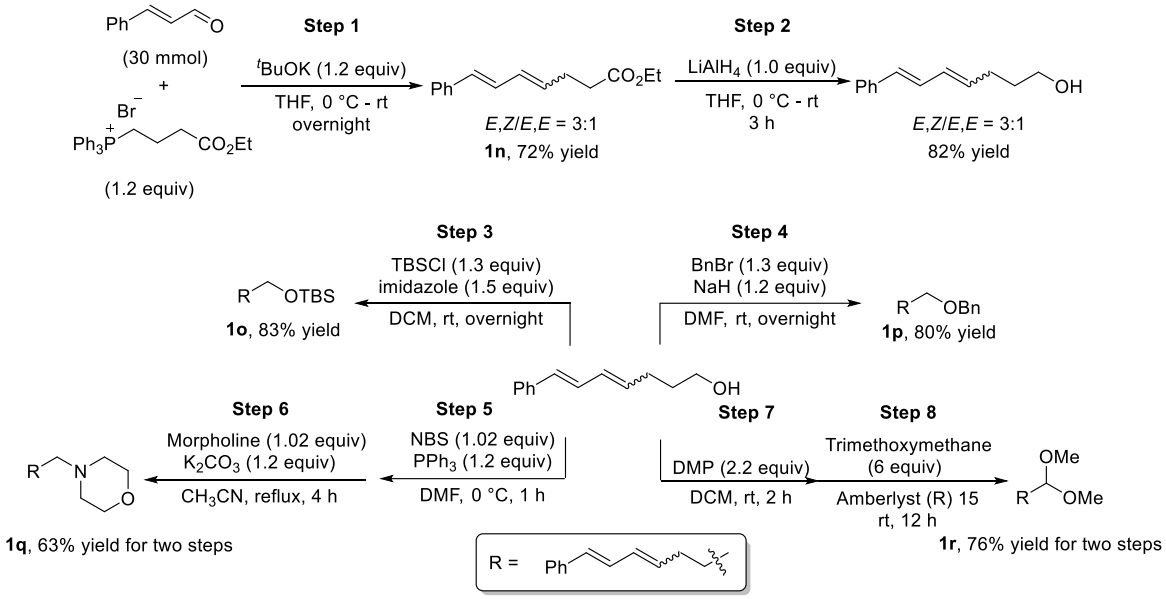
Unless mentioned otherwise, all manipulations were performed in an argon-filled glove-box MBRAUN LABstar or using standard Schlenk techniques. NMR spectra were recorded on a Bruker AV 400 spectrometer at 400 MHz (^{1}H NMR), 101 MHz (^{13}C NMR). Chemical shifts were reported in ppm relative to internal TMS for ^{1}H NMR data, deuterated solvent for ^{13}C NMR data, respectively. Data are presented in the following space: chemical shift, multiplicity, coupling constant in hertz (Hz), and signal area integration in natural numbers. High-resolution mass spectra were recorded on an IonSpec FT-ICR mass spectrometer with ESI or MALDI resource. Column chromatography was performed using silica gel P60 (mesh 230–400) supplied by Silicycle. Preparative TLC was performed using silica gel plate (200 × 200 × 1 mm) supplied by Xinnuo Chemical Company. All the solvents used for reactions were distilled under argon after drying over an appropriate drying agent. [$Ni(COD)_2$] (Strem Chemicals), P(4-$CF_3C_6H_4)_3$ (Accela), DPPPe (Strem Chemicals), ^{t}BuOLi (Aladdin), N_2H_4•H_2O (Alfa). Other commercially available reagents were purchased from Acros, Sigma-Adrich and Alfa Aesar Chemical Company.

2. Preparation of Substrates

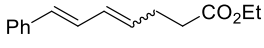
a) Diene substrates preparation

Method A: Aromatic 1,3-dienes (**1a**–**1l**) were prepared by Wittig olefination of enals or aldehydes according to previously reported procedures[1]. (*Note: the Z/E configuration of aromatic dienes has no effect on the yield and selectivity of the hydroalkylation reaction*)

Method B: Internal dienes **1n** can be synthesized according to previous reports[1,2a]. Dienes **1o-r** were prepared from **1o** using known procedures (step 1[1], step 2[2a], step 3[2a], step 4[2b], step 5[2c], step 6[2d], step 7[2e], step 8[2f]).

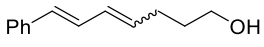


Ethyl (6*E*)-7-phenylhepta-4,6-dienoate (1n)



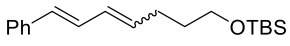
Isolated by flash silica gel chromatography (PE/EA = 4:1). A mixture of *E,Z*–isomer and *E,E*–isomer was obtained in 72% yield, *E,Z*/*E,E* = 3:1. Colorless oil, bp: 114–116 °C (0.1 Torr). ^{1}H NMR (400 MHz, $CDCl_3$) *δ E,Z*–isomer 7.42 (d, *J* = 8.0 Hz, 2H), 7.33–7.25 (m, 2H), 7.24–7.16 (m, 1H), 7.07 (dd, *J* = 15.5, 11.1 Hz, 1H), 6.54 (d, *J* = 15.6 Hz, 1H), 6.19 (t, *J* = 11.9 Hz, 1H), 5.47 (dt, *J* = 11.1, 7.7 Hz, 1H), 4.14 (q, *J* = 7.1 Hz, 2H), 2.62 (q, *J* = 7.4 Hz, 2H), 2.43 (t, *J* = 7.5 Hz, 2H), 1.24 (t, *J* = 7.3 Hz, 3H); *δ E,E*–isomer: 7.37 (d, *J* = 8.2 Hz, 2H), 7.33–7.25 (m, 2H), 7.24–7.16 (m, 1H), 6.73 (dd, *J* = 15.6, 10.4 Hz, 1H), 6.45 (d, *J* = 15.6 Hz, 1H), 6.28–6.22 (m, 1H), 5.84–5.77 (m, 1H), 4.14 (q, *J* = 7.1 Hz, 2H), 2.63–2.58 (m, 2H), 2.47–2.40 (m, 2H), 1.24 (t, *J* = 7.1 Hz, 3H). Spectral data matched those previously reported.[2a]

(6*E*)-7-phenylhepta-4,6-dien-1-ol



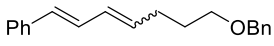
Isolated by flash silica gel chromatography (PE/EA = 3:1). A mixture of *E*,*Z*–isomer and *E*,*E*–isomer was obtained in 82% yield, *E*,*Z*/*E*,*E* = 3:1. Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ *E*,*Z*–isomer 7.41 (d, *J* = 7.3 Hz, 2H), 7.31 (t, *J* = 6.8 Hz, 2H), 7.25–7.15 (m, 1H), 7.07 (dd, *J* = 15.6, 11.1 Hz, 1H), 6.53 (d, *J* = 15.6 Hz, 1H), 6.19 (t, *J* = 10.9 Hz, 1H), 5.52 (q, *J* = 9.1, 8.5 Hz, 1H), 3.68 (td, *J* =6.2, 1.8 Hz, 2H), 2.38 (q, *J* = 7.5 Hz, 2H), 1.78–1.59 (m, 3H); δ *E*,*E*–isomer 7.37 (d, *J* = 7.4 Hz, 2H), 7.34–7.26 (m, 2H), 7.25–7.15 (m, 1H), 6.75 (dd, *J* = 15.6, 10.5 Hz, 1H), 6.45 (d, *J* = 15.7 Hz, 1H), 6.26–6.16 (m, 1H), 5.81 (dt, *J* = 15.6, 7.3 Hz, 1H), 3.70–3.65 (m, 2H), 2.24 (q, *J* = 7.0 Hz, 2H), 1.73–1.66 (m, 3H). Spectral data matched those previously reported.[2a]

***Tert*-butyldimethyl(((6*E*)-7-phenylhepta-4,6-dien-1-yl)oxy)silane (1o)**



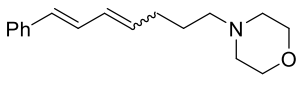
Isolated by flash silica gel chromatography (PE). A mixture of *E*,*Z*–isomer and *E*,*E*–isomer was obtained in 83% yield, *E*,*Z*/*E*,*E* = 3:1. Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ *E*,*Z*–isomer 7.39 (d, *J* = 8.0 Hz, 2H), 7.29 (t, *J* = 7.5 Hz, 2H), 7.20 (t, *J* = 7.3 Hz, 1H), 7.06 (dd, *J* = 15.5, 11.1 Hz, 1H), 6.51 (d, *J* = 15.6 Hz, 1H), 6.17 (t, *J* = 11.0 Hz, 1H), 5.57–5.47 (m, 1H), 3.64 (t, *J* = 6.4 Hz, 2H), 2.35 (q, *J* = 5.5 Hz, 2H), 1.71–1.60 (m, 2H), 0.89 (9H, s), 0.04 (6H, s); δ *E*,*E*–isomer 7.36 (d, *J* = 7.7 Hz, 2H), 7.31–7.26 (m, 2H), 7.21–7.16 (m, 1H), 6.75 (dd, *J* = 15.6, 10.4 Hz, 1H), 6.44 (d, *J* = 15.7 Hz, 1H), 6.22 (dd, *J* = 15.0, 10.5 Hz, 1H), 5.81 (dt, *J* = 14.4, 6.8 Hz, 1H), 3.66–3.61 (m, 2H), 2.19 (q, *J* = 7.0 Hz, 2H), 1.71–1.60 (m, 2H), 0.89 (s, 9H), 0.04 (s, 6H). Spectral data matched those previously reported.[2a]

((1*E*)-7-(benzyloxy)hepta-1,3-dien-1-yl)benzene (1p)



Isolated by flash silica gel chromatography (PE/EA = 10:1). A mixture of *E*,*Z*–isomer and *E*,*E*–isomer was obtained in 80% yield, *E*,*Z*/*E*,*E* = 6.0:1. Colorless oil, bp: 165–168 ℃ (0.2 Torr). ^{1}H NMR (400 MHz, $CDCl_3$) δ *E*,*Z*–isomer 7.38–7.26 (m, 9H), 7.23–7.17 (m, 1H), 7.09 (dd, *J* = 15.6, 11.1, 1H), 6.53 (d, *J* = 15.6 Hz, 1H), 6.19 (t, *J* = 10.6 Hz, 1H), 5.51 (dt, *J* = 10.6, 7.8 Hz, 1H), 4.56 (s, 2H), 3.51 (t, *J* = 6.3 Hz, 2H), 2.41 (qd, *J* = 7.6, 1.3 Hz, 2H), 1.80–1.70 (m, 2H); δ *E*,*E*–isomer 7.38–7.26 (m, 9H), 7.23–7.17 (m, 1H), 6.74 (dd, *J* = 15.6, 10.4 Hz, 1H), 6.43 (d, *J* = 15.6 Hz, 1H), 6.27–6.17 (m, 1H), 5.91–5.74 (m, 1H), 4.50 (s, 2H), 3.51 (t, *J* = 6.3 Hz, 2H), 2.25 (q, *J* = 7.1 Hz, 2H), 1.80–1.70 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 138.5, 137.5, 137.5, 134.9, 132.2, 132.1, 130.9, 130.2, 129.4, 129.2, 128.5, 128.5, 128.4, 128.3, 127.6, 127.6, 127.5, 127.4, 127.3, 127.1, 126.3, 126.1, 124.3, 72.9, 69.6, 69.4, 29.6, 29.4, 29.3, 24.5. HRMS (ESI) calcd for [$C_{20}H_{22}NaO$, M+Na]$^+$: 301.1563, Found: 301.1568.

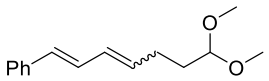
4-((6*E*)-7-phenylhepta-4,6-dien-1-yl)morpholine (1q)



Isolated by flash silica gel chromatography (EA). A mixture of *E*,*Z*–isomer and *E*,*E*–isomer was obtained in 63% yield for two steps, *E*,*Z*/*E*,*E* = 3.0:1. Yellow oil. ^{1}H NMR (400 MHz,

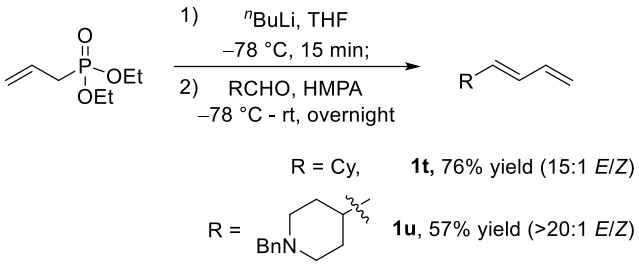
$CDCl_3$) δ *E,Z*–isomer 7.41 (d, *J* = 7.3 Hz, 2H), 7.31 (t, *J* = 7.5 Hz, 2H), 7.24–7.19 (m, 1H), 7.07 (dd, *J* = 15.6, 11.1, 1H), 6.53 (d, *J* = 15.6 Hz, 1H), 6.18 (t, *J* = 11.0 Hz, 1H), 5.51 (dt, *J* = 10.7, 7.7 Hz, 1H), 3.74–3,69 (m, 4H), 2.46–2.40 (m, 4H), 2.37–2.30 (m, 4H), 1.70–1.56 (m, 2H); δ *E,E*–isomer 7.41 (d, *J* = 7.3 Hz, 2H), 7.31 (t, *J* = 7.5 Hz, 2H), 7.24–7.19 (m, 1H), 6.75 (dd, *J* = 15.6, 10.4 Hz, 1H), 6.44 (d, *J* = 15.6 Hz, 1H), 6.24 (t, *J* = 10.9 Hz, 1H), 5.89–5.74 (m, 1H), 3.74–3,69 (m, 4H), 2.46–2.40 (m, 4H), 2.39–2.37 (m, 1H), 2.18 (dd, *J* = 14.1, 7.0 Hz, 3H), 1.70–1.56 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.5, 134.9, 132.3, 132.2, 130.9, 130.2, 129.2, 129.2, 128.5, 128.5, 128.4, 127.4, 127.1, 126.2, 126.1, 124.2, 67.0, 67.0, 58.4, 58.2, 53.7, 30.6, 26.4, 26.1, 25.6. HRMS (ESI) calcd for $[C_{17}H_{24}NO, M+H]^+$: 258.1852, Found: 258.1856.

((1*E*)-7,7-dimethoxyhepta-1,3-dien-1-yl)benzene (1r)

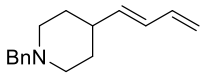


Isolated by flash silica gel chromatography (PE/EA = 10:1). A mixture of *E,Z*–isomer and *E,E*–isomer was obtained in 76% yield for two steps, *E,Z*/*E,E* = 1:1.2. Light yellow oil, bp: 135–137 °C (2 Torr). ^{1}H NMR (400 MHz, $CDCl_3$) δ *E,Z*–isomer 7.42 (d, *J* = 7.3 Hz, 2H), 7.29 (t, *J* = 7.6 Hz, 2H), 7.22–7.17 (m, 1H), 7.08 (dd, *J* = 15.6, 11.1, 1H), 6.53 (d, *J* = 15.6 Hz, 1H), 6.15 (dd, *J* = 11.6, 4.6 Hz, 1H), 5.51 (dt, *J* = 10.6, 7.8 Hz, 1H), 4.40 (t, *J* = 5.7 Hz, 1H), 3.33 (s, 6H), 2.36 (ddd, *J* = 15.6, 7.8, 1.3 Hz, 2H), 1.79–1.67 (m, 2H); δ *E,E*–isomer 7.37 (d, *J* = 7.3 Hz, 2H), 7.29 (t, *J* = 7.6 Hz, 2H), 7.22–7.17 (m, 1H), 6.75 (dd, *J* = 15.7, 10.4 Hz, 1H), 6.45 (d, *J* = 15.7 Hz, 1H), 6.23 (dd, *J* = 15.1, 10.5 Hz, 1H), 5.88–5.75 (m, 1H), 4.40 (t, *J* = 5.7 Hz, 1H), 3.33 (s, 6H), 2.21 (dd, *J* = 14.6, 7.1 Hz, 2H), 1.78–1.69 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.4, 134.3, 132.4, 131.6, 131.0, 130.4, 129.4, 129.1, 128.5, 128.5, 127.4, 127.1, 126.3, 126.1, 124.1, 103.8, 52.8, 52.7, 32.2, 31.9, 27.9, 23.1. HRMS (ESI) calcd for $[C_{15}H_{20}NaO_2, M+Na]^+$: 255.1356, Found: 255.1360.

Method C: Aliphatic 1,3-dienes **1s**–**1t** were prepared by olefination reactions with allylic phosphonate[3]. To a solution of diethyl allylphosphonate (1.07 g, 6.0 mmol) in anhydrous THF (15 mL), ^{n}BuLi (2.5 M in hexane, 2.4 mL, 6.0 mmol) was added dropwise at –78 ℃. After stirring for 15 minutes, a solution of the RCHO (5.0 mmol) in HMPA (2.1 mL, 12 mmol) was added dropwise via cannula. The resulting solution was stirred at –78 ℃ for 2 h, and then allowed to warm to room temperature. Stirring was continued overnight at room temperature before quenching with saturated aqueous NH_4Cl solution. The mixture was extracted with Et_2O (3 × 15 mL). The combined organic phases were washed with brine (30 mL), dried ($MgSO_4$) and concentrated to afford the crude product. Purification by flash chromatography gave pure dienes.

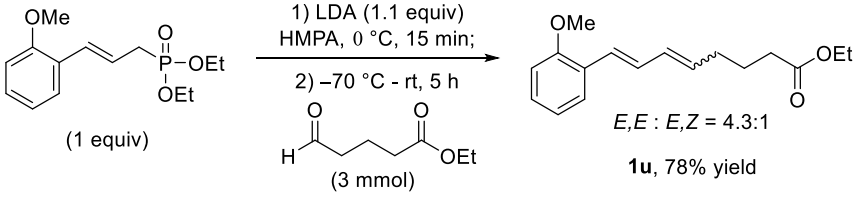


(*E*)-1-benzyl-4-(buta-1,3-dien-1-yl)piperidine (1t)

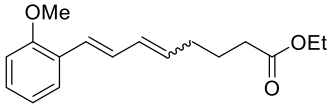


Isolated by flash silica gel chromatography (PE/EA = 10:1). *E*–isomer was obtained in 57% yield. Colorless oil, bp: 112-114 ℃ (1 Torr). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34–7.27 (m, 4H), 7.25–7.21 (m, 1H), 6.29 (dt, *J* = 17.0, 10.1 Hz, 1H), 6.03 (dd, *J* = 15.3, 10.1 Hz, 1H), 5.65 (dd, *J* = 15.3, 7.0 Hz, 1H), 5.09 (dd, *J* = 17.0, 1.4 Hz, 1H), 4.96 (dd, *J* = 10.1, 1.4 Hz, 1H), 3.48 (s, 2H), 2.87 (d, *J* = 11.7 Hz, 2H), 2.03–1.91 (m, 3H), 1.72–1.59 (m, 2H), 1.51–1.38 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.6, 138.4, 137.3, 129.1, 129.0, 128.1, 126.8, 115.1, 63.4, 53.4, 38.1, 31.8. HRMS (ESI) calcd for $[C_{16}H_{22}N, M+H]^+$: 228.1747, Found: 228.1751.

Method D: Internal diene **1u** was prepared by olefination reactions with cinnamyl phosphonate. To a solution of LDA (2.0 M in THF, 1.1 equiv) in THF (5.0 mL) was added newly distilled HMPA (5.0 mL) at 0 ℃, and cinnamyl phosphonate (3.0 mmol, 1 equiv) by syringe. After stirring 15 minutes at 0 ℃, the yellow-orange solution was cooled to –70 ℃ by a dry ice/acetone bath, and a solution of ethyl 5-oxopentanoate in THF (2.5 mL) was added dropwise via cannula. After stirring 5 h the reaction was carefully quenched with saturated aqueous NH_4Cl (10 mL) and water (10 mL). The combined aqueous layers were extracted with EtOAc (3 × 10 mL) and the combined organic fractions were dried over $MgSO_4$, filtered, and concentrated. Purification by flash chromatography (PE/EA = 8:1) gave the internal diene **1u**.



Ethyl (7*E*)-8-(2-methoxyphenyl)octa-5,7-dienoate (1u)

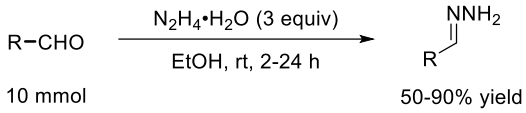


Isolated by flash silica gel chromatography (PE/EA = 8:1). A mixture of *E,E*–isomer and *E,Z*–isomer was obtained in 78% yield, *E,Z*/*E,E* = 19:81. Light yellow oil, bp: 140–142 ℃ (0.2 Torr). The data for *E,E* isomer: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (dd, *J* = 7.6, 1.3 Hz, 1H), 7.21–7.16 (m, 1H), 6.93–6.76 (m, 4H), 6.31–

6.20 (m, 1H), 5.82–5.68 (m, 1H), 4.13 (q, *J* = 7.2 Hz, 2H), 3.85 (s, 3H), 2.41–2.26 (m, 2H), 2.18 (dd, *J* = 14.4, 7.2 Hz, 2H), 1.83–1.65 (m, 2H), 1.26 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 173.6, 156.6, 133.5, 132.2, 129.8, 128.2, 126.5, 126.2, 125.3, 120.6, 110.8, 60.2, 55.4, 33.7, 3.13, 24.5, 14.2. HRMS (ESI) calcd for [$C_{17}H_{22}NaO_3$, M+Na]$^+$: 297.1461, Found: 297.1465.

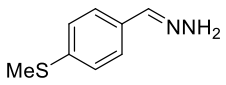
b) Hydrazone substrates preparation

Method A): The aromatic hydrazone substrates (**2a–2r**) and aliphatic hydrazone substrates **2s** are prepared by following procedure[4].



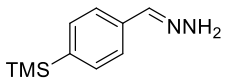
To a solution of hydrazine hydrate (1.5 mL, 30 mmol, 98% purity) in absolute EtOH (10 mL), aldehyde (10 mmol) was added dropwise under nitrogen. The resulting solution was stirred at room temperature for 2 h. After consumption of the aldehyde, water (10 mL) was added, and the mixture was extracted with DCM (3 × 10 mL). Combined organic layers were dried over sodium sulfate, filtered and concentrated at room temperature under reduced pressure to afford the hydrazones (50–85% yield). (*The hydrazone products were stored in dry-box*)

(4-(methylthio)benzylidene)hydrazine (2f)



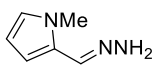
White solid, mp: 55–56 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (s, 1H), 7.46 (d, *J* = 8.4 Hz, 2H), 7.21 (d, *J* = 6.6 Hz, 1H), 5.49 (s, 2H), 2.49 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 142.7, 139.2, 131.9, 126.5, 126.2, 15.5. HRMS (ESI) calcd for [$C_8H_{11}N_2S$, M+H]$^+$: 167.0637, Found: 167.0639.

(4-(trimethylsilyl)benzylidene)hydrazine (2h)



Light yellow solid, mp: 47–48 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (s, 1H), 7.55–7.44 (m, 4H), 5.54 (s, 2H), 0.26 (s, 9H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.1, 141.2, 135.4, 133.5, 125.4, -1.2. HRMS (ESI) calcd for [$C_{10}H_{17}N_2Si$, M+H]$^+$: 193.1156, Found: 193.1157.

2-(hydrazonomethyl)-1-methyl-1H-pyrrole (2o)

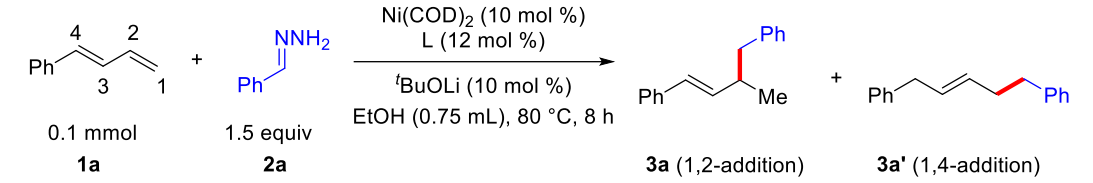


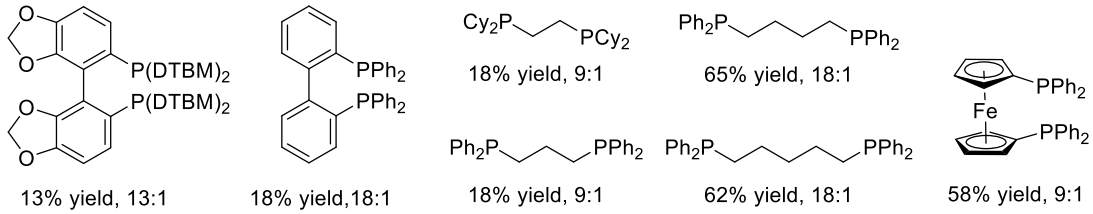
Brown solid, mp: 35–36 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (s, 1H), 6.67–6.48 (m, 1H), 6.28 (dd, *J* = 3.6, 1.7 Hz, 1H), 6.09 (dd, *J* = 3.6, 2.7 Hz, 1H), 5.23 (s, 2H), 3.81 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.4, 128.1, 126.0, 112.2, 107.7, 36.4. HRMS (ESI) calcd for [$C_6H_{10}N_3$, M+H]$^+$: 124.0869, Found: 124.0869.

Method B): The preparation of the α,β-unsaturated hydrazones (**5a**-**5j**) in situ: to a solution of hydrazine hydrate (1.05 mmol, 98% purity) in absolute EtOH (1.0 mL), α,β-unsaturated aldehyde (1.0 mmol) was added dropwise under nitrogen. The resulting solution was stirred at room temperature for 2 h and directly used for the hydroalkenylation reaction (*Note: The H_2O produced in the solution didn't affect the yield of hydroalkenylation reaction.*).

3. Hydroalkylation Procedure and Characterization of Products

Table S1: Optimization of reaction conditions (ligand)



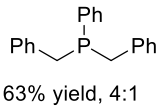


IMes: 13% yield, 13:1

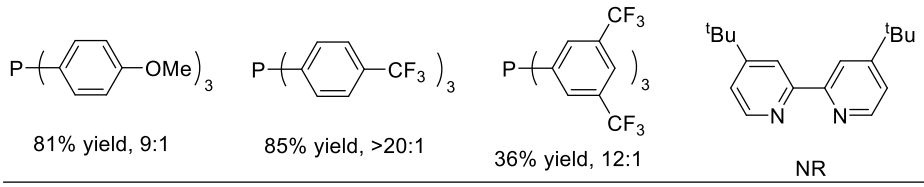
PCy_3: 33% yield, 3:1

P^tBu_3: N.D.

PBn_3: 38% yield, 6:1

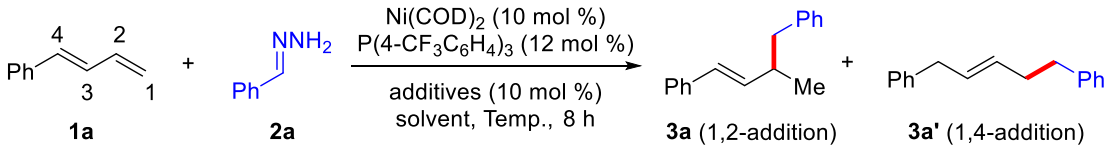


PPh_3: 64% yield, 11:1



Reaction conditions: 1-phenylbutadiene **1a** (0.10 mmol), hydrazone **2a** (0.15 mmol), $Ni(COD)_2$ (0.010 mmol), ligand (0.012 mmol for monodentate ligand, 0.012 mmol for bidentate ligand), additives (0.01 mmol), solvent (0.75 mL) at 80 °C for 8 h. ^1H NMR yields of major isomer **3a** using 1,3,5-trimethoxybenzene as internal standard. Regioselectivity (ratio of 1,2- and 1,4-hydrogenation products) was determined by ^1H NMR analysis of reaction mixture.

Table S2: Optimization of reaction conditions (additives/solvent/temperature/ratio)

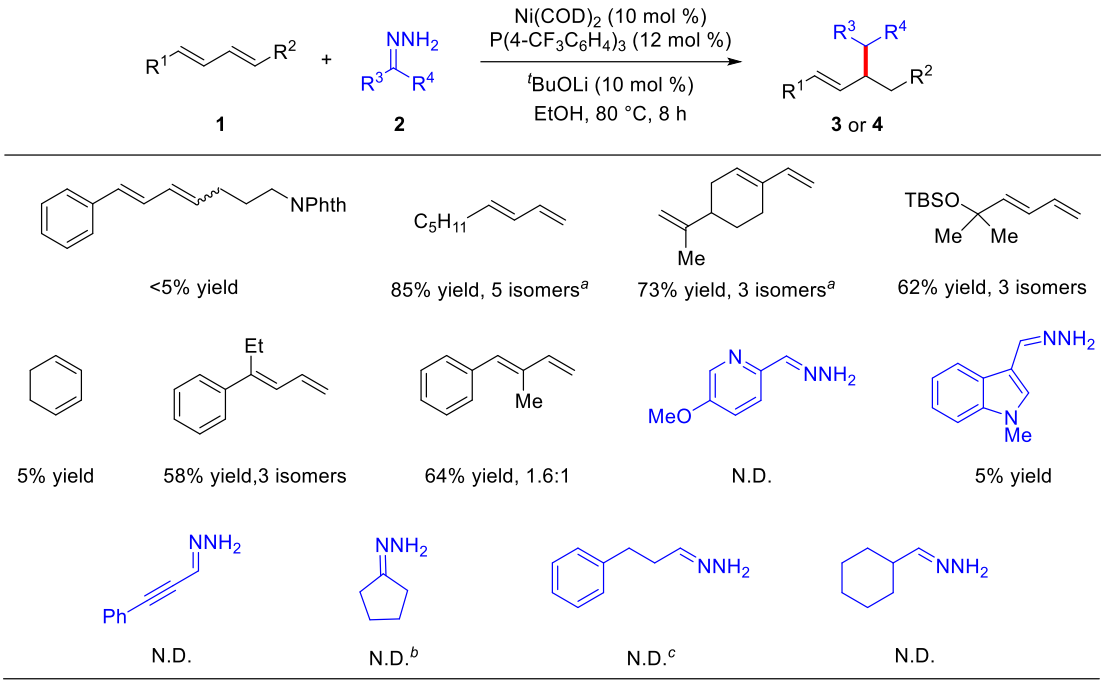


entry	additives	solvent	temp. (°C)	ratio (**1a**/**2a**)	yield (%)[a]	**3a**/**3a'**[b]
1	^{t}BuOLi (1.0 equiv)	EtOH	80	1:1.5	85	>20:1
2	^{t}BuOLi (0.1 equiv)	EtOH	80	1:1.5	85	>20:1

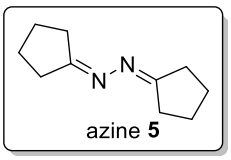
3	^{t}BuOLi (0.05 equiv)	EtOH	80	1:1.5	69	15:1
4	none	EtOH	80	1:1.5	30	6:1
5	Na_2CO_3	EtOH	80	1:1.5	43	9:1
6	^{t}BuONa	EtOH	80	1:1.5	78	19:1
7	NaOH	EtOH	80	1:1.5	82	>20:1
8	NaOEt	EtOH	80	1:1.5	81	>20:1
9	K_3PO_4	EtOH	80	1:1.5	75	19:1
10	^{t}BuOLi	THF	80	1:1.5	7	2:1
11	^{t}BuOLi	Toluene	80	1:1.5	7	1:2
12	^{t}BuOLi	MeOH	80	1:1.5	28	11:1
13	^{t}BuOLi	^{n}PrOH	80	1:1.5	80	>20:1
14	^{t}BuOLi	^{i}PrOH	80	1:1.5	71	16:1
15	^{t}BuOLi	EtOH (0.25 mL)	80	1:1.5	68	14:1
16	^{t}BuOLi	EtOH (0.50 mL)	80	1:1.5	79	>20:1
17	^{t}BuOLi	EtOH (1.0 mL)	80	1:1.5	82	>20:1
18	^{t}BuOLi	EtOH	rt (23)	1:1.5	53	18:1
19	^{t}BuOLi	EtOH	40	1:1.5	51	18:1
20	^{t}BuOLi	EtOH	60	1:1.5	82	>20:1
21	^{t}BuOLi	EtOH	100	1:1.5	73	>20:1
22	^{t}BuOLi	EtOH	80	1:2	76	>20:1
23	^{t}BuOLi	EtOH	80	1.5:1	81	>20:1
24	^{t}BuOLi	EtOH	80	2:1	95 (92)[c]	>20:1

Original reaction conditions: 1-phenylbutadiene **1a** (0.10 mmol), hydrazone **2a** (0.15 mmol), $Ni(COD)_2$ (0.010 mmol), ligand (0.012 mmol), additive (0.010 mmol), solvent (0.75 mL) at 80 °C for 8 h. [a] ^{1}H NMR yields of major isomer **3a** using 1,3,5-trimethoxybenzene as internal standard. [b] Regioselectivity was determined by ^{1}H NMR analysis of reaction mixture. [c] Isolated yield in the parentheses. [d] 83% yield when using 5 mol % catalyst in the optimized condition.

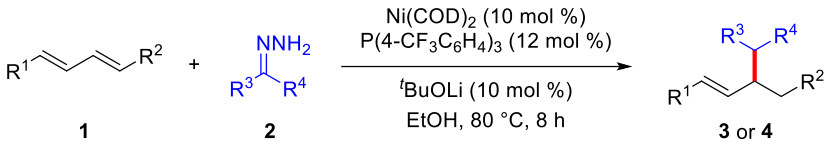
Table S3: Substrates with low yield or no reaction



Reaction conditions: **1** (0.40 mmol), hydrazones **2** (0.20 mmol), $Ni(COD)_2$ (0.020 mmol), P(4-$CF_3C_6H_4)_3$ (0.024 mmol), ^{t}BuOLi (0.020 mmol), EtOH (1.5 mL) at 80 °C for 8 h. Isolated yields. Regioselectivity was determined by ^{1}H NMR analysis, isomers were determined by ^{1}H NMR or GC/MS. [a] DPPPe as the ligand. [b] no product was provided, only azines **5** were detected by GC/MS. [c] Wolff-Kishner reduction product was detected by GC/MS.



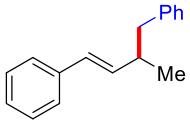
a) General procedure for hydroalkylation



In an argon-filled glove-box, an oven-dried tube was charged with a stir bar, $Ni(COD)_2$ (5.5 mg, 0.020 mmol), ligand P(4-$CF_3C_6H_4)_3$ (11.2 mg, 0.024 mmol), 1,3-diene **1** (0.40 mmol), hydrazone **2** (0.20 mmol) and ^{t}BuOLi (1.6 mg, 0.020 mmol). The tube was sealed and removed from the glove box, and degassed ethanol (1.5 mL) was injected into the tube under argon. The reaction mixture was stirred at room temperature for 5 minutes and heated at 80 ℃ for 8 hours, after cooling to room temperature, the solvent was removed under vacuum. The pure product **3** or **4** was obtained by preparative TLC. (*Note: The Z/E configuration of aromatic dienes had no effect on the yield and selectivity of the reaction. Pure E-isomer should be used for aliphatic dienes.*)

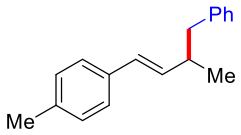
b) Characterization of products

(*E*)-(3-methylbut-1-ene-1,4-diyl)dibenzene (3a) [5a]



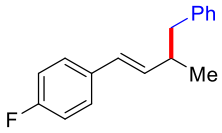
The same results were obtained when *E*–**1a** or *Z*/*E*–**1a** (2:1) substrates used. 92% yield, **3a**/**3a′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33–7.24 (m, 6H), 7.20–7.16 (m, 4H), 6.31 (d, *J* = 15.9 Hz, 1H), 6.18 (dd, *J* = 15.9, 6.5 Hz, 1H), 2.81–2.75 (m, 1H), 2.69–2.50 (m, 2H), 1.08 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.5, 137.8, 135.9, 129.3, 128.4, 128.2, 128.1, 126.8, 126.0, 125.8, 43.6, 38.8, 19.8.

(*E*)-1-methyl-4-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3b)



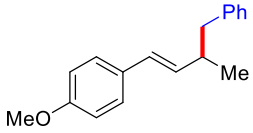
E–**1b** was used. 92% yield, **3b**/**3b′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28–7.25 (m, 2H), 7.24–7.14 (m, 5H), 7.09 (d, *J* = 7.9 Hz, 2H), 6.28 (d, *J* = 15.9 Hz, 1H), 6.12 (dd, *J* = 15.9, 6.8 Hz, 1H), 2.77 (dd, *J* = 16.2, 9.7 Hz, 1H), 2.70–2.53 (m, 2H), 2.32 (s, 3H), 1.07 (d, *J* = 6.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.6, 136.5, 135.0, 134.9, 129.3, 129.1, 128.1, 128.0, 125.9, 125.8, 43.7, 38.8, 21.1, 19.8. HRMS (EI) *m/z* calcd for [$C_{18}H_{20}$, M]$^+$: 236.1565, Found: 236.1559.

(*E*)-1-fluoro-4-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3c) [5a]



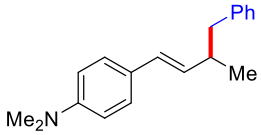
E–**1c** was used. 95% yield, **3c**/**3c′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29–7.24 (m, 3H), 7.21–7.13 (m, 3H), 6.99–6.91 (m, 3H), 6.26 (d, *J* = 15.9 Hz, 1H), 6.08 (dd, *J* = 15.9, 6.6 Hz, 1H), 2.80–2.66 (m, 1H), 2.63–2.57 (m, 2H), 1.07 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.9 (d, *J* = 245.6 Hz), 140.4, 135.6 (d, *J* = 2.0 Hz), 129.2 (d, *J* = 4.4 Hz), 128.1, 127.4, 127.4, 127.1, 125.9, 115.3 (d, *J* = 21.5 Hz), 43.6, 38.8, 19.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ –115.1.

(*E*)-1-methoxy-4-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3d)[5a]



E–**1d** was used. 83% yield, **3d**/**3d′** >20:1. Isolated by preparative TLC (PE/EA = 50:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29–7.21 (m, 4H), 7.17 (t, *J* = 7.5 Hz, 3H), 6.82 (d, *J* = 8.7 Hz, 2H), 6.25 (d, *J* = 15.9 Hz, 1H), 6.03 (dd, *J* = 15.9, 6.7 Hz, 1H), 3.77 (s, 3H), 2.79–2.73 (m, 1H), 2.61-2.57 (m, 2H), 1.06 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 158.7, 140.6, 133.8, 130.6, 129.2, 128.1, 127.6, 127.0, 125.8, 113.9, 55.2, 43.7, 38.7, 19.8.

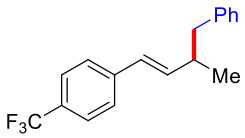
(*E*)-N,N-dimethyl-4-(3-methyl-4-phenylbut-1-en-1-yl)aniline (3e)[5b]



E–**1e** was used. 80% yield, **3e**/**3e′** >20:1. Isolated by preparative TLC (PE/EA = 50:1). Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30–7.10 (m, 7H), 6.66 (d, *J* = 8.7 Hz, 2H), 6.23 (d, *J* = 15.9 Hz, 1H), 5.98 (dd, *J* = 15.9, 6.7 Hz, 1H), 2.92 (s, 6H), 2.80–2.73 (m,

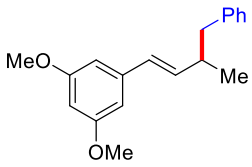
1H), 2.60–2.56 (m, 2H), 1.05 (d, J = 6.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 149.7, 140.8, 131.9, 129.3, 128.0, 127.9, 126.8, 126.5, 125.7, 112.6, 43.9, 40.6, 38.7, 19.9.

(*E*)-1-(3-methyl-4-phenylbut-1-en-1-yl)-4-(trifluoromethyl)benzene (3f)



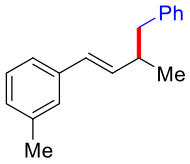
(2:1 *Z*/*E*)–**1f** was used. 95% yield, **3f**/**3f′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (d, J = 8.1 Hz, 2H), 7.43 (d, J = 8.1 Hz, 2H), 7.32 (t, J = 7.3 Hz, 2H), 7.23 (dd, J = 15.5, 7.3 Hz, 4H), 6.37 (d, J = 16.0 Hz, 1H), 6.31 (dd, J = 16.0, 5.6 Hz, 1H), 2.84–2.78 (m, 1H), 2.71–2.66 (m, 2H), 1.15 (d, J = 6.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 141.2 (q, J = 1.5 Hz), 140.2, 138.6, 129.2, 128.6 (q, J = 32.3 Hz), 128.2, 127.2, 126.1, 126.0, 125.4 (q, J = 3.8 Hz), 122.9 (q, J = 270.1 Hz), 43.4, 38.9, 19.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ –58.1. HRMS (EI) *m/z* calcd for $[C_{18}H_{17}F_3, M]^+$: 290.1282, Found: 290.1276.

(*E*)-1,3-dimethoxy-5-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3g)



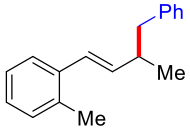
(2:1 *Z*/*E*)–**1g** was used. 64% yield, **3g**/**3g′** >20:1. Isolated by preparative TLC (PE/EA = 30:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29–7.24 (m, 2H), 7.20-7.14 (m, 3H), 6.48 (d, J = 1.6 Hz, 2H), 6.33 (s, 1H), 6.24 (d, J = 15.9 Hz, 1H), 6.16 (dd, J = 15.9, 6.2 Hz, 1H), 3.78 (s, 6H), 2.80–2.74 (m, 1H), 2.66–2.47 (m, 2H), 1.07 (d, J = 6.0 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 160.8, 140.4, 139.9, 136.5, 129.2, 128.1, 125.9, 106.5, 104.1, 99.2, 55.3, 43.5, 38.8, 19.7. HRMS (EI) *m/z* calcd for $[C_{19}H_{22}O_2, M]^+$: 282.1620, Found: 282.1617.

(*E*)-1-methyl-3-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3h)



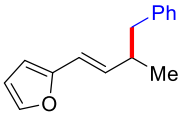
(3:1 *Z*/*E*)–**1h** was used. 90% yield, **3h**/**3h′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27 (t, J = 7.4 Hz, 2H), 7.21–7.07 (m, 6H), 7.00 (d, J = 7.2 Hz, 1H), 6.28 (d, J = 15.9 Hz, 1H), 6.17 (dd, J = 15.9, 6.7 Hz, 1H), 2.77 (dd, J = 16.1, 9.5 Hz, 1H), 2.67–2.52 (m, 2H), 2.32 (s, 3H), 1.07 (d, J = 6.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.5, 138.0, 137.7, 135.7, 129.3, 128.4, 128.3, 128.1, 127.6, 126.7, 125.8, 123.1, 43.6, 38.8, 21.4, 19.8. HRMS (EI) *m/z* calcd for $[C_{18}H_{20}, M]^+$: 236.1565, Found: 236.1560.

(*E*)-1-methyl-2-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3i)



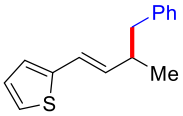
(2:1 *Z*/*E*)–**1i** was used. 81% yield, **3i**/**3i′** 10:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (d, J = 6.7 Hz, 1H), 7.32–7.23 (m, 2H), 7.20–7.17 (m, 3H), 7.13–7.10 (m, 3H), 6.45 (d, J = 15.8 Hz, 1H), 6.00 (dd, J = 15.8, 7.0 Hz, 1H), 2.78–2.72 (m, 1H), 2.69–2.56 (m, 2H), 2.23 (s, 3H), 1.11 (d, J = 6.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.6, 137.3, 137.0, 135.0, 130.0, 129.3, 128.1, 126.8, 126.4, 126.0, 125.8, 125.5, 43.7, 39.2, 20.1, 19.7. HRMS (EI) *m/z* calcd for $[C_{18}H_{20}, M]^+$: 236.1565, Found: 236.1558.

(*E*)-2-(3-methyl-4-phenylbut-1-en-1-yl)furan (3j)



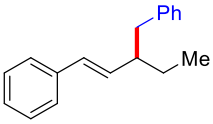
E–**1j** was used. 76% yield, **3j**/**3j′** >20:1. Isolated by preparative TLC (PE). Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32–7.25 (m, 3H), 7.22–7.13 (m, 3H), 6.33 (dd, *J* = 3.2, 1.8 Hz, 1H), 6.16 (d, *J* = 5.6 Hz, 2H), 6.12 (dd, *J* = 3.2, 0.5 Hz, 1H), 3.00–2.68 (m, 1H), 2.68–2.44 (m, 2H), 1.05 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 153.2, 141.2, 140.4, 134.8, 129.2, 128.1, 125.9, 117.0, 111.1, 106.3, 43.4, 38.5, 19.6. HRMS (EI) *m/z* calcd for $[C_{15}H_{16}O, M]^+$: 212.1201, Found: 212.1196.

(*E*)-2-(3-methyl-4-phenylbut-1-en-1-yl)thiophene (3k)



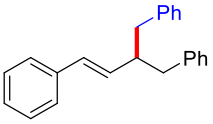
(1:1 *Z*/*E*)–**1k** was used. 96% yield, **3k**/**3k′** >20:1. Isolated by preparative TLC (PE). Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27 (t, *J* = 7.3 Hz, 3H), 7.18 (dd, *J* = 13.4, 7.2 Hz, 3H), 7.08 (d, *J* = 5.0 Hz, 1H), 6.92 (t, *J* = 4.2 Hz, 1H), 6.84 (d, *J* = 2.9 Hz, 1H), 6.43 (d, *J* = 15.7 Hz, 1H), 6.05 (dd, *J* = 15.7, 6.6 Hz, 1H), 2.80–2.74 (m, 1H), 2.68–2.42 (m, 2H), 1.06 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.1, 140.4, 135.9, 129.2, 128.2, 127.2, 125.9, 124.4, 123.2, 121.6, 43.5, 38.6, 19.6. HRMS (EI) *m/z* calcd for $[C_{15}H_{16}S, M]^+$: 228.0973, Found: 228.0971.

(*E*)-(3-ethylbut-1-ene-1,4-diyl)dibenzene (3l)



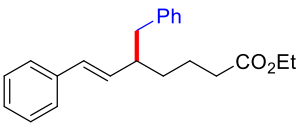
(1:1.5 *E*,*Z*/*E*,*E*)–**1l** was used. 83% yield, **3l**/**3l′** 20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32–7.24 (m, 6H), 7.20–7.15 (m, 4H), 6.25 (d, *J* = 15.8 Hz, 1H), 6.02 (dd, *J* = 15.8, 8.7 Hz, 1H), 2.72 (d, *J* = 7.0 Hz, 2H), 2.36 (dq, *J* = 15.8, 8.1 Hz, 1H), 1.65–1.47 (m, 1H), 1.36 (dt, *J* = 13.9, 7.5 Hz, 1H), 0.90 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.6, 137.8, 134.4, 130.0, 129.3, 128.4, 128.1, 126.8, 126.0, 125.7, 46.7, 41.9, 27.2, 11.8. HRMS (EI) *m/z* calcd for $[C_{18}H_{20}, M]^+$: 236.1565, Found: 236.1560.

(*E*)-(3-benzylbut-1-ene-1,4-diyl)dibenzene (3m)



E,*E*–**1m** was used. 69% yield, **3m**/**3m′** >20:1. Isolated by preparative TLC (PE/EA = 100:1). Light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30–7.20 (m, 8H), 7.20–7.09 (m, 7H), 6.13 (d, *J* = 15.9 Hz, 1H), 6.06 (dd, *J* = 15.9, 6.6 Hz, 1H), 2.86–2.65 (m, 5H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.2, 137.7, 133.5, 130.2, 129.3, 128.4, 128.2, 126.9, 126.0, 125.9, 46.4, 41.3. HRMS (EI) *m/z* calcd for $[C_{23}H_{22}, M]^+$: 298.1722, Found: 298.1718.

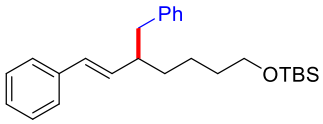
Ethyl (*E*)-5-benzyl-7-phenylhept-6-enoate (3n)



(3:1 *E*,*Z*/*E*,*E*)–**1n** was used. 72% yield, **3n**/**3n′** 10:1. Isolated by preparative TLC (PE/EA = 50:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31–7.23 (m, 6H), 7.21–7.08 (m, 4H), 6.26 (d, *J* = 15.8 Hz, 1H), 6.00 (dd, *J* = 15.8, 8.8 Hz, 1H),

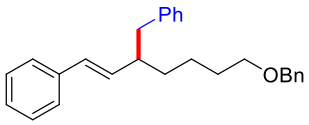
4.09 (q, *J* = 7.1 Hz, 2H), 2.72 (d, *J* = 7.0 Hz, 2H), 2.48–2.42 (m, 1H), 2.26 (td, *J* = 7.7, 2.9 Hz, 2H), 1.78–1.65 (m, 1H), 1.65–1.45 (m, 2H), 1.45–1.30 (m, 1H), 1.21 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 173.5, 140.2, 137.6, 133.9, 130.3, 129.3, 128.4, 128.1, 126.9, 126.0, 125.8, 60.2, 44.8, 42.2, 34.3, 33.8, 22.8, 14.2. HRMS (EI) *m/z* calcd for [$C_{22}H_{26}$, M]$^+$: 322.1933, Found: 322.1927.

(*E*)-((5-benzyl-7-phenylhept-6-en-1-yl)oxy)(tert-butyl)dimethylsilane (3o)



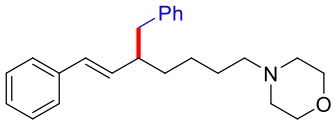
(3:1 *E*,*Z*/*E*,*E*)–**1o** was used. 69% yield, **3o**/**3o′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35–7.25 (m, 6H), 7.20 (dd, *J* = 7.9, 6.5 Hz, 4H), 6.28 (d, *J* = 15.8 Hz, 1H), 6.05 (dd, *J* = 15.8, 8.8 Hz, 1H), 3.60 (t, *J* = 6.5 Hz, 2H), 2.75 (d, *J* = 7.0 Hz, 2H), 2.57–2.36 (m, 1H), 1.63–1.21 (m, 6H), 0.90 (s, 9H), 0.05 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.4, 137.8, 134.5, 129.9, 129.3, 128.4, 128.1, 126.8, 126.0, 125.8, 63.1, 45.0, 42.2, 34.2, 32.8, 26.0, 23.5, 18.3, -5.3. HRMS (ESI) calcd for [$C_{26}H_{38}NaOSi$, M+Na]$^+$: 417.2584, Found: 417.2584.

(*E*)-(3-(4-(benzyloxy)butyl)but-1-ene-1,4-diyl)dibenzene (3p)



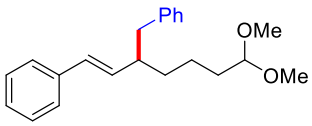
(6:1 *E*,*Z*/*E*,*E*)–**1p** was used. 83% yield, **3p**/**3p′** >20:1. Isolated by preparative TLC (PE/EA = 50:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40–7.22 (m, 11H), 7.20–7.13 (m, 4H), 6.24 (d, *J* = 15.8 Hz, 1H), 6.01 (dd, *J* = 15.8, 8.8 Hz, 1H), 4.46 (s, 2H), 3.42 (t, *J* = 6.5 Hz, 2H), 2.71 (d, *J* = 7.0 Hz, 2H), 2.50–2.40 (m, 1H), 1.70–1.40 (m, 4H), 1.41–1.17 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.4, 138.6, 137.7, 134.4, 123.0, 129.3, 128.4, 128.3, 128.1, 127.6, 127.4, 126.8, 126.0, 125.8, 72.8, 70.3, 45.0, 42.2, 34.2, 29.7, 23.9. HRMS (ESI) calcd for [$C_{27}H_{30}NaO$, M+Na]$^+$: 393.2189, Found: 393.2194.

(*E*)-4-(5-benzyl-7-phenylhept-6-en-1-yl)morpholine (3q)



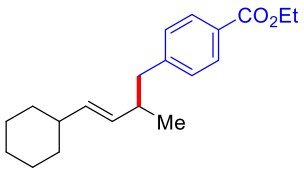
(3:1 *E*,*Z*/*E*,*E*)–**1q** was used. Diene **1q** (0.2 mmol), hydrazones **2a** (0.3 mmol). 69% yield, **3q**/**3q′** >20:1. Isolated by preparative TLC (EA). White solid, mp: 153–154 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31–7.23 (m, 6H), 7.21–7.10 (m, 4H), 6.24 (d, *J* = 15.8 Hz, 1H), 6.01 (dd, *J* = 15.8, 8.8 Hz, 1H), 3.77–3.54 (m, 4H), 2.71 (d, *J* = 7.0 Hz, 2H), 2.54–2.31 (m, 5H), 2.27 (t, *J* = 7.6 Hz, 2H), 1.62–1.24 (m, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.4, 137.6, 134.4, 130.0, 129.3, 128.4, 128.1, 126.9, 126.0, 125.8, 66.9, 59.0, 53.7, 44.9, 42.2, 34.3, 26.5, 25.1. HRMS (ESI) calcd for [$C_{24}H_{32}NO$, M+H]$^+$: 350.2478, Found: 350.2481.

(*E*)-(3-(4,4-dimethoxybutyl)but-1-ene-1,4-diyl)dibenzene (3r)



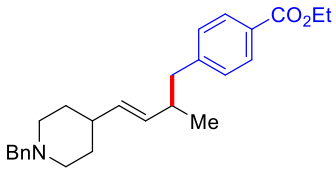
(1:1.2 *E*,*Z*/*E*,*E*)–**1r** was used. 75% yield, **3r**/**3r′** >20:1. Isolated by preparative TLC (PE/EA = 10:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43–7.22 (m, 6H), 7.22–7.08 (m, 4H), 6.25 (d, *J* = 15.8 Hz, 1H), 6.01 (dd, *J* = 15.8, 8.8 Hz, 1H), 4.30 (t, *J* = 5.7 Hz, 1H), 3.27 (d, *J* = 1.1 Hz, 6H), 2.71 (d, *J* = 7.0 Hz, 2H), 2.54–2.33 (m, 1H), 1.72–0.98 (m, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.3, 137.7, 134.2, 130.1, 129.3, 128.4, 128.1, 126.9, 126.0, 125.8, 104.4, 52.7, 52.5, 44.9, 42.2, 34.2, 32.5, 22.4. HRMS (ESI) calcd for [$C_{22}H_{28}NaO_2$, M+Na]$^+$: 347.1982, Found: 347.1985.

Ethyl (*E*)-4-(4-cyclohexyl-2-methylbut-3-en-1-yl)benzoate (3s)



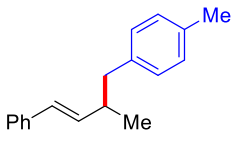
(1:15 *Z*/*E*)–**1s** was used. DPPPe (*1,5-Bis(diphenylphosphino)pentane*) as the ligand. 80% yield, **3s**/**3s′** 8:1. Isolated by preparative TLC (PE/EA = 50:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.2 Hz, 2H), 7.18 (d, *J* = 8.2 Hz, 2H), 5.35–5.10 (m, 2H), 4.36 (q, *J* = 7.1 Hz, 2H), 2.65 (dd, *J* = 13.2, 7.3 Hz, 1H), 2.56 (dd, *J* = 13.2, 7.3 Hz, 1H), 2.37 (dt, *J* = 13.4, 6.8 Hz, 1H), 1.84 (tdd, *J* = 11.1, 7.6, 3.4 Hz, 1H), 1.73–1.55 (m, 6H), 1.39 (t, *J* = 7.1 Hz, 3H), 1.30–1.06 (m, 4H), 0.96 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 146.5, 135.4, 132.2, 129.3, 129.2, 127.9, 60.7, 43.8, 40.6, 38.3, 33.1, 26.2, 26.0, 20.2, 14.3. HRMS (EI) *m/z* calcd for [$C_{20}H_{28}O_2$, M]$^+$: 300.2089, Found: 300.2083.

Ethyl (*E*)-4-(4-(1-benzylpiperidin-4-yl)-2-methylbut-3-en-1-yl)benzoate (3t)



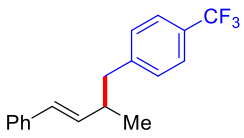
E–**1t** was used. DPPPe (*1,5-Bis(diphenylphosphino)pentane*) as the ligand. 70% yield, **3t**/**3t′** 13:1. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.2 Hz, 2H), 7.30 (d, *J* = 4.3 Hz, 4H), 7.28–7.21 (m, 1H), 7.17 (d, *J* = 8.2 Hz, 2H), 5.25 (qd, *J* = 15.6, 6.4 Hz, 2H), 4.35 (q, *J* = 7.1 Hz, 2H), 3.47 (s, 2H), 2.84 (d, *J* = 11.1 Hz, 2H), 2.66–2.49 (m, 2H), 2.45–2.31 (m, 1H), 1.93 (td, *J* = 11.6, 2.1 Hz, 2H), 1.88–1.79 (m, 1H), 1.63–1.49 (m, 2H), 1.46–1.26 (m, 5H), 0.96 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 146.3, 138.5, 134.0, 133.0, 129.2, 129.2, 129.1, 128.1, 128.0, 126.8, 63.5, 60.7, 53.5, 43.7, 38.6, 38.2, 32.2, 32.2, 20.2, 14.3. HRMS (ESI) calcd for [$C_{26}H_{28}NO_2$, M+H]$^+$: 392.2584, Found: 392.2588.

(*E*)-1-methyl-4-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4a)



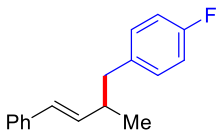
85% yield, **4a**/**4a′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (dt, *J* = 15.1, 7.5 Hz, 4H), 7.18 (t, *J* = 7.0 Hz, 1H), 7.12–7.04 (m, 4H), 6.32 (d, *J* = 15.9 Hz, 1H), 6.19 (dd, *J* = 15.9, 6.8 Hz, 1H), 2.77–2.71 (m, 1H), 2.60–2.54 (m, 2H), 2.31 (s, 3H), 1.07 (d, *J* = 6.3 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.8, 137.4, 136.1, 135.2, 129.1, 128.8, 128.4, 128.1, 126.8, 126.0, 43.2, 38.8, 21.0, 19.7. HRMS (EI) *m/z* calcd for [$C_{18}H_{20}$, M]$^+$: 236.1565, Found: 236.1559.

(E)-1-(2-methyl-4-phenylbut-3-en-1-yl)-4-(trifluoromethyl)benzene (4b)



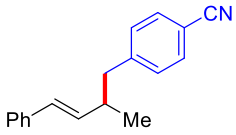
87% yield, **4b**/**4b′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (d, *J* = 8.0 Hz, 2H), 7.32–7.26 (m, 6H), 7.24–7.15 (m, 1H), 6.30 (d, *J* = 15.9 Hz, 1H), 6.14 (dd, *J* = 15.9, 6.0 Hz, 1H), 2.81 (dd, *J* = 12.8, 6.6 Hz, 1H), 2.71–2.59 (m, 2H), 1.10 (d, *J* = 5.6 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 144.6 (q, *J* = 1.5 Hz), 137.5, 135.1, 129.5, 128.8, 128.5, 127.0, 126.01, 125.06 (q, *J* = 3.8 Hz), 123.02 (q, *J* = 272.2 Hz), 43.4, 38.7, 19.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ –62.3. HRMS (EI) *m/z* calcd for $[C_{18}H_{17}F_3, M]^+$: 290.1282, Found: 290.1278.

(*E*)-1-fluoro-4-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4c)



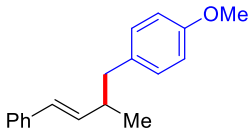
78% yield, **4c**/**4c′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34–7.25 (m, 4H), 7.23–7.16 (m, 1H), 7.15–7.07 (m, 2H), 7.00–6.89 (m, 2H), 6.29 (d, *J* = 15.9 Hz, 1H), 6.14 (dd, *J* = 15.9, 7.0 Hz, 1H), 2.79–2.66 (m, 1H), 2.62–2.53 (m, 2H), 1.08 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.3 (d, *J* = 243.4 Hz), 137.7, 136.1 (d, *J* = 3.2 Hz), 135.5, 130.5 (d, *J* = 7.8 Hz), 128.5, 128.5, 126.9, 126.0, 114.9 (d, *J* = 21.0 Hz), 42.79, 39.0, 19.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ –117.1. HRMS (EI) *m/z* calcd for $[C_{17}H_{17}F, M]^+$: 240.1314, Found: 240.1309.

(*E*)-4-(2-methyl-4-phenylbut-3-en-1-yl)benzonitrile (4d)



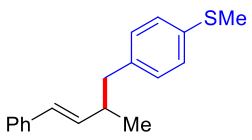
64% yield, **4d**/**4d′** >20:1. Isolated by preparative TLC (PE/EA = 50:1). White solid, mp: 58–59 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (d, *J* = 8.2 Hz, 2H), 7.29 (d, *J* = 4.3 Hz, 4H), 7.27 (d, *J* = 7.4 Hz, 2H), 7.21 (dd, *J* = 8.5, 4.3 Hz, 1H), 6.27 (d, *J* = 15.9 Hz, 1H), 6.10 (dd, *J* = 15.9, 7.4 Hz, 1H), 2.80 (dd, *J* = 13.1, 7.4 Hz, 1H), 2.74–2.65 (m, 1H), 2.67–2.57 (m, 1H), 1.11 (d, *J* = 6.6 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 146.2, 137.3, 134.6, 132.0, 130.0, 129.1, 128.5, 127.1, 126.0, 119.1, 109.8, 43.6, 38.7, 20.0. HRMS (EI) *m/z* calcd for $[C_{18}H_{17}N, M]^+$: 247.1361, Found: 247.1356.

(*E*)-1-methoxy-4-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4e)[5c]



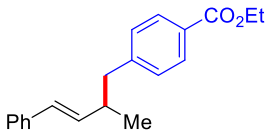
74% yield, **4e**/**4e′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.23 (m, 4H), 7.20–7.16 (m, 1H), 7.08 (d, *J* = 7.9 Hz, 2H), 6.82 (d, *J* = 7.9 Hz, 2H), 6.30 (d, *J* = 15.8 Hz, 1H), 6.17 (dd, *J* = 15.8, 6.1 Hz, 1H), 3.77 (s, 3H), 2.75–2.64 (m, 1H), 2.58–2.52 (m, 2H), 1.07 (d, *J* = 5.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 157.8, 137.8, 136.0, 132.6, 130.1, 128.4, 128.2, 126.8, 126.0, 113.5, 55.2, 42.7, 39.0, 19.7.

(*E*)-methyl(4-(2-methyl-4-phenylbut-3-en-1-yl)phenyl)sulfane (4f)



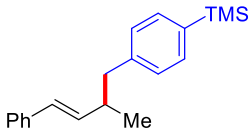
93% yield, **4f**/**4f′** 13:1. Isolated by preparative TLC (PE). Light yellow solid, mp: 36–37 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38–7.25 (m, 4H), 7.20–7.17 (m, 3H), 7.13–7.08 (m, 2H), 6.30 (d, *J* = 15.9 Hz, 1H), 6.16 (dd, *J* = 15.9, 6.8 Hz, 1H), 2.82–2.66 (m, 1H), 2.64–2.51 (m, 2H), 2.46 (s, 3H), 1.07 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.7, 137.6, 135.7, 135.3, 129.8, 128.4, 128.3, 126.9, 126.8, 126.0, 43.0, 38.8, 19.8, 16.2. HRMS (EI) *m/z* calcd for $[C_{18}H_{20}S, M]^+$: 268.1286, Found: 268.1280.

Ethyl (*E*)-4-(2-methyl-4-phenylbut-3-en-1-yl)benzoate (4g)



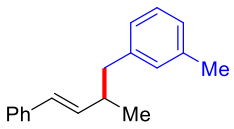
89% yield, **4g**/**4g′** >20:1. Isolated by preparative TLC (PE/EA = 50:1). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.96 (d, *J* = 8.3 Hz, 2H), 7.63–7.09 (m, 7H), 6.29 (d, *J* = 15.9 Hz, 1H), 6.14 (dd, *J* = 15.9, 7.1 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 2.80 (dd, *J* = 12.8, 6.7 Hz, 1H), 2.65 (ddd, *J* = 25.6, 13.3, 7.0 Hz, 2H), 1.38 (t, *J* = 7.1 Hz, 3H), 1.09 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 145.9, 137.5, 135.2, 129.4, 129.2, 128.6, 128.4, 128.2, 127.0, 126.0, 60.8, 43.6, 38.7, 19.9, 14.3. HRMS (EI) *m/z* calcd for $[C_{20}H_{22}O_2, M]^+$: 294.1620, Found: 294.1617.

(*E*)-trimethyl(4-(2-methyl-4-phenylbut-3-en-1-yl)phenyl)silane (4h)



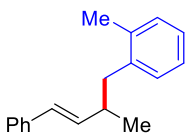
87% yield, **4h**/**4h′** 17:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (d, *J* = 7.9 Hz, 2H), 7.30 (dt, *J* = 15.1, 7.4 Hz, 4H), 7.18 (t, *J* = 7.5 Hz, 3H), 6.34 (d, *J* = 15.9 Hz, 1H), 6.20 (dd, *J* = 15.9, 6.9 Hz, 1H), 2.78 (dd, *J* = 11.8, 5.0 Hz, 1H), 2.60 (dt, *J* = 12.2, 7.2 Hz, 2H), 1.08 (d, *J* = 6.4 Hz, 3H), 0.25 (s, 9H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 141.1, 137.8, 137.4, 136.0, 133.2, 128.7, 128.4, 128.2, 126.8, 126.0, 43.6, 38.6, 19.8, -1.0. HRMS (EI) *m/z* calcd for $[C_{20}H_{26}Si, M]^+$: 294.1804, Found: 294.1801.

(*E*)-1-methyl-3-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4i)



75% yield, **4i**/**4i′** 20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36–7.25 (m, 4H), 7.21–7.12 (m, 2H), 6.99 (t, *J* = 9.0 Hz, 3H), 6.33 (d, *J* = 15.9 Hz, 1H), 6.19 (dd, *J* = 15.9, 6.9 Hz, 1H), 2.75 (dd, *J* = 12.2, 5.6 Hz, 1H), 2.67–2.50 (m, 2H), 2.32 (s, 3H), 1.07 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.4, 137.8, 137.6, 136.1, 130.1, 128.4, 128.1, 128.0, 126.8, 126.6, 126.3, 126.0, 43.5, 38.7, 21.4, 19.7. HRMS (EI) *m/z* calcd for $[C_{18}H_{20}, M]^+$: 236.1565, Found: 236.1560.

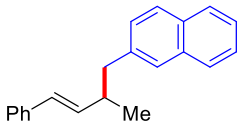
(*E*)-1-methyl-2-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4j)



73% yield, **4j**/**4j′** >20:1. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42–7.24 (m, 4H), 7.23–7.06 (m, 5H), 6.30 (d, *J* = 15.9 Hz, 1H), 6.20 (dd, *J* = 15.9, 6.7 Hz, 1H), 2.82–2.70 (m, 1H), 2.66–2.55 (m, 2H), 2.32 (s, 3H), 1.11 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 138.8, 137.8, 136.2, 136.0, 130.2, 130.1, 128.4, 128.0,

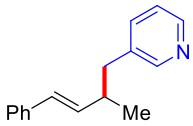
126.8, 126.0, 125.6, 40.7, 37.8, 19.9, 19.6. HRMS (EI) *m/z* calcd for [$C_{18}H_{20}$, M]$^+$: 236.1565, Found: 236.1560.

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)naphthalene (4k)



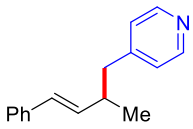
90% yield, **4k**/**4k′** 20:1. Isolated by preparative TLC (PE). White solid, mp: 40–41 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (dd, *J* = 15.4, 8.5 Hz, 3H), 7.61 (s, 1H), 7.52–7.36 (m, 2H), 7.35–7.23 (m, 5H), 7.19 (dd, *J* = 15.1, 8.1 Hz, 1H), 6.34 (d, *J* = 15.9 Hz, 1H), 6.23 (dd, *J* = 15.9, 6.4 Hz, 1H), 2.96–2.92 (m, 1H), 2.79–2.69 (m, 2H), 1.11 (d, *J* = 5.9 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 138.1, 137.8, 135.9, 133.5, 132.0, 128.4, 128.3, 128.0, 127.6, 127.6, 127.5, 126.9, 126.0, 125.8, 125.1, 43.8, 38.7, 19.8. HRMS (EI) *m/z* calcd for [$C_{21}H_{20}$, M]$^+$: 272.1565, Found: 272.1562.

(*E*)-3-(2-methyl-4-phenylbut-3-en-1-yl)pyridine (4l)



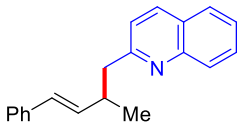
90% yield, **4l**/**4l′** 17:1. Isolated by preparative TLC (PE/EA = 5:1). Light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45 (s, 2H), 7.48 (dt, *J* = 7.7, 1.7 Hz, 1H), 7.32–7.28 (m, 4H), 7.24–7.16 (m, 2H), 6.29 (d, *J* = 15.9 Hz, 1H), 6.13 (dd, *J* = 15.9, 7.2 Hz, 1H), 2.81–2.55 (m, 3H), 1.12 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 150.6, 147.4, 137.4, 136.6, 135.6, 134.8, 129.0, 128.4, 127.0, 126.0, 123.1, 40.5, 38.7, 19.9. HRMS (EI) *m/z* calcd for [$C_{16}H_{17}N$, M]$^+$: 223.1361, Found: 223.1355.

(*E*)-4-(2-methyl-4-phenylbut-3-en-1-yl)pyridine (4m)



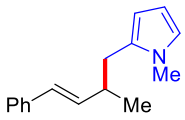
79% yield, **4m**/**4m′** 17:1. Isolated by preparative TLC (PE/EA = 5:1). Light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.49 (d, *J* = 5.3 Hz, 2H), 7.30–7.26 (m, 4H), 7.24–7.15 (m, 1H), 7.09 (d, *J* = 5.2 Hz, 2H), 6.29 (d, *J* = 15.9 Hz, 1H), 6.11 (dd, *J* = 15.9, 6.8 Hz, 1H), 2.81–2.44 (m, 3H), 1.11 (d, *J* = 6.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 149.6, 149.4, 137.3, 134.6, 129.0, 128.5, 127.1, 126.0, 124.6, 42.8, 38.1, 20.0. HRMS (EI) *m/z* calcd for [$C_{16}H_{17}N$, M]$^+$: 223.1361, Found: 223.1356.

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)quinoline (4n)



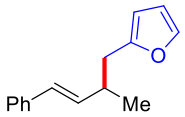
44% yield, **4n**/**4n′** >20:1. Isolated by preparative TLC (PE/EA = 5:1). Light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (t, *J* = 8.6 Hz, 2H), 7.77 (d, *J* = 8.1 Hz, 1H), 7.69 (t, *J* = 7.7 Hz, 1H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33–7.22 (m, 5H), 7.17 (t, *J* = 6.9 Hz, 1H), 6.33 (d, *J* = 15.9 Hz, 1H), 6.25 (dd, *J* = 15.9, 6.6 Hz, 1H), 3.17–3.07 (m, 1H), 3.05–2.96 (dt, *J* = 18.6, 6.9 Hz, 2H), 1.18 (d, *J* = 6.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.2, 148.0, 137.6, 135.9, 135.5, 129.3, 128.9, 128.6, 128.4, 127.5, 126.9, 126.8, 126.0, 125.7, 122.2, 46.5, 37.9, 20.2. HRMS (EI) *m/z* calcd for [$C_{20}H_{19}N$, M]$^+$: 273.1517, Found: 273.1518.

(*E*)-1-methyl-2-(2-methyl-4-phenylbut-3-en-1-yl)-1H-pyrrole (4o)



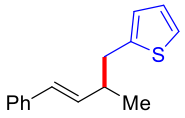
60% yield, **4o**/**4o′** >20:1. Isolated by preparative TLC (PE/EA = 50:1). Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (d, *J* = 7.1 Hz, 2H), 7.29 (t, *J* = 7.6 Hz, 2H), 7.19 (t, *J* = 7.1 Hz, 1H), 6.55–6.50 (m, 1H), 6.37 (d, *J* = 15.9 Hz, 1H), 6.20 (dd, *J* = 15.9, 6.8 Hz, 1H), 6.06 (t, *J* = 3.0 Hz, 1H), 5.96–5.92 (m, 1H), 3.53 (s, 3H), 2.74–2.54 (m, 3H), 1.14 (d, *J* = 6.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.7, 135.8, 131.4, 128.5, 128.3, 126.9, 126.0, 121.1, 107.1, 106.5, 37.2, 33.8, 33.7, 20.0. HRMS (EI) *m/z* calcd for [$C_{16}H_{19}N$, M]$^+$: 225.1517, Found: 225.1512.

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)furan (4p)



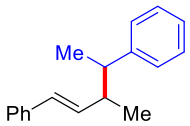
82% yield, **4p**/**4p′** >20:1. Isolated by preparative TLC (PE). Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38–7.25 (m, 5H), 7.22–7.14 (m, 1H), 6.36 (d, *J* = 15.9 Hz, 1H), 6.27 (dd, *J* = 3.0, 1.9 Hz, 1H), 6.16 (dd, *J* = 15.9, 6.9 Hz, 1H), 6.02 (d, *J* = 2.6 Hz, 1H), 3.12–2.41 (m, 3H), 1.11 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 154.5, 140.9, 137.7, 135.4, 128.6, 128.4, 126.9, 126.0, 110.1, 106.1, 36.4, 35.5, 20.0. HRMS (EI) *m/z* calcd for [$C_{16}H_{19}O$, M]$^+$: 212.1201, Found: 212.1195.

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)thiophene (4q)



83% yield, **4q**/**4q′** >20:1. Isolated by preparative TLC (PE). Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.25 (m, 4H), 7.19 (t, *J* = 7.1 Hz, 1H), 7.11 (d, *J* = 5.0 Hz, 1H), 6.99–6.85 (m, 1H), 6.79 (d, *J* = 3.0 Hz, 1H), 6.37 (d, *J* = 15.9 Hz, 1H), 6.18 (dd, *J* = 15.9, 7.4 Hz, 1H), 2.96 (dd, *J* = 14.5, 7.0 Hz, 1H), 2.87 (dd, *J* = 14.5, 7.0 Hz, 1H), 2.74–2.56 (m, 1H), 1.13 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.0, 137.7, 135.2, 128.9, 128.5, 127.0, 126.6, 126.1, 125.3, 123.3, 39.2, 37.4, 19.9. HRMS (EI) *m/z* calcd for [$C_{15}H_{16}S$, M]$^+$: 228.0973, Found: 228.0968.

(*E*)-(3-methylpent-1-ene-1,4-diyl)dibenzene (4r)

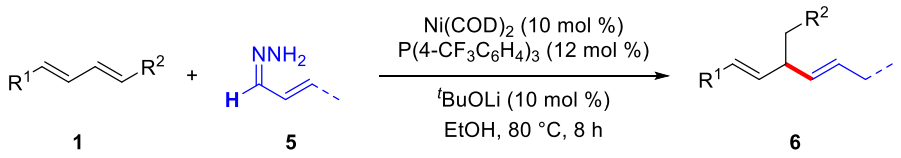


Diene **1a** (0.2 mmol), hydrazone **2r** (0.3 mmol), $Ni(COD)_2$ (0.02 mol), PBn_3 (0.024 mmol), ^{t}BuOLi (0.02 mmol), EtOH (1.0 mL) at 80 ℃ for 8 h. 58% yield, **4r**/**4r′** >20:1, 1.6:1 *dr*. Data for the major isomer: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 (d, *J* = 7.4 Hz, 1H), 7.33–7.24 (m, 5H), 7.19 (dd, *J* = 14.6, 7.4 Hz, 4H), δ 6.38 (d, *J* = 15.8 Hz, 1H), 6.12 (dd, *J* = 15.8, 8.6 Hz, 1H), 2.64–2.55 (m, 1H), 2.45 (td, *J* = 15.1, 7.0 Hz, 1H), 1.25 (d, *J* = 7.0 Hz, 3H), 0.91 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 146.2, 137.8, 135.2, 129.4, 128.5, 128.2, 127.7, 126.9, 126.0, 125.9, 46.0, 44.4, 20.1, 18.1. The minor isomer: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 (d, *J* = 7.4 Hz, 1H), 7.33–7.24 (m, 5H), 7.19 (dd, *J* = 14.6, 7.4 Hz, 4H), 6.27 (d, *J* = 15.9 Hz, 1H), 6.02 (dd, *J* = 15.9, 8.0 Hz, 1H), 2.80 (p, *J* = 7.0 Hz, 1H), 2.52 (dd, *J* = 13.8, 7.0 Hz, 1H), 1.29 (d, *J* = 7.0 Hz, 3H), 1.05 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 145.1, 137.9, 134.6, 129.0, 128.4, 128.1, 127.9,

126.8, 126.0, 125.9, 45.3, 43.3, 19.3, 17.4. HRMS (EI) *m/z* calcd for $[C_{18}H_{20}, M]^+$: 236.1565, Found: 236.1560.

4. Hydroalkenylation Procedure and Characterization of Products

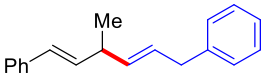
a) General procedure for hydroalkenylation



In an argon-filled glove-box, an oven-dried tube was charged with a stir bar, $Ni(COD)_2$ (5.5 mg, 0.020 mmol), ligand $P(4\text{-}CF_3C_6H_4)_3$ (11.2 mg, 0.024 mmol), 1,3-diene **1** (0.40 mmol) and ^{t}BuOLi (1.6 mg, 0.020 mmol). The tube was sealed and removed from the glove box, and the degassed α,β-unsaturated hydrazone solution **5** (0.20 mmol, 1.0 M in EtOH) and degassed ethanol (Note that the total dosage of EtOH was 1.5 mL) were injected into the tube under argon. The mixture was stirred at room temperature for 5 minutes and heated at 80 ℃ for 8 hours. After cooling to room temperature, the solvent was removed under vacuum. The pure product **6** was obtained by preparative TLC.

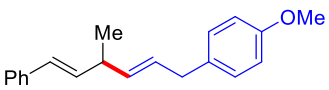
b) Characterization of products

((1*E*,4*E*)-3-methylhexa-1,4-diene-1,6-diyl)dibenzene (6a)



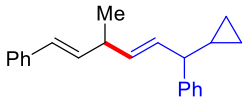
55% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38–7.32 (m, 2H), 7.31–7.27 (m, 4H), 7.23–7.14 (m, 4H), 6.36 (d, *J* = 15.9 Hz, 1H), 6.17 (dd, *J* = 15.9, 6.9 Hz, 1H), 5.67–5.52 (m, 2H), 3.37 (d, *J* = 6.4 Hz, 2H), 3.09–2.97 (m, 1H), 1.19 (d, *J* = 6.9 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.8, 137.7, 135.5, 134.8, 128.5, 128.5, 128.4, 128.3, 128.0, 126.9, 126.0, 125.9, 39.6, 39.0, 20.3. HRMS (EI) *m/z* calcd for $[C_{19}H_{20}, M]^+$: 248.1565, Found: 248.1560.

1-methoxy-4-((2*E*,5*E*)-4-methyl-6-phenylhexa-2,5-dien-1-yl)benzene (6b)



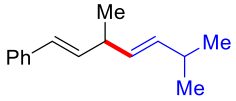
63% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (d, *J* = 7.3 Hz, 2H), 7.29 (t, *J* = 7.3 Hz,2H), 7.19 (t, *J* = 7.6 Hz, 1H), 7.11 (d, *J* = 8.4 Hz, 2H), 6.84 (d, *J* = 8.4 Hz, 2H), 6.35 (d, *J* = 15.9 Hz, 1H), 6.17 (dd, *J* = 15.9, 6.9 Hz, 1H), 5.70–5.44 (m, 2H), 3.78 (s, 3H), 3.30 (d, *J* = 6.3 Hz, 2H), 3.07–2.98 (m, 1H), 1.19 (d, *J* = 6.9 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 157.9, 137.7, 135.2, 134.9, 132.8, 129.4, 128.4, 128.2, 127.8, 126.9, 126.0, 113.8, 55.2, 39.6, 38.1, 20.4. HRMS (EI) *m/z* calcd for $[C_{20}H_{22}O, M]^+$: 278.1671, Found: 278.1668.

((1*E*,4*E*)-6-cyclopropyl-3-methylhexa-1,4-diene-1,6-diyl)dibenzene (6c)



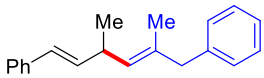
75% yield, 1.5:1 *dr*. Colorless oil. Isolated by preparative TLC (PE). ^{1}H NMR (400 MHz, $CDCl_3$) δ the major isomer 7.37–7.27 (m, 8H), 7.20 (dd, *J* = 13.8, 7.0 Hz, 2H), 6.34 (d, *J* = 6.7 Hz, 1H), 6.20 (dd, *J* = 6.7, 3.0 Hz, 1H), 5.64 (d, *J* = 6.7 Hz, 1H), 5.57 (t, *J* = 6.1 Hz, 1H), 3.06–3.01 (m, 1H), 2.60 (t, *J* = 7.7 Hz, 1H), 1.19 (dd, *J* = 6.7, 4.5 Hz, 3H), 1.13–0.98 (m, 1H), 0.67–0.55 (m, 1H), 0.53–0.46 (m, 1H), 0.30–0.18 (m, 2H); δ the minor isomer 7.37–7.27 (m, 8H), 7.20 (dd, *J* = 13.8, 7.0 Hz, 2H), 6.38 (d, *J* = 6.6 Hz, 1H), 6.16 (dd, *J* = 6.7, 3.0 Hz, 1H), 5.68 (d, *J* = 6.6 Hz, 1H), 5.53 (t, *J* = 6.1 Hz, 1H), 3.06–3.01 (m, 1H), 2.60 (t, *J* = 7.7 Hz, 1H), 1.19 (dd, *J* = 6.7, 4.5 Hz, 3H), 1.13–0.98 (m, 1H), 0.67–0.55 (m, 1H), 0.53–0.46 (m, 1H), 0.30–0.18 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 144.8, 137.8, 135.0 (135.0), 134.1, 132.0, 131.9, 128.5, 128.3 (128.3), 128.2, 127.8, 126.9, 126.1, 52.7 (52.7), 39.6, 20.4 (20.4), 16.3 (16.3), 4.5, 4.2 (4.1). HRMS (EI) *m/z* calcd for $[C_{22}H_{24}, M]^+$: 288.1878, Found: 288.1876.

((1*E*,4*E*)-3,6-dimethylhepta-1,4-dien-1-yl)benzene (6d)



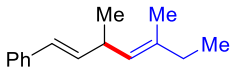
84% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39–7.33 (m, 2H), 7.31–7.25 (m, 2H), 7.22–7.16 (m, 1H), 6.34 (d, *J* = 15.9 Hz, 1H), 6.17 (dd, *J* = 15.9, 6.9 Hz, 1H), 5.40 (qd, *J* = 15.6, 5.9 Hz, 2H), 3.04–2.84 (m, 1H), 2.32–2.19 (m, 1H), 1.16 (d, *J* = 6.9 Hz, 3H), 0.98 (d, *J* = 6.8 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.8, 136.7, 135.4, 130.9, 128.4, 128.0, 126.8, 126.0, 39.6, 31.0, 22.6, 22.6, 20.5. HRMS (EI) *m/z* calcd for $[C_{15}H_{20}, M]^+$: 200.1565, Found: 200.1560.

((1*E*,4*E*)-3,5-dimethylhexa-1,4-diene-1,6-diyl)dibenzene (6e)



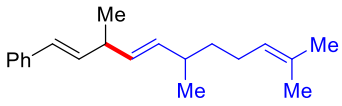
62% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (d, *J* = 7.3 Hz, 2H), 7.28 (t, *J* = 7.6 Hz, 4H), 7.22–7.15 (m, 4H), 6.34 (d, *J* = 15.9 Hz, 1H), 6.17 (dd, *J* = 15.9, 6.4 Hz, 1H), 5.20 (d, *J* = 8.9 Hz, 1H), 3.35–3.19 (m, 3H), 1.59 (s, 3H), 1.17 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.2, 137.8, 135.1, 134.2, 130.4, 128.8, 128.4, 128.2, 127.6, 126.8, 126.0, 126.0, 46.2, 35.7, 21.1, 16.0. HRMS (EI) *m/z* calcd for $[C_{20}H_{22}, M]^+$: 262.1722, Found: 262.1718.

((1*E*,4*E*)-3,5-dimethylhepta-1,4-dien-1-yl)benzene (6f)



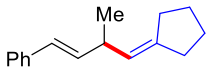
84% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.32 (m, 2H), 7.30–7.26 (m, 2H), 7.20–7.15 (m, 1H), 6.33 (d, *J* = 15.9 Hz, 1H), 6.15 (dd, *J* = 15.9, 6.5 Hz, 1H), 5.08–4.98 (m, 1H), 3.29–3.14 (m, 1H), 2.02 (q, *J* = 7.4 Hz, 2H), 1.66 (d, *J* = 1.2 Hz, 3H), 1.13 (d, *J* = 6.8 Hz, 3H), 1.01 (t, *J* = 7.5 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.9, 136.7, 135.5, 128.4, 127.2, 126.8, 126.7, 126.0, 35.6, 32.3, 21.2, 16.2, 12.7. HRMS (EI) *m/z* calcd for $[C_{15}H_{20}, M]^+$: 200.1565, Found: 200.1560.

((1*E*,4*E*)-3,6,10-trimethylundeca-1,4,9-trien-1-yl)benzene (6g)



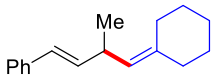
55% yield, 1:1 *dr*. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (d, *J* = 7.6 Hz, 2H), 7.29 (t, *J* = 7.4 Hz, 2H), 7.19 (t, *J* = 7.2 Hz, 1H), 6.35 (d, *J* = 15.9 Hz, 1H), 6.17 (dd, *J* = 15.9, 6.8 Hz, 1H), 5.35 (qd, *J* = 15.4, 6.8 Hz, 2H), 5.10 (t, *J* = 6.8 Hz, 1H), 3.07–2.91 (m, 1H), 2.10 (dt, *J* = 13.7, 6.8 Hz, 1H), 1.96 (d, *J* = 7.3 Hz, 2H), 1.68 (s, 3H), 1.59 (s, 3H), 1.30 (q, *J* = 7.4 Hz, 2H), 1.17 (d, *J* = 6.8 Hz, 3H), 0.98 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.8, 135.4, 135.3, 132.3, 131.2, 128.4, 128.0 (127.9), 126.8, 126.0, 124.8 (124.77), 39.7 (39.6), 37.2, 36.3, 25.8 (25.8), 25.7, 20.9 (20.8), 20.6 (20.5), 17.7. HRMS (EI) *m/z* calcd for $[C_{20}H_{28}, M]^+$: 268.2191, Found: 268.2188.

(*E*)-(4-cyclopentylidene-3-methylbut-1-en-1-yl)benzene (6h)



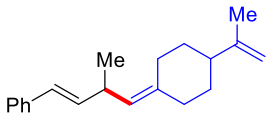
1a (0.2 mmol), α,β-unsaturated hydrazones **5** (0.4 mmol). 65% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.31 (m, 2H), 7.32–7.24 (m, 2H), 7.21–7.13 (m, 1H), 6.33 (d, *J* = 15.9 Hz, 1H), 6.15 (dd, *J* = 15.9, 6.8 Hz, 1H), 5.25–5.13 (m, 1H), 3.17–2.99 (m, 1H), 2.32–2.13 (m, 4H), 1.73–1.55 (m, 4H), 1.14 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.0, 137.9, 135.2, 128.4, 127.1, 126.7, 126.0, 123.6, 37.7, 33.7, 28.6, 26.4, 26.4, 20.9. HRMS (EI) *m/z* calcd for $[C_{16}H_{20}, M]^+$: 212.1565, Found: 212.1560.

(*E*)-(4-cyclohexylidene-3-methylbut-1-en-1-yl)benzene (6i)



1a (0.2 mmol), α,β-unsaturated hydrazones **5** (0.4 mmol). 81% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (d, *J* = 7.6 Hz, 2H), 7.28 (t, *J* = 7.6 Hz, 2H), 7.17 (t, *J* = 7.2 Hz, 1H), 6.33 (d, *J* = 15.9 Hz, 1H), 6.16 (dd, *J* = 15.9, 6.3 Hz, 1H), 4.99 (d, *J* = 8.8 Hz, 1H), 3.31–3.22 (m, 1H), 2.26–2.13 (m, 2H), 2.12–2.06 (m, 2H), 1.57–1.48 (m, 6H), 1.13 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.4, 138.0, 135.9, 128.5, 127.3, 126.8, 126.0, 125.1, 37.2, 34.7, 29.2, 28.8, 28.0, 26.9, 21.5. HRMS (EI) *m/z* calcd for $[C_{17}H_{22}, M]^+$: 226.1722, Found: 226.1714.

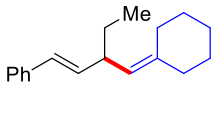
(*E*)-(3-methyl-4-(4-(prop-1-en-2-yl)cyclohexylidene)but-1-en-1-yl)benzene (6j)



71% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ the major isomer 7.37–7.31 (m, 2H), 7.31–7.25 (m, 2H), 7.21–7.15 (m, 1H), 6.31 (d, *J* = 15.0 Hz, 1H), 6.18 (dd, *J* = 15.0, 6.3 Hz, 1H), 5.03 (d, *J* = 7.5 Hz, 1H), 4.69 (s, 2H), 3.34–3.22 (m, 1H), 2.68 (d, *J* = 13.9 Hz, 1H), 2.28–2.2 (m, 1H), 2.15–2.03 (m, 2H), 1.85–1.76 (m, 3H), 1.72 (s, 3H), 1.36–1.18 (m, 2H), 1.17–1.11 (m, 3H). δ the minor isomer 7.37–7.31 (m, 2H), 7.31–7.25 (m, 2H), 7.21–7.15 (m, 1H), 6.35 (d, *J* = 15.3 Hz, 1H), 6.14 (dd, *J* = 15.3, 6.2 Hz, 1H), 5.01 (d, *J* = 7.9 Hz, 1H), 4.67 (s, 2H), 3.34–3.22 (m, 1H), 2.68 (d, *J* = 13.9 Hz, 1H), 2.28–2.2 (m, 1H), 2.15–2.03 (m, 2H), 1.85–1.76 (m, 3H), 1.71 (s, 3H), 1.36–1.18 (m, 2H), 1.17–1.11 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 150.3 (150.2), 138.4 (138.4), 137.9 (137.9), 135.8 (135.6), 128.4

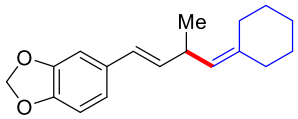
(128.4), 127.3, 126.8, 126.0, 125.6 (125.5), 108.4 (108.4), 45.6 (45.6), 36.6 (36.6), 34.9 (34.7), 33.4 (33.4), 32.7 (32.6), 28.6 (28.5), 21.6 (21.2), 21.0 (20.9). HRMS (EI) *m/z* calcd for $[C_{20}H_{26}, M]^+$: 266.2035, Found: 266.2030.

(*E*)-(3-(cyclohexylidenemethyl)pent-1-en-1-yl)benzene (6k)



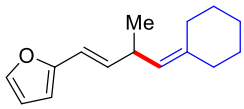
48% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (d, *J* = 7.6 Hz, 2H), 7.28 (t, *J* = 7.6 Hz, 2H), 7.17 (t, *J* = 7.2 Hz, 1H), 6.33 (d, *J* = 15.9 Hz, 1H), 6.11 (dd, *J* = 15.9, 7.1 Hz, 1H), 4.96 (d, *J* = 9.1 Hz, 1H), 3.13–2.86 (m, 1H), 2.26–2.00 (m, 4H), 1.56–1.46 (m, 7H), 1.43–1.30 (m, 1H), 0.90 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.2, 138.0, 134.7, 128.4, 128.2, 126.7, 126.0, 123.7, 42.4, 37.4, 29.3, 28.9, 28.8, 27.9, 26.9, 11.9. HRMS (EI) *m/z* calcd for $[C_{18}H_{24}, M]^+$: 240.1878, Found: 240.1872.

(*E*)-5-(4-cyclohexylidene-3-methylbut-1-en-1-yl)benzo[d][1,3]dioxole (6l)



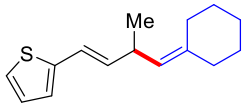
Diene (0.2 mmol, *E*-isomer), α,β-unsaturated hydrazones **5** (0.4 mmol). 70% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.90 (d, *J* = 1.3 Hz, 1H), 6.78–6.70 (m, 2H), 6.24 (d, *J* = 15.9 Hz, 1H), 5.99 (dd, *J* = 15.9, 6.6 Hz, 1H), 5.92 (s, 2H), 4.97 (d, *J* = 8.8 Hz, 1H), 3.31–3.14 (m, 1H), 2.22–2.12 (m, 2H), 2.10–2.05 (m, 2H), 1.56–1,47 (m, 6H), 1.11 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 146.5, 139.3, 134.2, 132.6, 126.9, 125.2, 120.3, 108.2, 105.5, 100.9, 37.2, 34.6, 29.2, 28.7, 28.0, 26.9, 21.5. HRMS (EI) *m/z* calcd for $[C_{18}H_{22}O, M]^+$: 270.1620, Found: 270.1616.

(*E*)-2-(4-cyclohexylidene-3-methylbut-1-en-1-yl)furan (6m)



Diene (0.2 mmol), α,β-unsaturated hydrazones **5** (0.4 mmol). 73% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30–7.28 (m, 1H), 6.34–6.31 (m, 1H), 6.16–6.11 (m, 3H), 4.95 (d, *J* = 8.8 Hz, 1H), 3.28–3.19 (m, 1H), 2.22–2.12 (m, 2H), 2.11–2.06 (m, 2H), 1.54 (s, 6H), 1.11 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 153.5, 141.2, 139.6, 134.9, 124.8, 116.2, 111.1, 106.1, 37.2, 34.3, 29.2, 28.7, 27.9, 26.9, 21.3. HRMS (EI) *m/z* calcd for $[C_{15}H_{20}O, M]^+$: 216.1514, Found: 216.1508.

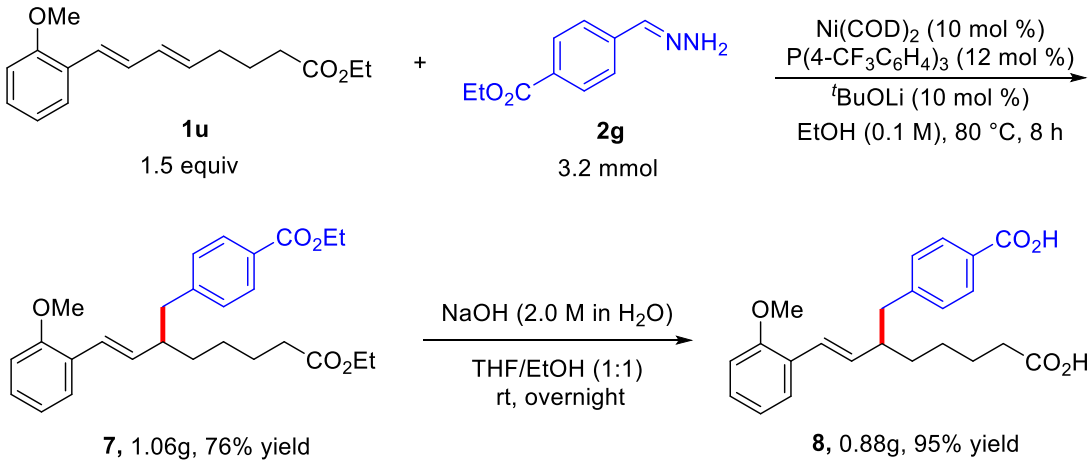
(*E*)-2-(4-cyclohexylidene-3-methylbut-1-en-1-yl)thiophene (6n)



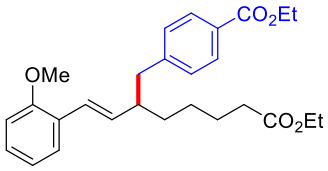
Diene (0.2 mmol), α,β-unsaturated hydrazones **5** (0.4 mmol). 72% yield. Isolated by preparative TLC (PE). Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.07 (d, *J* = 5.0 Hz, 1H), 6.96–6.90 (m, 1H), 6.86 (d, *J* = 3.3 Hz, 1H), 6.45 (d, *J* = 15.7 Hz, 1H), 6.02 (dd, *J* = 15.7, 6.2 Hz, 1H), 4.96 (d, *J* = 8.9 Hz, 1H), 3.35–3.14 (m, 1H), 2.21–2.13 (m, 2H), 2.11–2.06 (m, 2H), 1.57–1.48 (m, 6H), 1.11 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.3, 139.6,

135.8, 127.2, 124.8, 124.3, 123.0, 120.7, 37.2, 34.4, 29.1, 28.7, 27.9, 26.9, 21.3. HRMS (EI) *m/z* calcd for $[C_{15}H_{20}S, M]^+$: 232.1286, Found: 232.1282.

5. Synthetic Application

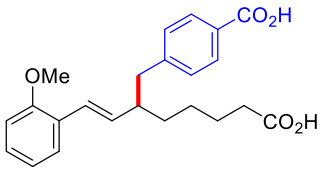


Ethyl (*E*)-4-(7-ethoxy-2-(2-methoxystyryl)-7-oxoheptyl)benzoate (7)



The hydroalkylation was conducted in a modified procedure. In an argon-filled glove box, an oven-dried tube was charged with a stir bar, $Ni(COD)_2$ (87.0 mg, 0.317 mmol), ligand $P(4\text{-}CF_3C_6H_4)_3$ (178 mg, 0.380 mmol), 1,3-diene **1u** (1.30 g, 4.76 mmol), hydrazone **2g** (0.610 g, 3.17 mmol) and ^{t}BuOLi (25.0 mg, 0.317 mmol). The tube was sealed and removed from the glove box, and degassed ethanol (32.0 mL) was injected into the tube under argon. The mixture was stirred at room temperature for 5 minutes and heated at 80 ℃ for 8 hours. After cooling to room temperature, the solvent was evaporated under vacuum. The pure product **7** was obtained by flash silica gel chromatography (PE/EA = 15:1) as light yellow oil (1.06 g, 2.42 mmol, 76% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 7.9 Hz, 2H), 7.36 (d, *J* = 7.5 Hz, 1H), 7.25–7.10 (m, 3H), 6.89 (t, *J* = 7.5 Hz, 1H), 6.83 (d, *J* = 8.2 Hz, 1H), 6.56 (d, *J* = 16.0 Hz, 1H), 5.95 (dd, *J* = 16.0, 8.8 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 4.09 (q, *J* = 7.1 Hz, 2H), 3.79 (s, 3H), 2.77 (d, *J* = 6.9 Hz, 2H), 2.53–2.43 (d, *J* = 4.3 Hz, 1H), 2.25 (t, *J* = 7.5 Hz, 2H), 1.66–1.52 (m, 2H), 1.51–1.30 (m, 7H), 1.22 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 173.7, 166.7, 156.3, 146.0, 134.1, 129.4, 129.3, 128.1, 128.0, 126.5, 126.3, 125.0, 120.5, 110.9, 60.7, 60.1, 55.4, 44.9, 42.2, 34.2, 34.2, 26.8, 24.9, 14.3, 14.2. HRMS (ESI) calcd for [$C_{27}H_{34}NaO_5$, M+Na]$^+$: 461.2298, Found: 461.2303.

(*E*)-4-(6-carboxy-2-(2-methoxystyryl)hexyl)benzoic acid (8)



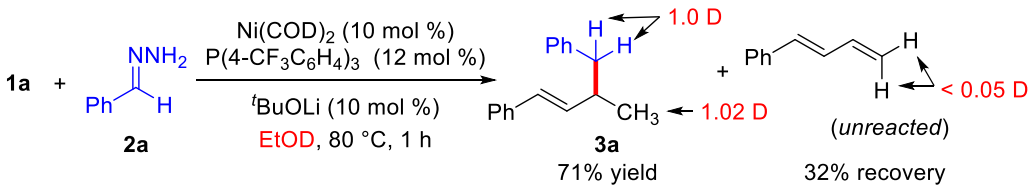
To a solution of substrate **7** (1.06 g, 2.42 mmol) in ethanol (36.0 ml) and tetrahydrofuran (36.0 ml) was added NaOH (2.0 M, 18.2 ml, 36.3 mmol). The mixture was stirred overnight at room temperature. The solvents were evaporated under vacuum, and 10 mL H_2O was added to the residue. The aqueous solution was adjusted to pH 2–4 via addition of 6 N HCl. The

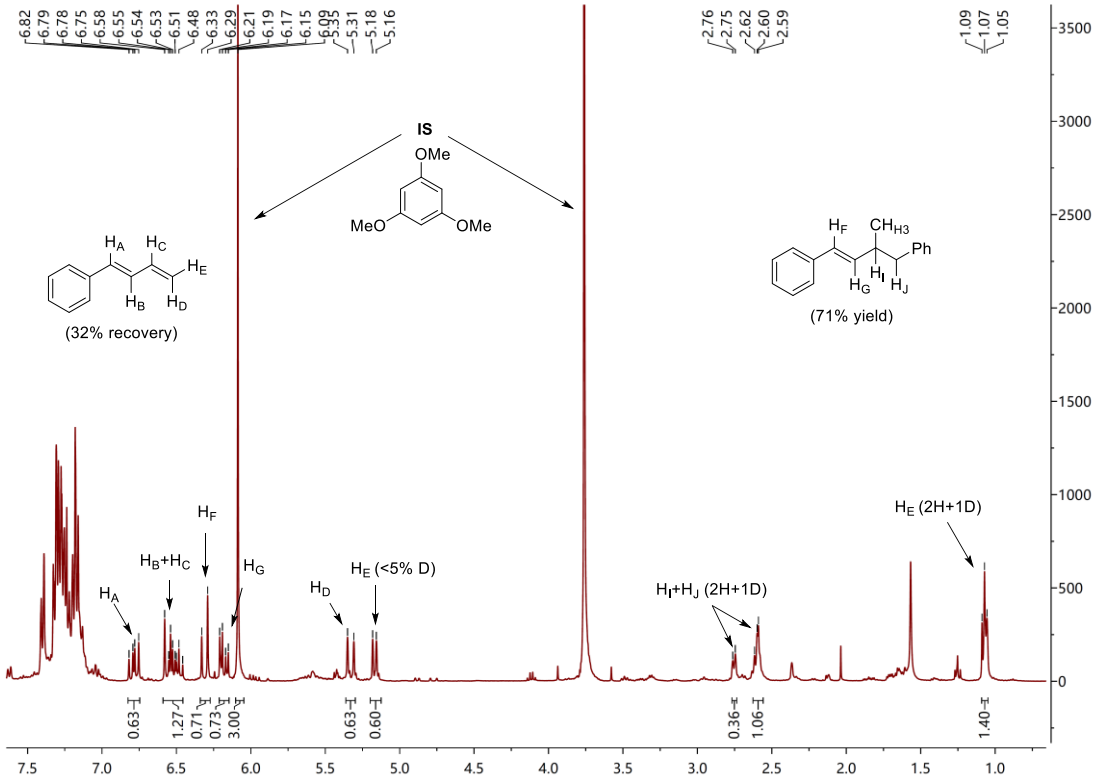
resulting aqueous solution was extracted with EtOAc (20 mL × 3). The combined organic layer was dried over anhydrous sodium sulfate, and concentrated to give a light yellow solid. The solid was washed with a little amount of MeOH and petroleum ether, dried to give the title product **8** (0.88 g, 95% yield). White solid, mp: 151–152 °C. ^{1}H NMR (400 MHz, DMSO) δ 12.38 (s, 2H), 7.82 (d, *J* = 7.7 Hz, 2H), 7.38 (d, *J* = 7.4 Hz, 1H), 7.29 (d, *J* = 7.6 Hz, 2H), 7.17 (t, *J* = 7.6 Hz, 1H), 6.92 (d, *J* = 8.1 Hz, 1H), 6.87 (t, *J* = 7.4 Hz, 1H), 6.42 (d, *J* = 15.8 Hz, 1H), 6.01 (dd, *J* = 15.8, 8.7 Hz, 1H), 3.72 (s, 3H), 2.79 (dd, *J* = 12.7, 5.6 Hz, 1H), 2.73–2.62 (m, 1H), 2.50–2.38 (m, 1H), 2.16 (t, *J* = 6.9 Hz, 2H), 1.57–1.17 (m, 6H); ^{13}C NMR (101 MHz, DMSO) δ 174.5, 167.4, 155.8, 145.9, 134.3, 129.4, 129.2, 128.3, 128.2, 125.9, 125.7, 124.1, 120.5, 111.3, 55.4, 44.7, 41.4, 34.1, 33.6, 26.4, 24.6. HRMS (ESI) calcd for $[C_{23}H_{25}O_5$, M-H$]^-$: 381.1707, Found: 381.1705.

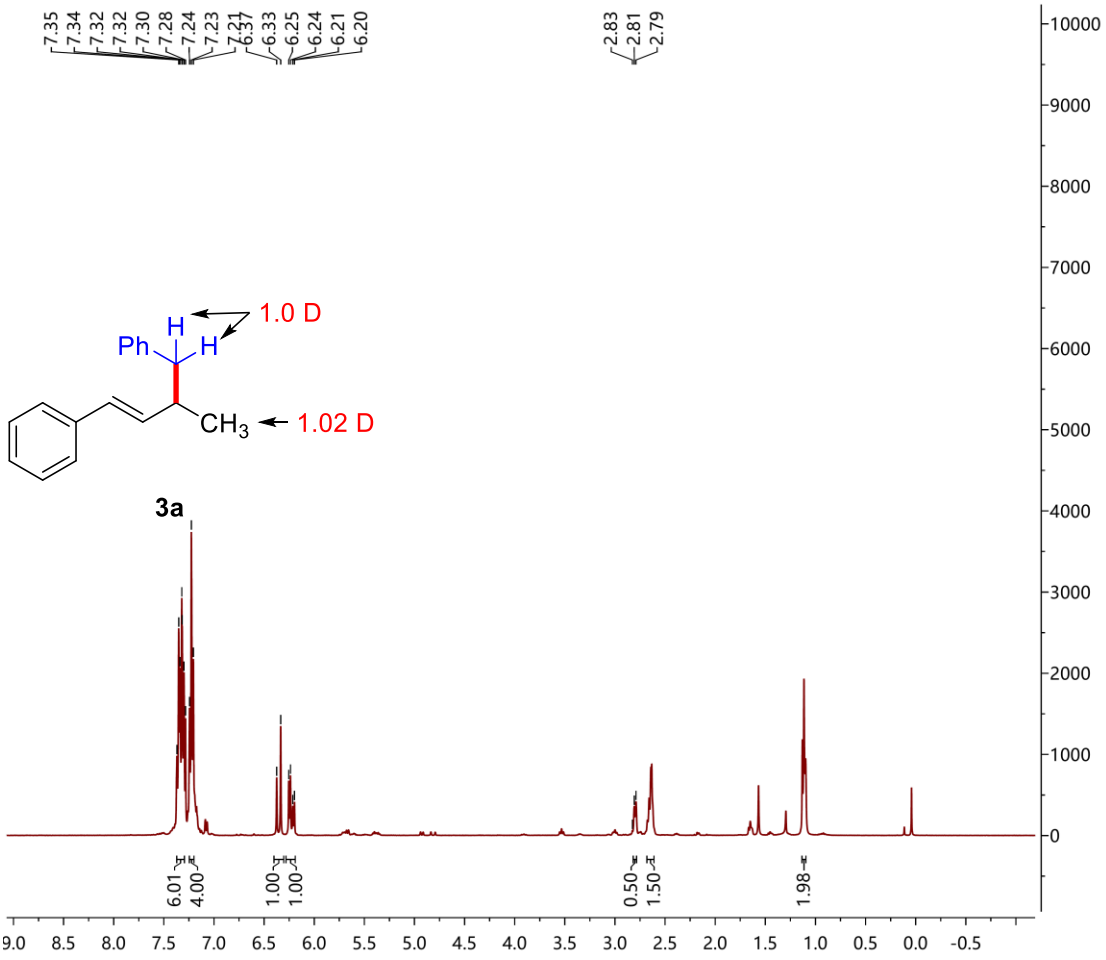
6. Mechanism Studies

a) Labelling experiment of hydroalkylation in ethanol-D

In an argon-filled glove-box, an oven-dried tube charged with a stir bar, $Ni(COD)_2$ (5.5 mg, 0.020 mmol), ligand $P(4\text{-}CF_3C_6H_4)_3$ (11.2 mg, 0.024 mmol), 1,3-diene **1a** (0.40 mmol), hydrazone **2a** (0.20 mmol) and ^{t}BuOLi (1.6 mg, 0.020 mmol) were added. The tube was sealed and removed from the glove box, and degassed **ethanol-D** (1.5 mL) was injected into the tube under argon. The mixture was stirred at room temperature for 5 minutes and heated at 80 ℃ for 1 hour. The reaction was concentrated and 1,3,5-trimethoxybenzene was added as internal standard. The deuterium incorporation was analyzed by ^{1}H NMR. The **3a** was obtained in 71% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38–7.27 (m, 6H), 7.26–7.22 (m, 4H), 6.35 (d, *J* = 15.9 Hz, 1H), 6.23 (dd, *J* = 15.9, 7.1 Hz, 1H), 2.83–2.77 (m, 0.5H), 2.68–2.61 (m, 1.5H), 1.14–1.09 (m, 1.98 H); 32% 1,3-diene was recovered with < 5% deuterium into the terminal diene C−H bonds.

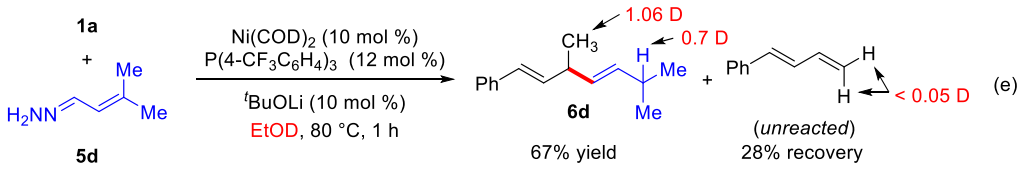


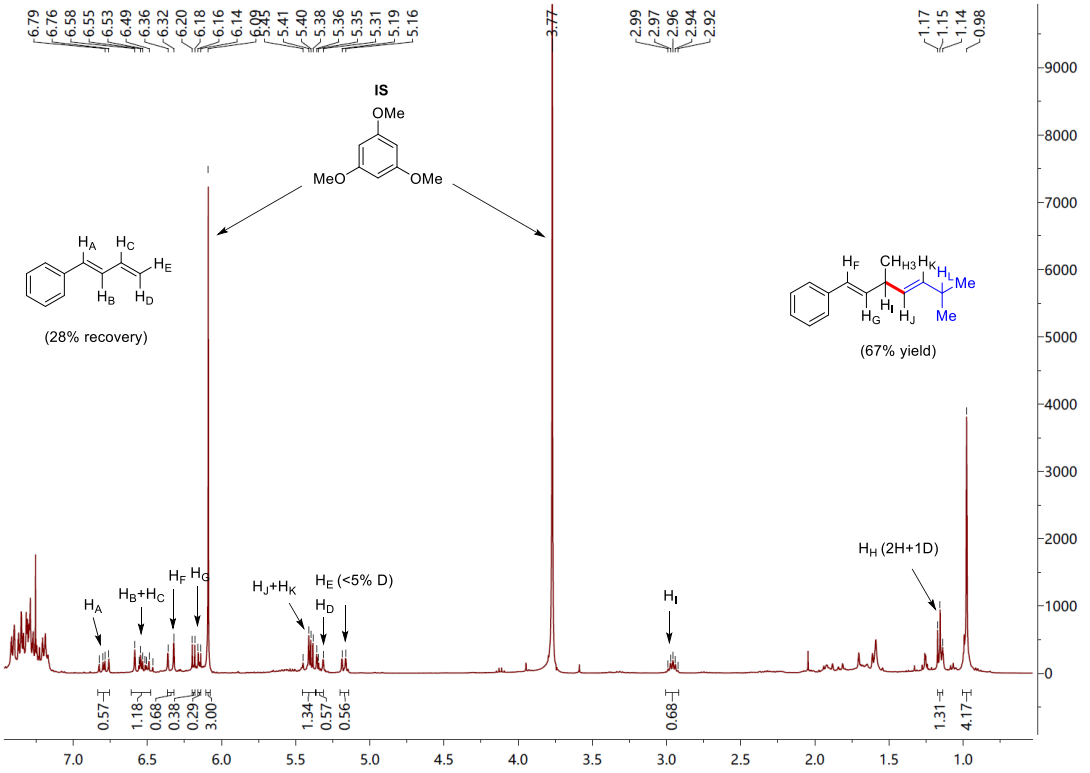


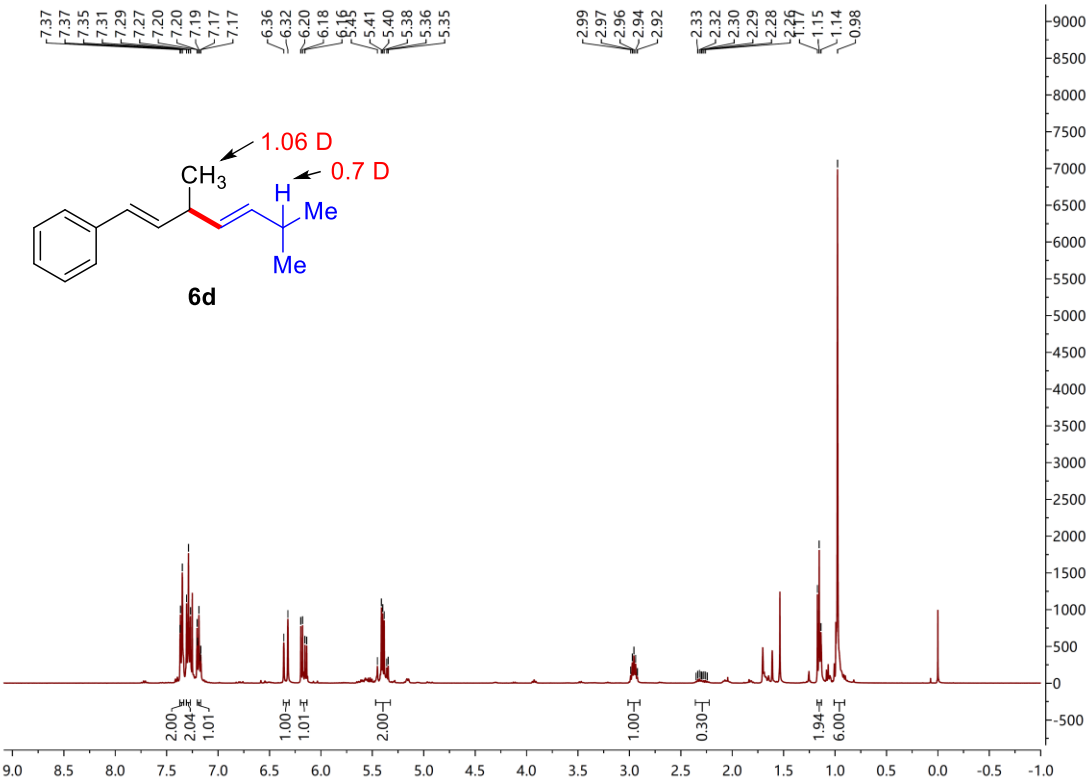


b) Labelling experiment of hydroalkenylation in ethanol-D

In an argon-filled glove-box, an oven-dried tube charged with a stir bar, $Ni(COD)_2$ (5.5 mg, 0.020 mmol), ligand $P(4\text{-}CF_3C_6H_4)_3$ (11.2 mg, 0.024 mmol), 1,3-diene **1a** (0.40 mmol), hydrazone **5d** (0.20 mmol, EtOH of **5d** solution was evaporated before use) and ^{t}BuOLi (1.6 mg, 0.020 mmol) were added. The tube was sealed and removed from the glove box, and degassed **ethanol-D** (1.5 mL) was injected into the tube under argon. The reaction mixture was stirred at room temperature for 5 minutes and heated at 80 ℃ for 1 hour. The reaction was concentrated and 1,3,5-trimethoxybenzene was added as internal standard. The deuterium incorporation was analyzed by ^{1}H NMR. The product **6d** was obtained in 67% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38–7.33 (m, 2H), 7.29 (t, *J* = 7.6 Hz, 2H), 7.21–7.15 (m, 1H), 6.34 (d, *J* = 16.0 Hz, 1H), 6.17 (dd, *J* = 16.0, 6.9 Hz, 1H), 5.48–5.31 (m, 2H), 3.04–2.89 (m, 1H), 2.35–2.24 (m, 2H), 1.15 (t, *J* = 6.8 Hz, 1.94H), 0.98 (s, 6H); 28% 1,3-diene was recovered with < 5% deuterium into the terminal diene C−H bonds.



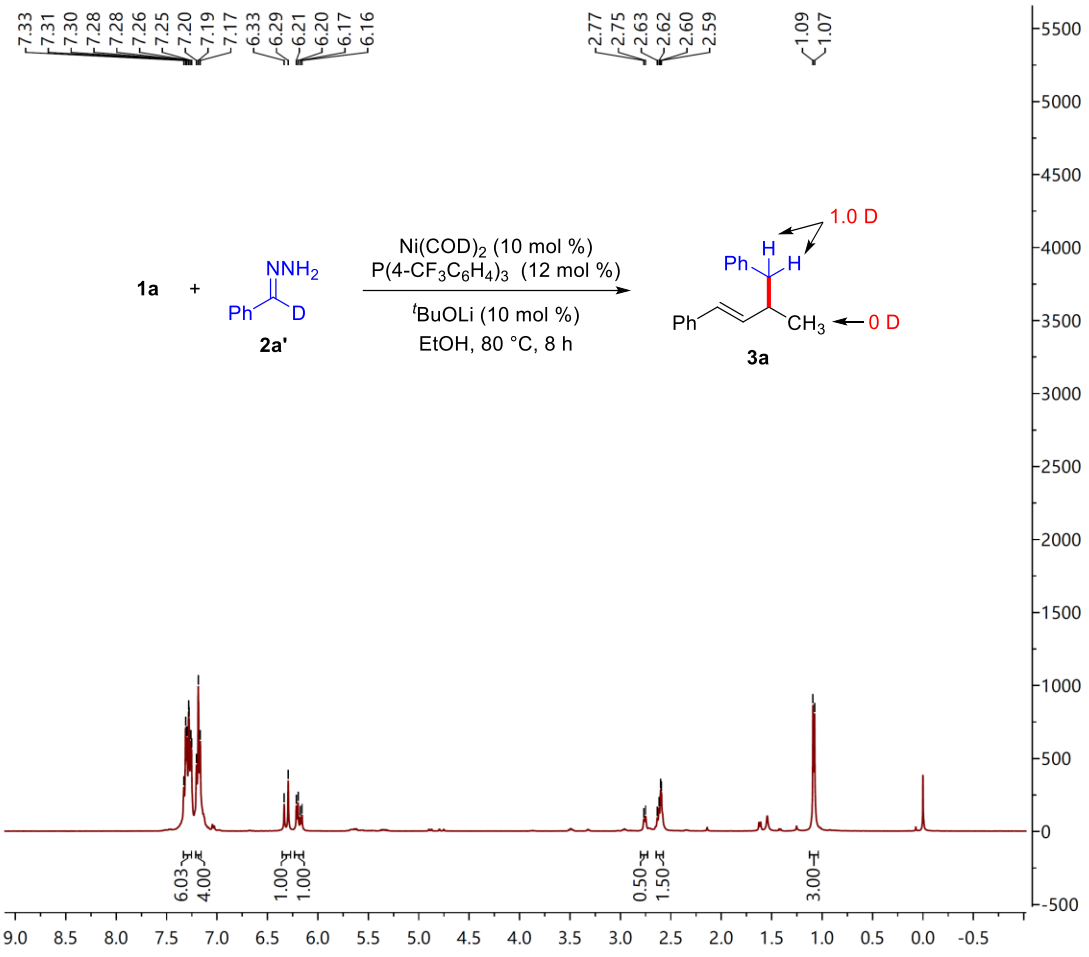




c) Labelling experiment using deuterated phenyl hydrazone 2a'

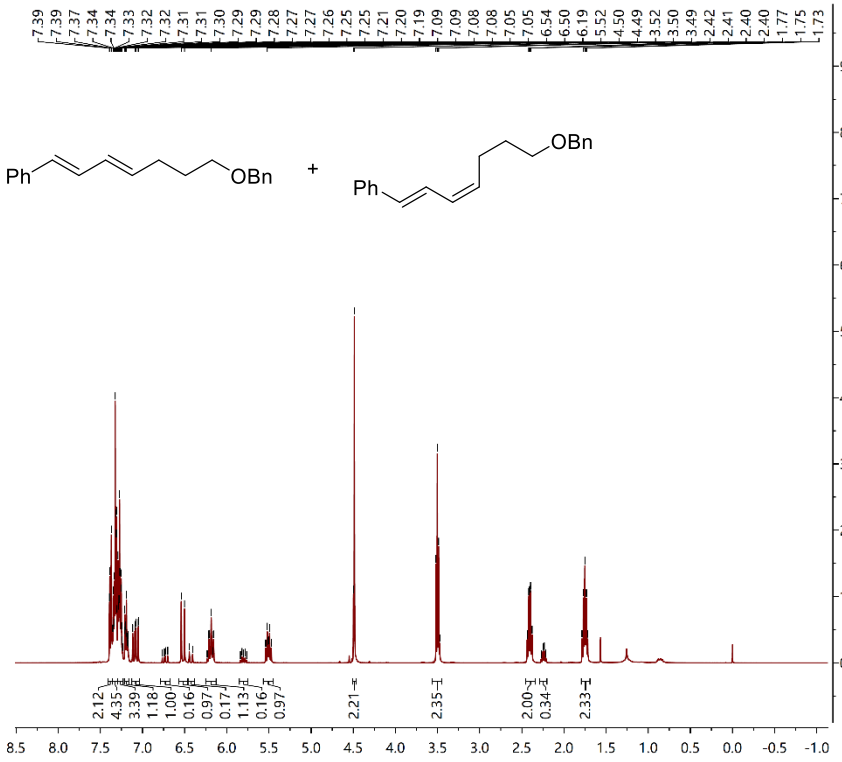
In an argon-filled glove-box, an oven-dried tube charged with a stir bar, $Ni(COD)_2$ (5.5 mg, 0.020 mmol), ligand $P(4\text{-}CF_3C_6H_4)_3$ (11.2 mg, 0.024 mmol), 1,3-diene **1a** (0.40

mmol), hydrazone **D-2a'** (0.20 mmol) and ^{t}BuOLi (1.6 mg, 0.020 mmol) were added. The tube was sealed and removed from the glove box, and degassed ethanol (1.5 mL) was injected into the tube under argon. The mixture was stirred at room temperature for 5 minutes and heated at 80 ℃ for 8 hours. After cooling to room temperature, the solvent was removed under vacuum. The pure product **3a** was obtained as light yellow oil in 90% yield by preparative TLC (PE). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.23 (m, 6H), 7.21–7.15 (m, 4H), 6.31 (d, *J* = 15.9 Hz, 1H), 6.19 (dd, *J* = 15.9, 7.0 Hz, 1H), 2.78–2.73 (m, 0.5H), 2.64–2.57 (m, 1.5H), 1.08 (d, *J* = 6.4 Hz, 3H).



7. NMR Spectra of Important Compounds

((1*E*)-7-(benzyloxy)hepta-1,3-dien-1-yl)benzene (1p)



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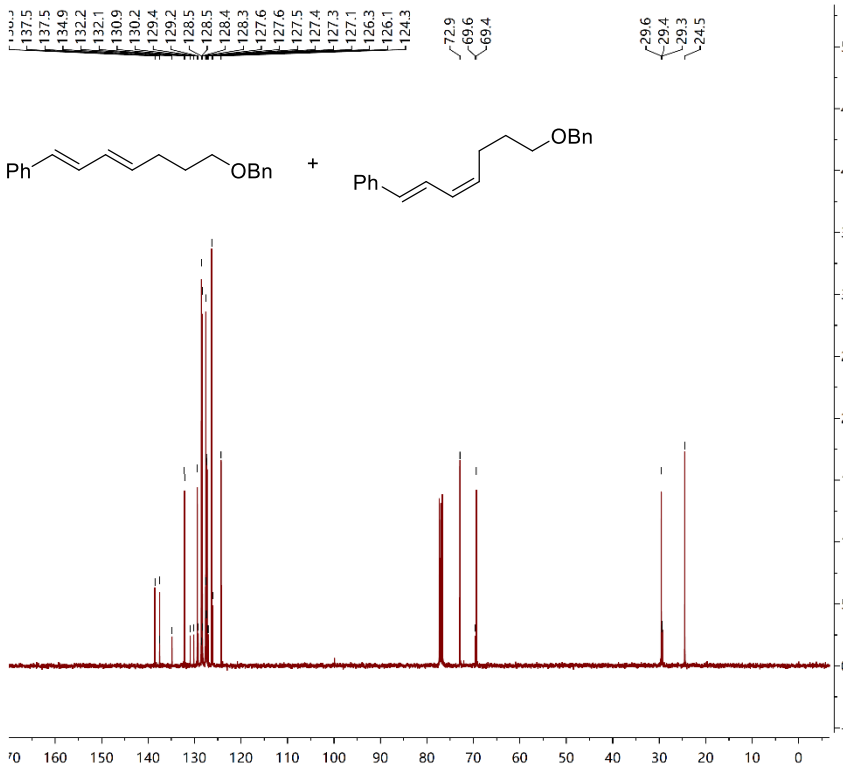
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-198.3
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	40
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	2.9999
18	Acquisition Date	2019-05-14T23:11:00
19	Modification Date	2019-05-14T23:11:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	-1672.9
23	Nucleus	1H
24	Acquired Size	24670
25	Spectral Size	65536



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8	Author	
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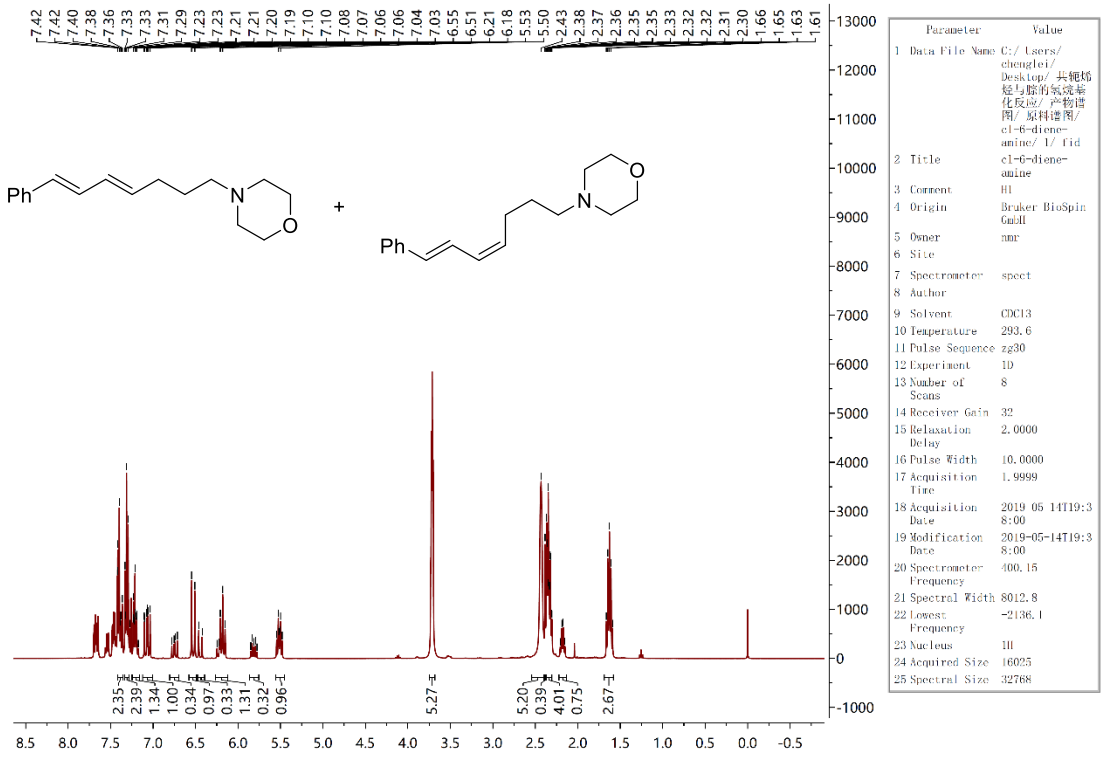
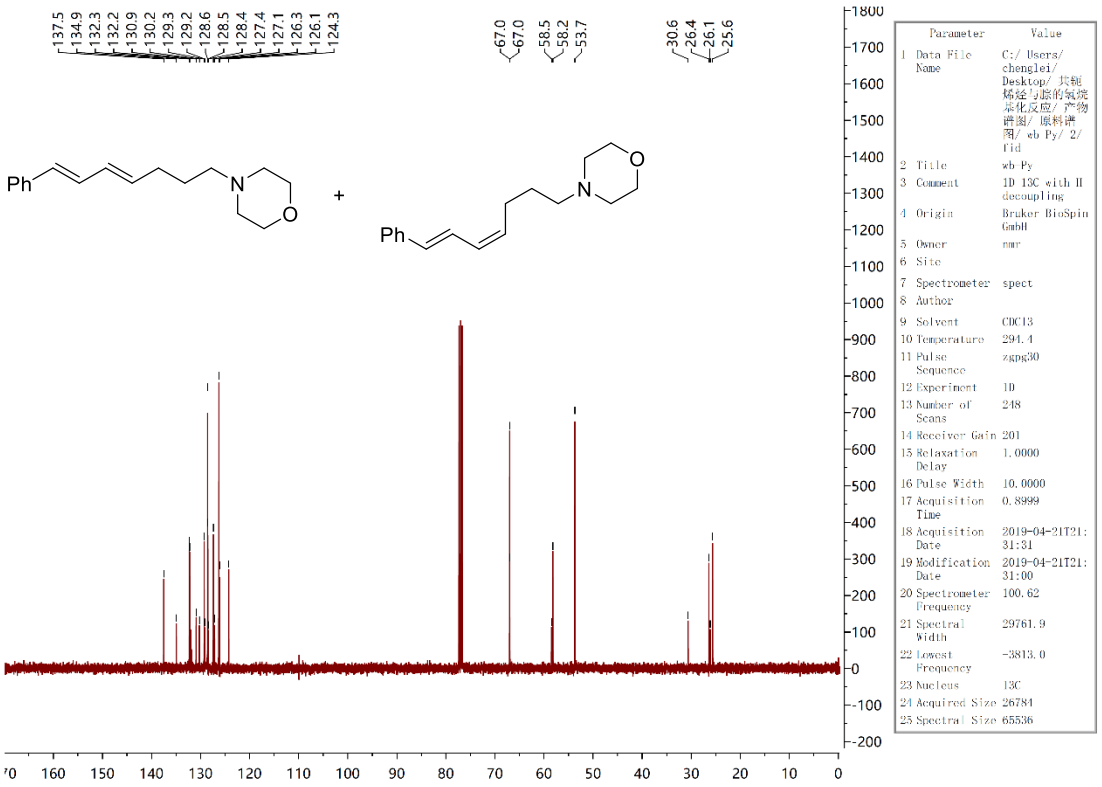
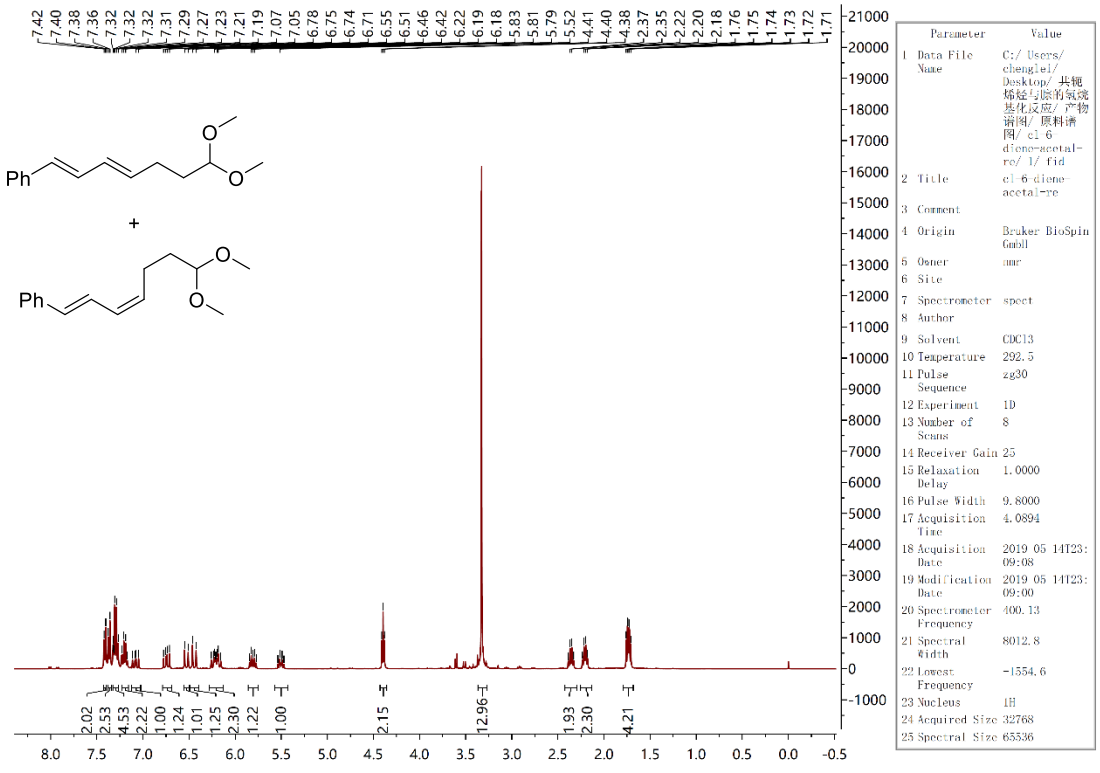
17	Acquisition Time	0.5506
18	Acquisition Date	2019-05-14T23:14:00
19	Modification Date	2019-05-14T23:23:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.2
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

4-((6*E*)-7-phenylhepta-4,6-dien-1-yl)morpholine (1q)





((1*E*)-7,7-dimethoxyhepta-1,3-dien-1-yl)benzene (1r)



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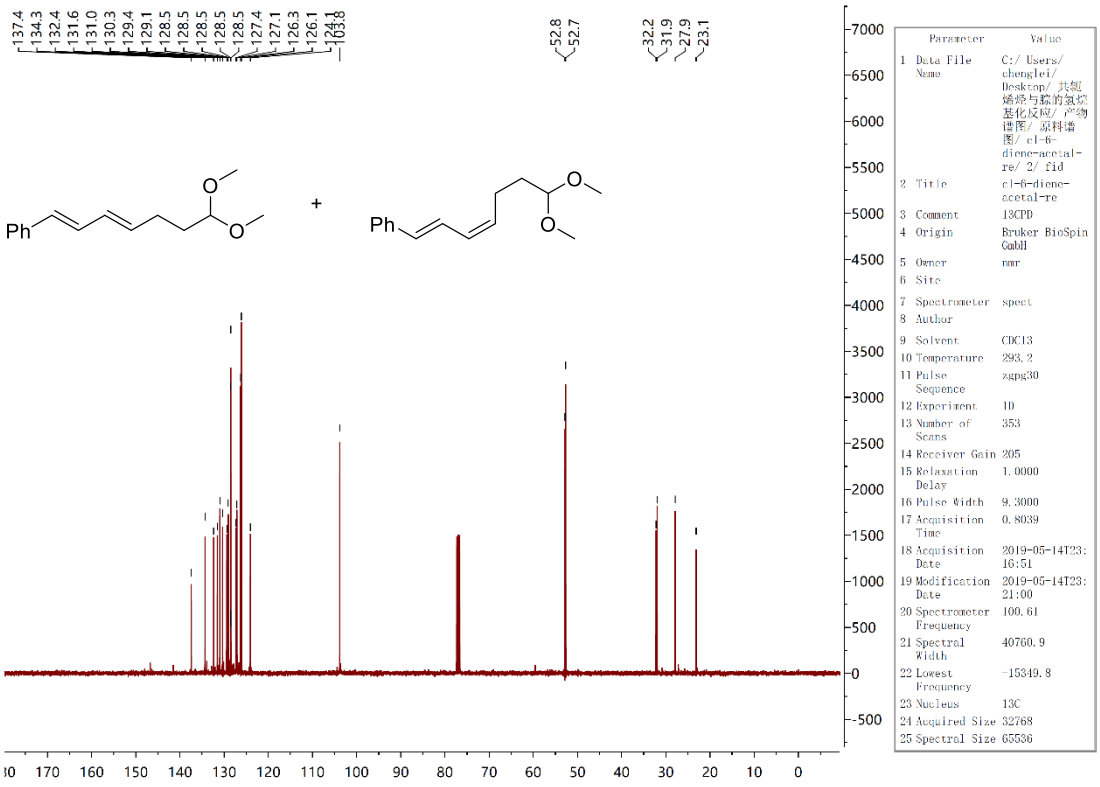

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3 Comment	13CPD
4 Origin	Bruker BioSpin GmbH
5 Owner	nmr
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
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22 Lowest Frequency	-15349.8
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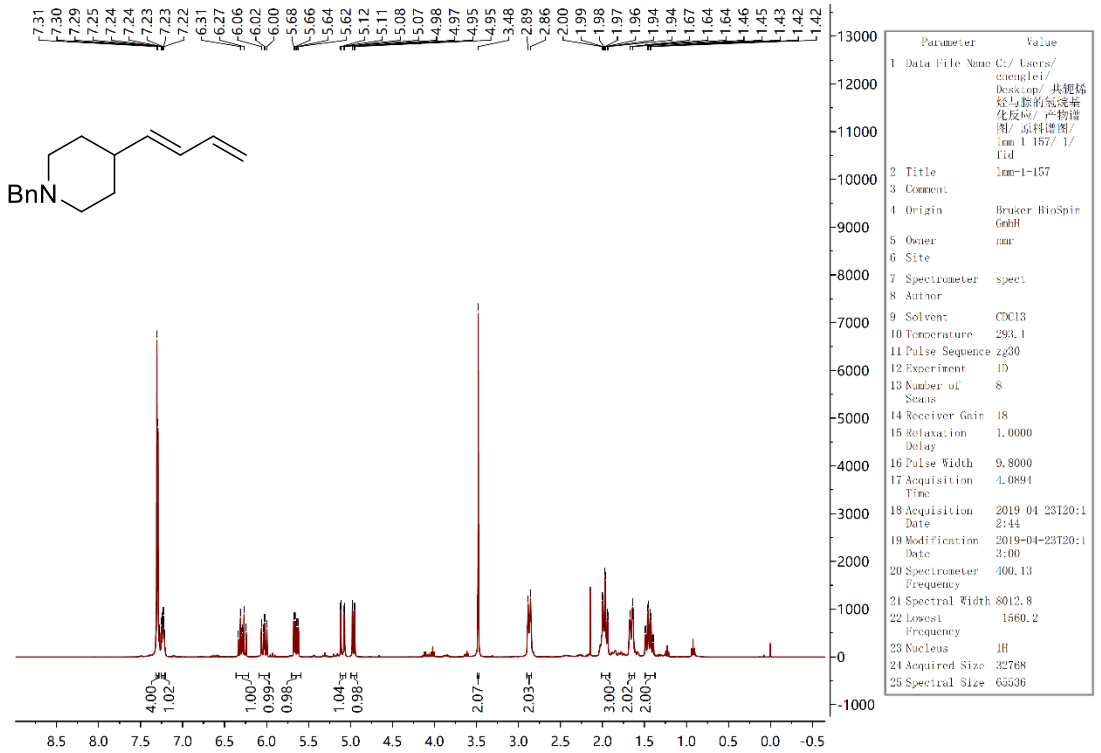
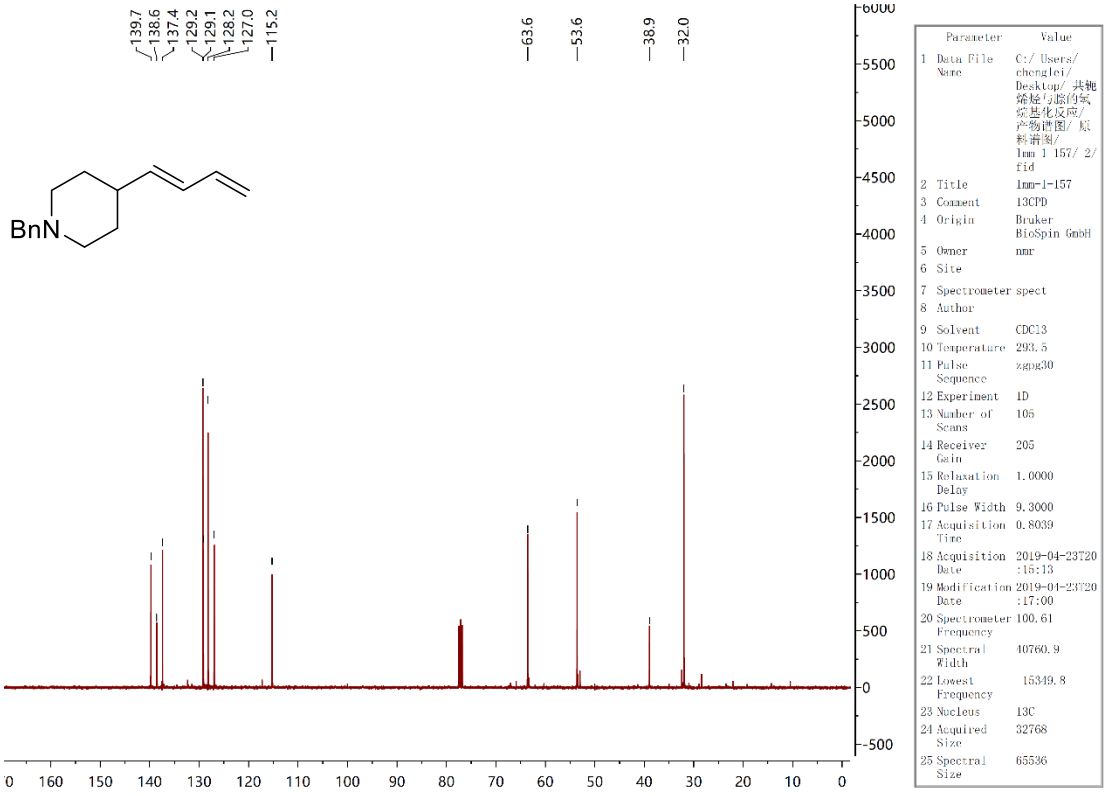
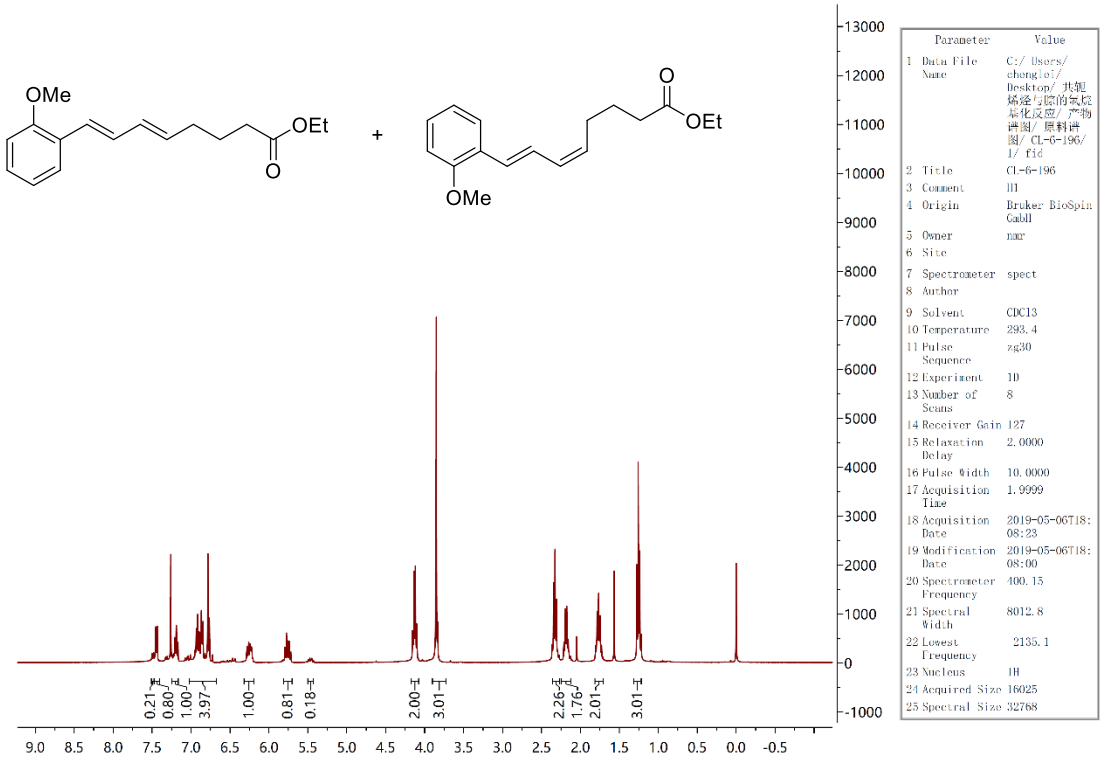
(*E*)-1-benzyl-4-(buta-1,3-dien-1-yl)piperidine (1s)





Ethyl (7*E*)-8-(2-methoxyphenyl)octa-5,7-dienoate (1t)



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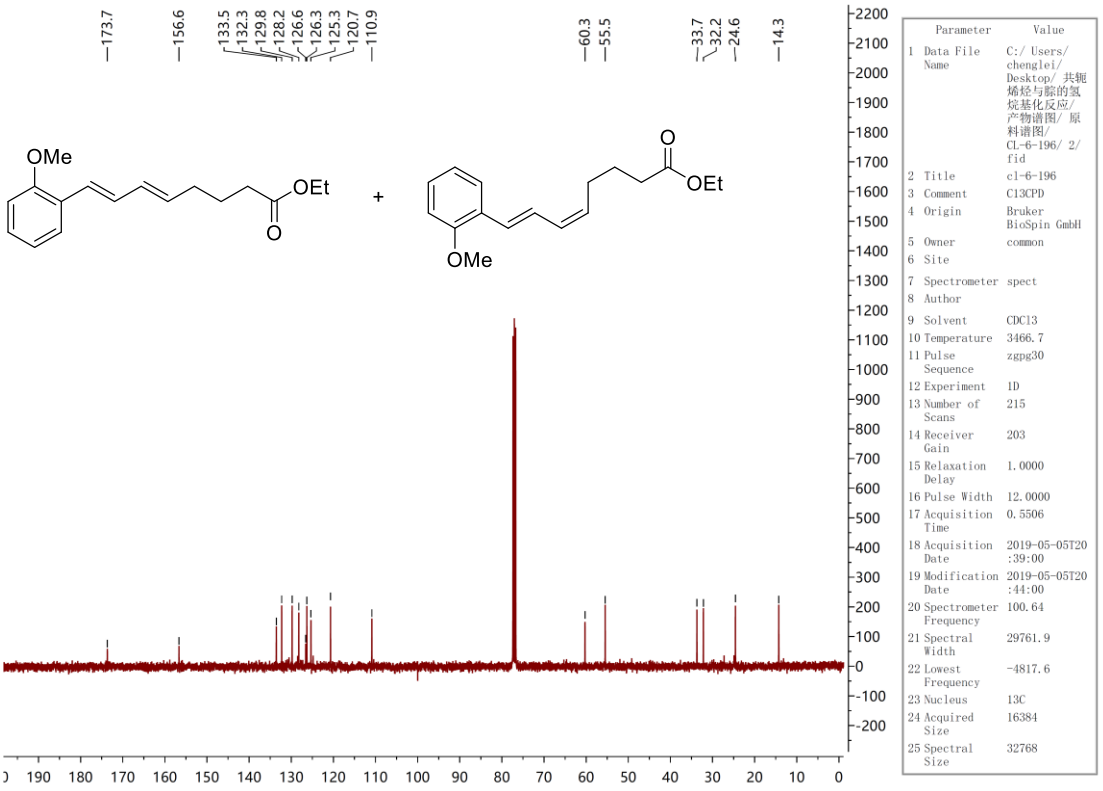

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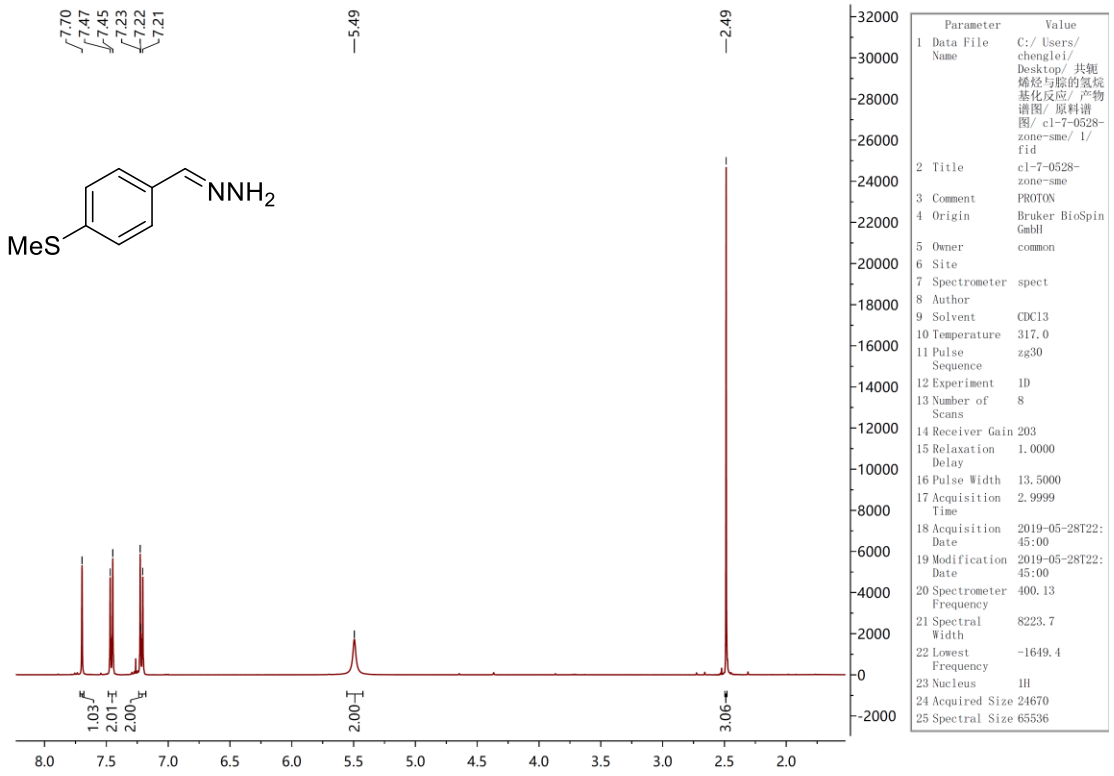
(4-(methylthio)benzylidene)hydrazine (2f)



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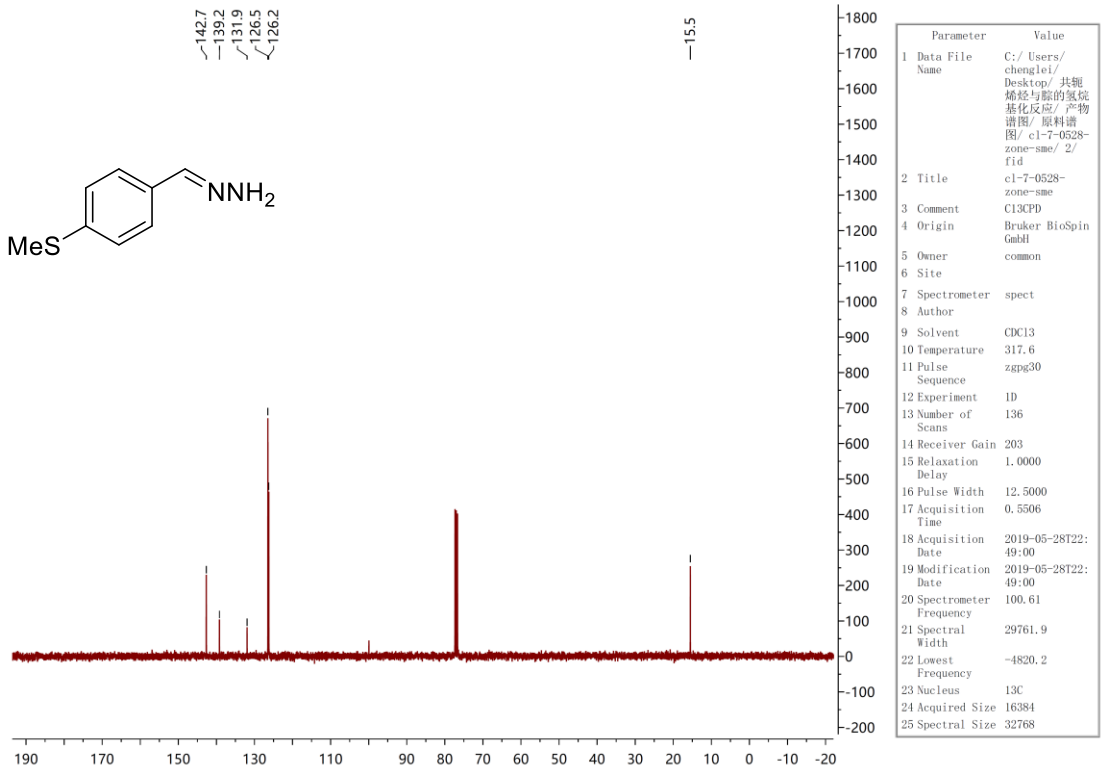

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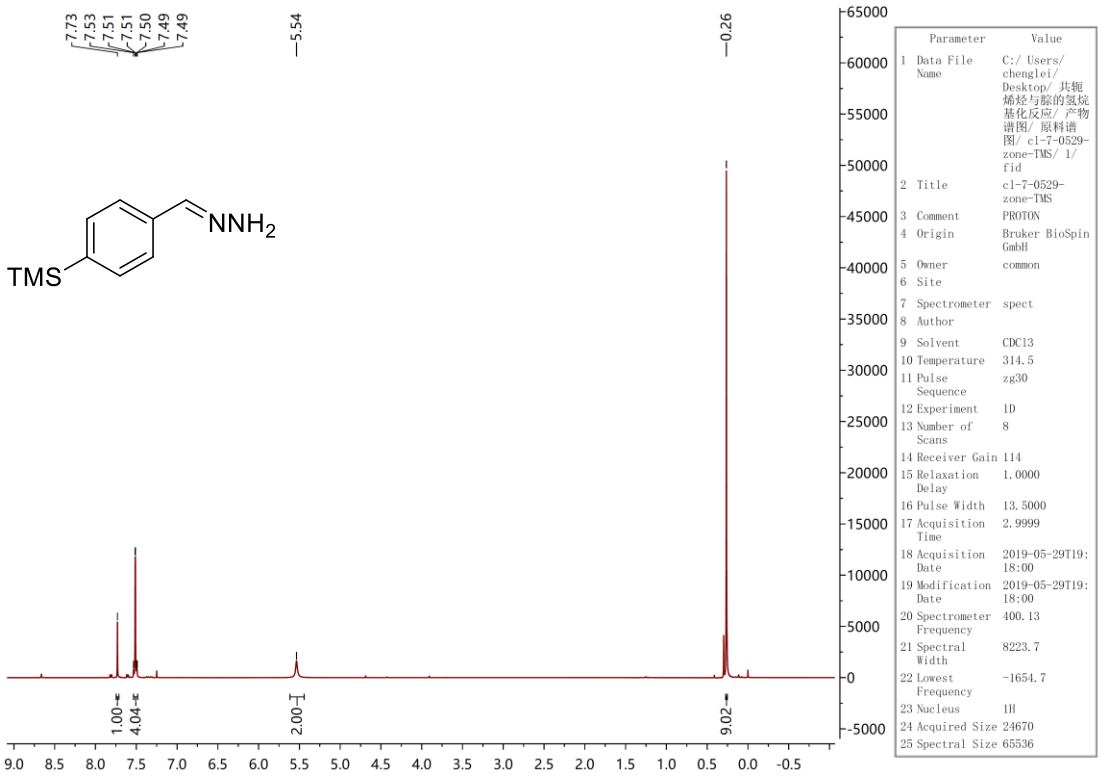
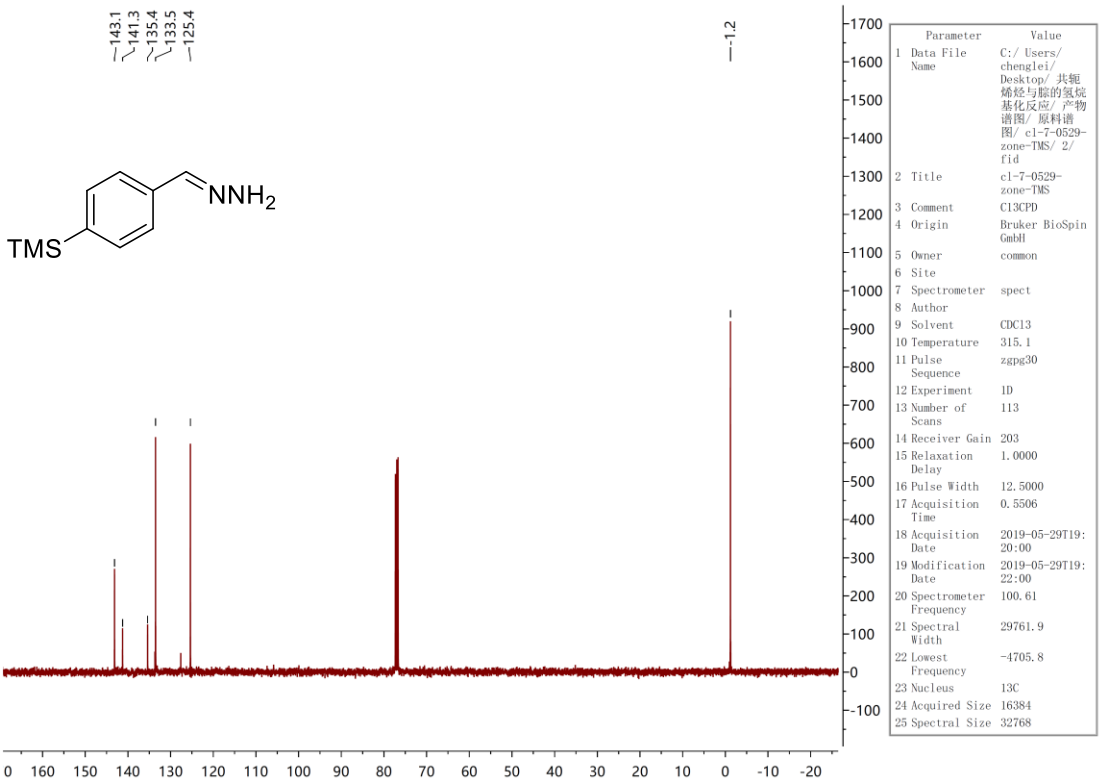
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.2
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(4-(trimethylsilyl)benzylidene)hydrazine (2h)



Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 原料谱图/ cl-7-0529-zone-TMS/ 1/ fid
2 Title	cl-7-0529-zone-TMS
3 Comment	PROTON
4 Origin	Bruker BioSpin GmbH
5 Owner	common
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	314.5
11 Pulse Sequence	zg30
12 Experiment	1D
13 Number of Scans	8
14 Receiver Gain	114
15 Relaxation Delay	1.0000
16 Pulse Width	13.5000
17 Acquisition Time	2.9999
18 Acquisition Date	2019-05-29T19:18:00
19 Modification Date	2019-05-29T19:18:00
20 Spectrometer Frequency	400.13
21 Spectral Width	8223.7
22 Lowest Frequency	-1654.7
23 Nucleus	1H
24 Acquired Size	24670
25 Spectral Size	65536



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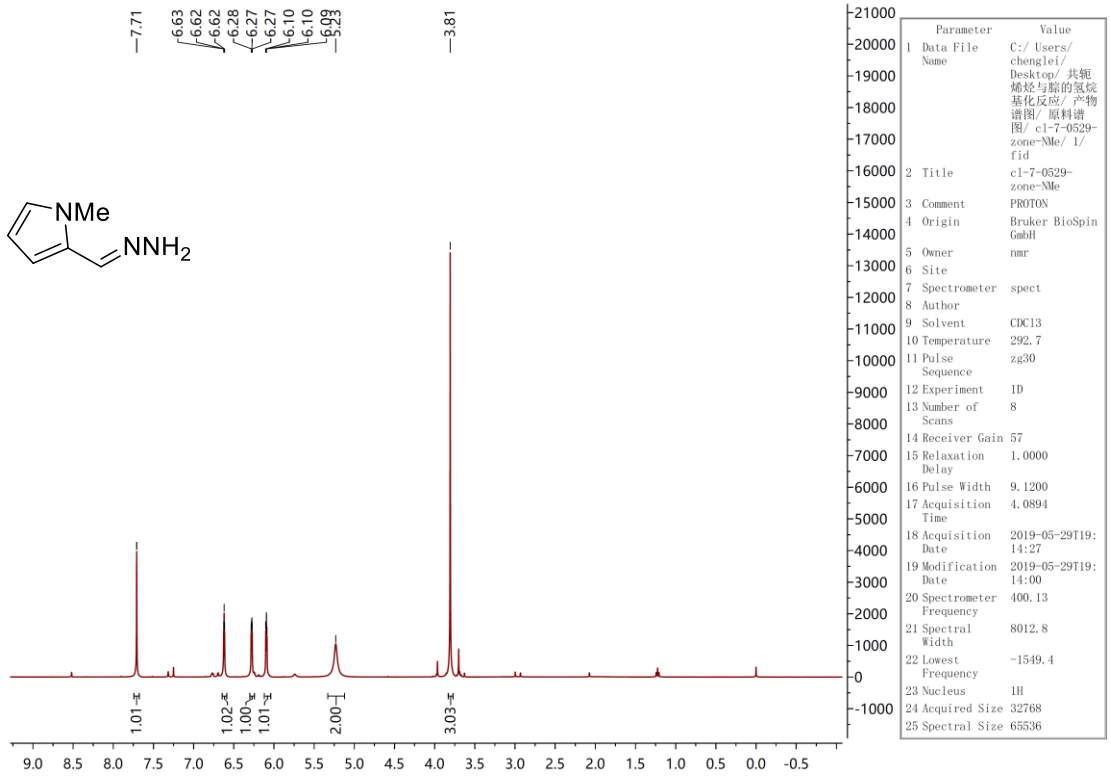
2 Title	cl-7-0529-zone-TMS
3 Comment	C13CPD
4 Origin	Bruker BioSpin GmbH
5 Owner	common
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	315.1
11 Pulse Sequence	zgpg30
12 Experiment	1D
13 Number of Scans	113
14 Receiver Gain	203
15 Relaxation Delay	1.0000
16 Pulse Width	12.5000
17 Acquisition Time	0.5506
18 Acquisition Date	2019-05-29T19:20:00
19 Modification Date	2019-05-29T19:22:00
20 Spectrometer Frequency	100.61
21 Spectral Width	29761.9
22 Lowest Frequency	-4705.8
23 Nucleus	13C
24 Acquired Size	16384
25 Spectral Size	32768

2-(hydrazonomethyl)-1-methyl-1H-pyrrole (2o)



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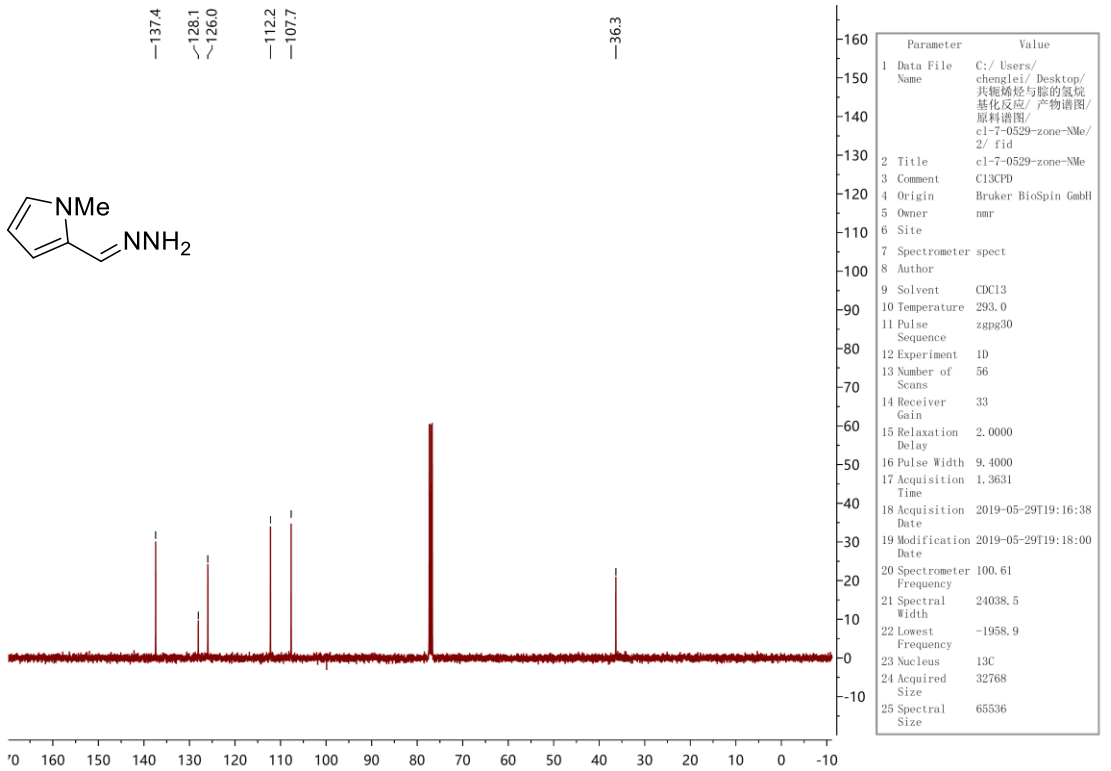
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与腙的氢烷基化反应/ 产物谱图/ 原料谱图/ cl-7-0529-zone-NMe/ 1/ fid
2	Title	cl-7-0529-zone-NMe
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	292.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	57
15	Relaxation Delay	1.0000
16	Pulse Width	9.1200
17	Acquisition Time	4.0894
18	Acquisition Date	2019-05-29T19:14:27
19	Modification Date	2019-05-29T19:14:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1549.4
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536



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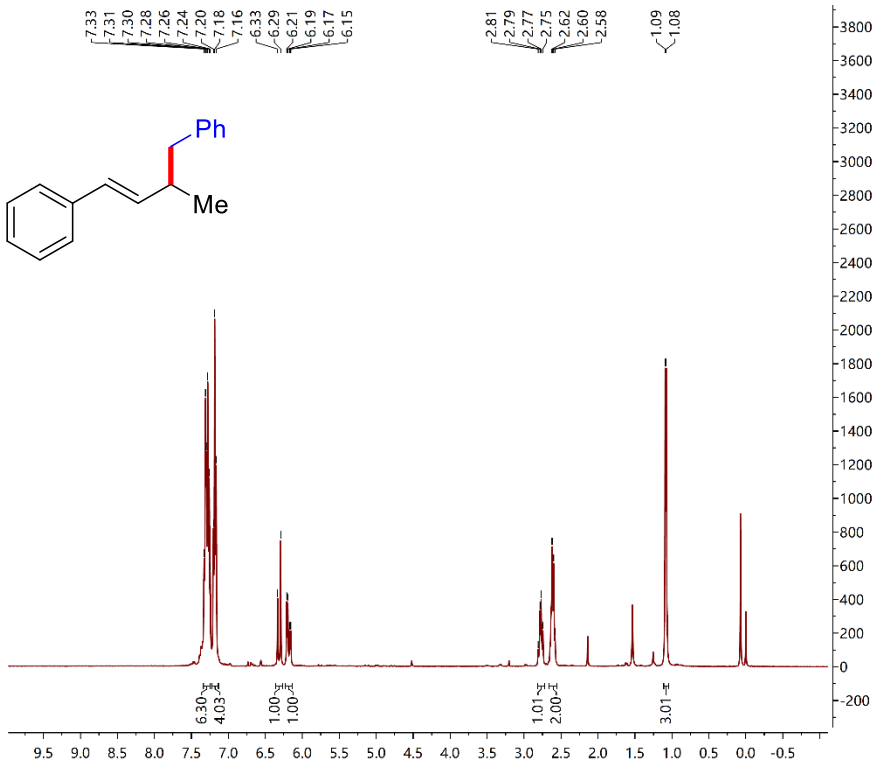
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与腙的氢烷基化反应/ 产物谱图/ 原料谱图/ cl-7-0529-zone-NMe/ 2/ fid
2	Title	cl-7-0529-zone-NMe
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.0
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	56
14	Receiver Gain	33
15	Relaxation Delay	2.0000
16	Pulse Width	9.4000
17	Acquisition Time	1.3631
18	Acquisition Date	2019-05-29T19:16:38
19	Modification Date	2019-05-29T19:18:00
20	Spectrometer Frequency	100.61
21	Spectral Width	24038.5
22	Lowest Frequency	-1958.9
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-(3-methylbut-1-ene-1,4-diyl)dibenzene (3a)



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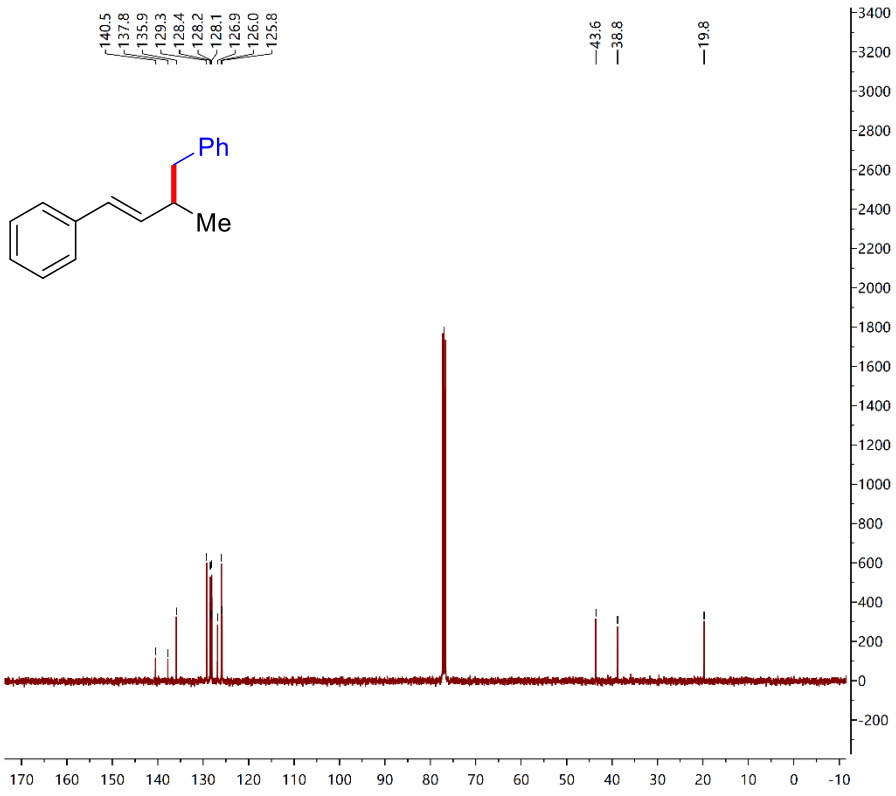
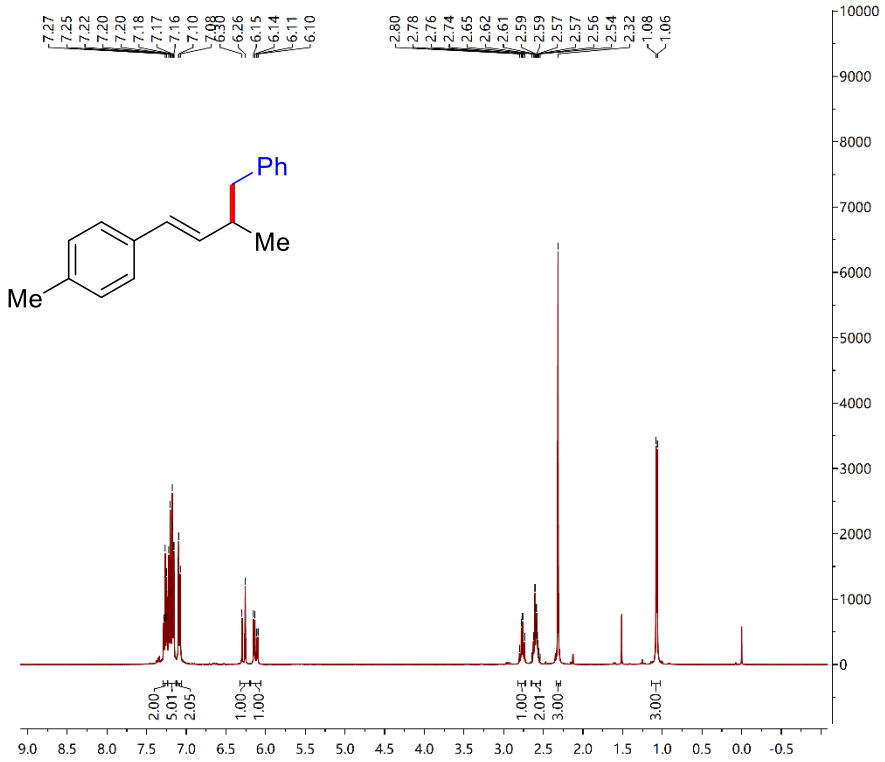
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 标准产物/ H/ fid
2	Title	cl-6-74-s
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-549.0
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	114
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	1.9923
18	Acquisition Date	2019-04-24T23:01:00
19	Modification Date	2019-04-24T23:01:00
20	Spectrometer Frequency	400.23
21	Spectral Width	8223.7
22	Lowest Frequency	-1640.3
23	Nucleus	1H
24	Acquired Size	16384
25	Spectral Size	32768

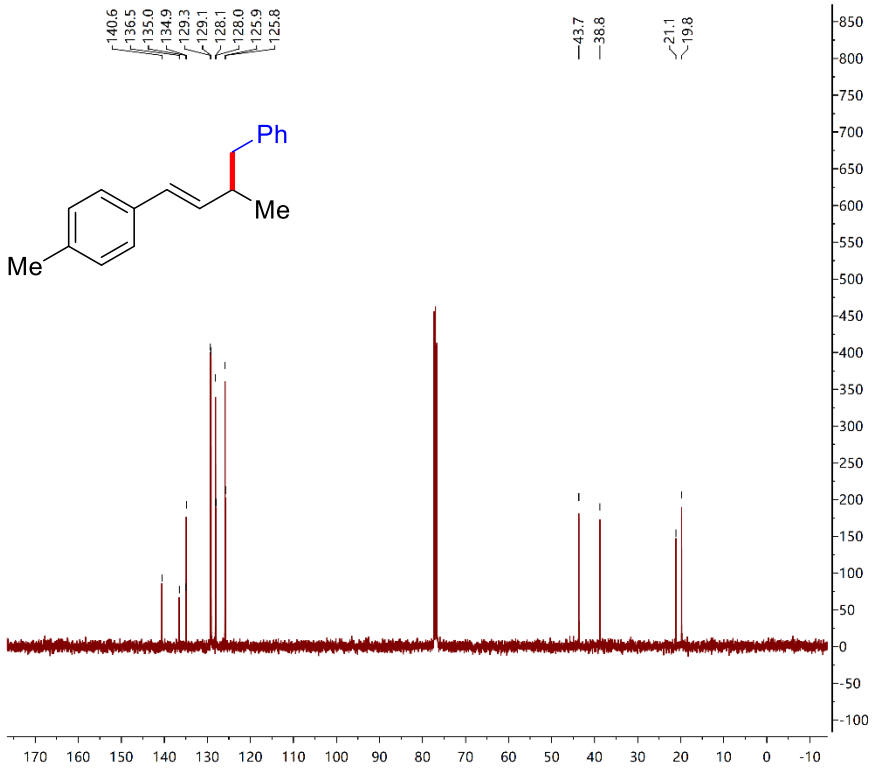


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 标准产物/ 2/ fid
2	Title	cl-6-7-PPh3-A
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-1030.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	331
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.5506
18	Acquisition Date	2018-11-28T17:07:00
19	Modification Date	2018-11-28T17:16:00
20	Spectrometer Frequency	100.64
21	Spectral Width	29761.9
22	Lowest Frequency	-4817.6
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-1-methyl-4-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3b)

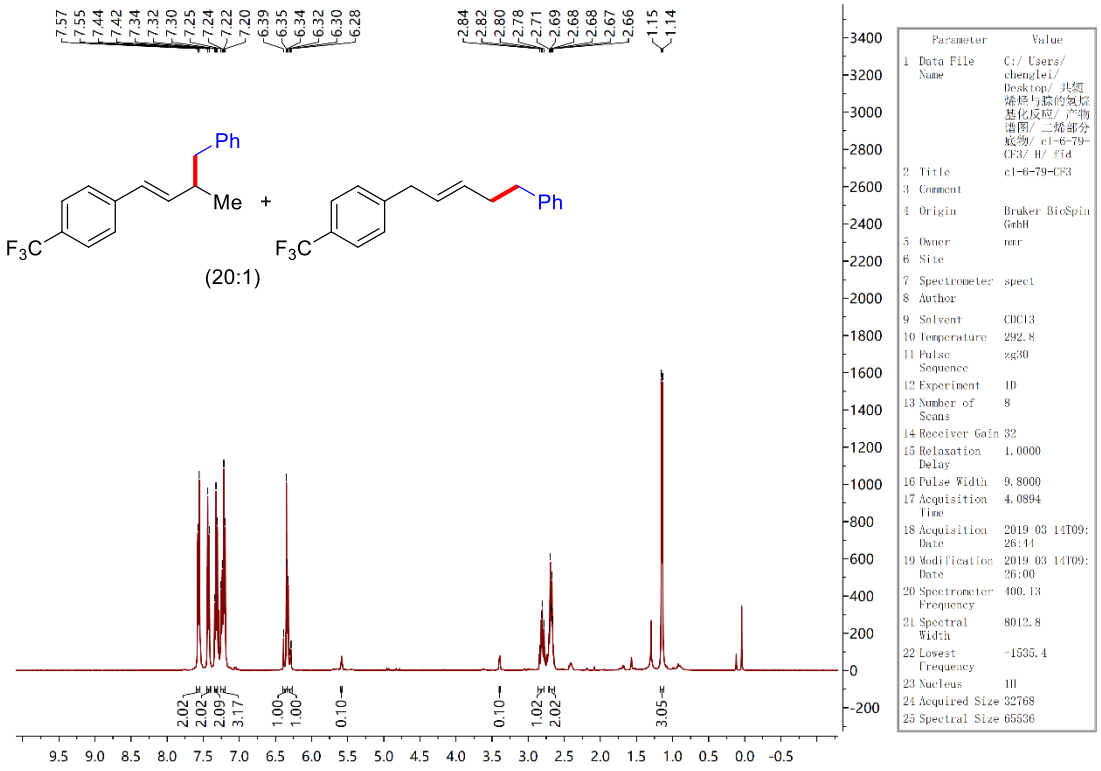


	Parameter	Value
1	Data File Name	Z:/ Data/ NMR/ 2019-04/ cl-6-p-Me-diene-0430/ 1/ fid
2	Title	cl 6 p Me diene 0430
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.5
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	111
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019 04 30T22 :27:13
19	Modification Date	2019-04-30T22 :27:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1529.1
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536

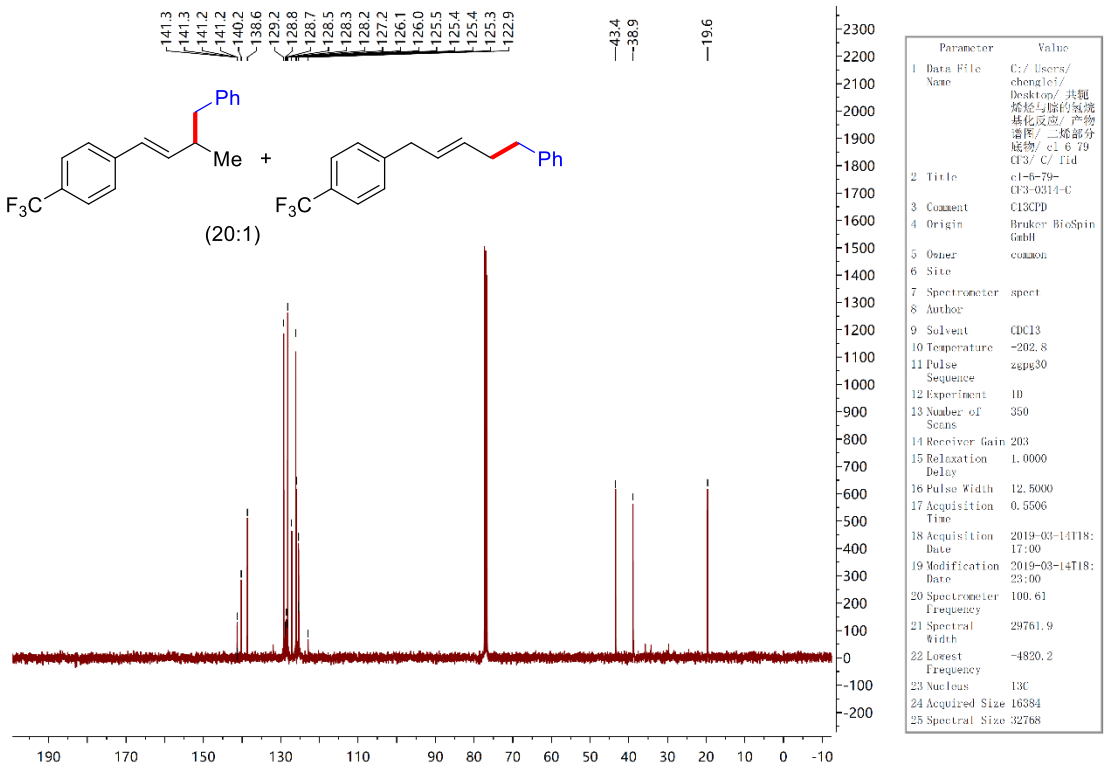


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烯的氢锆盐化反应/ 产物谱图/ 一通用分类物/ cl-6-73-p-Me/ 2/ fid
2	Title	cl-6-73-p-Me
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	297.2
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	170
14	Receiver Gain	87
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-04-30T22 :30:02
19	Modification Date	2019 04 30T22 :32:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-1-(3-methyl-4-phenylbut-1-en-1-yl)-4-(trifluoromethyl)benzene (3f)

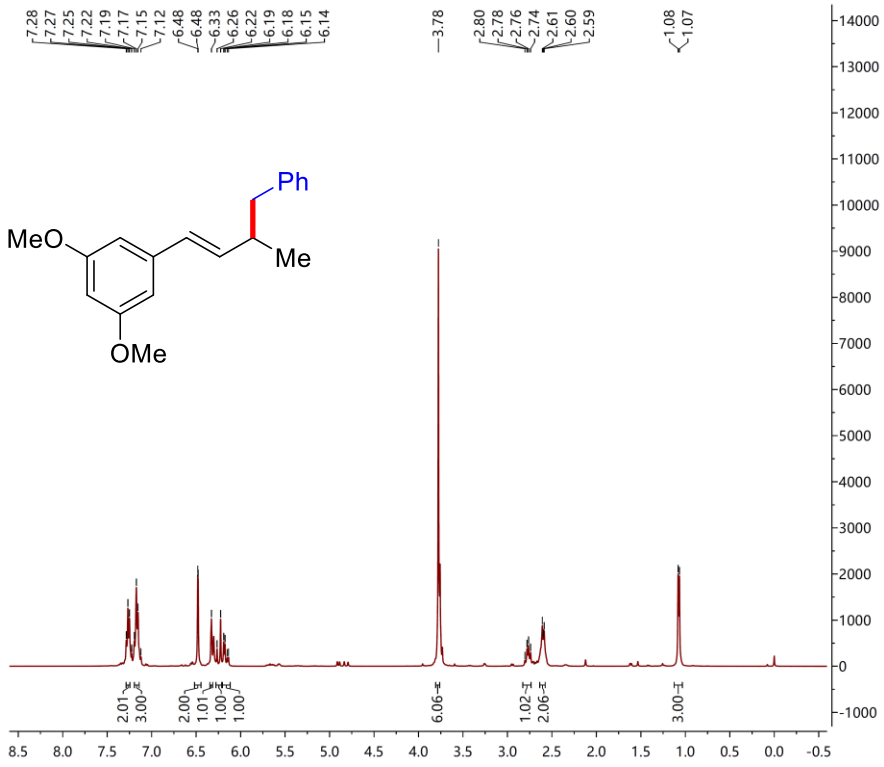


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烷的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-79-CF3/ H/ fid
2	Title	cl-6-79-CF3
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	292.8
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	32
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	4.0894
18	Acquisition Date	2019 03 14T09: 26:44
19	Modification Date	2019 03 14T09: 26:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

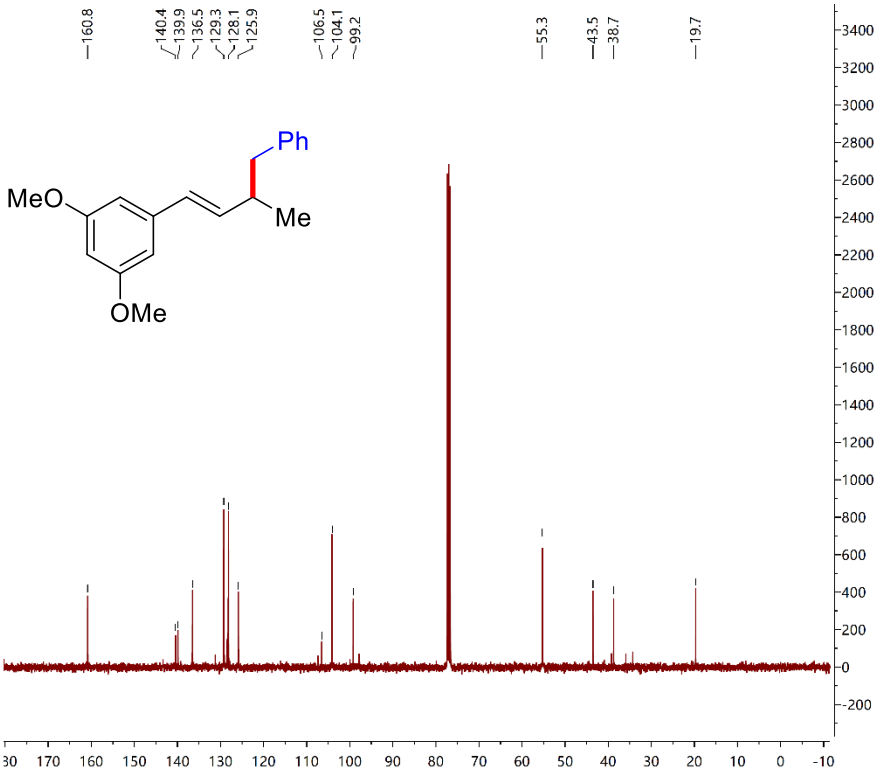


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烷的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl 6 79 CF3/ C/ fid
2	Title	cl-6-79-CF3-0314-C
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-202.8
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	350
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.5000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-03-14T18: 17:00
19	Modification Date	2019-03-14T18: 23:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.2
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-1,3-dimethoxy-5-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3g)

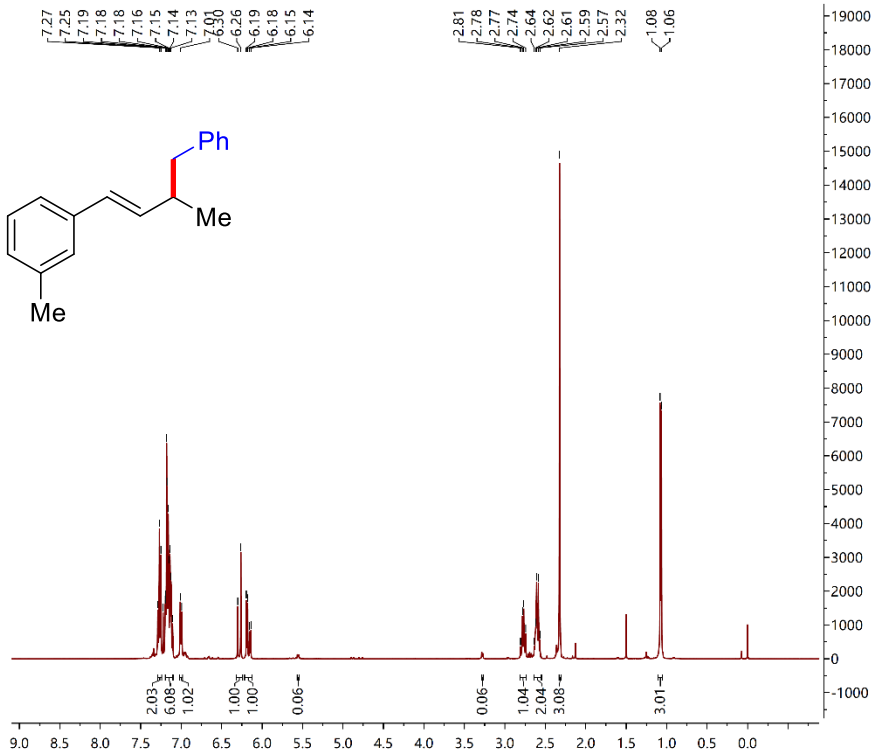


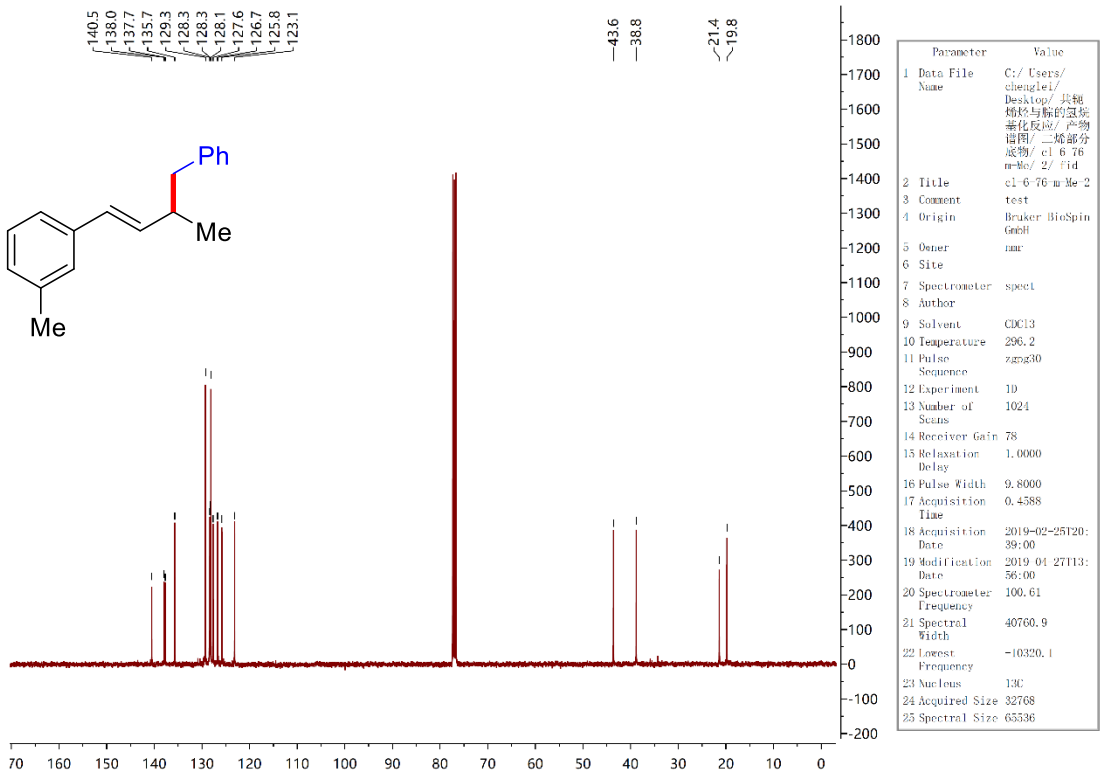
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氢烷基化反应/ 产物谱图/ 二烯部分底物/ c1-6-80-MeO/ 1/ fid
2	Title	c1-6-80-MeO
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	298.6
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	81
15	Relaxation Delay	1.0000
16	Pulse Width	13.7000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-02-19T21:48:00
19	Modification Date	2019-02-19T21:48:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	-1640.9
23	Nucleus	1H
24	Acquired Size	16446
25	Spectral Size	65536



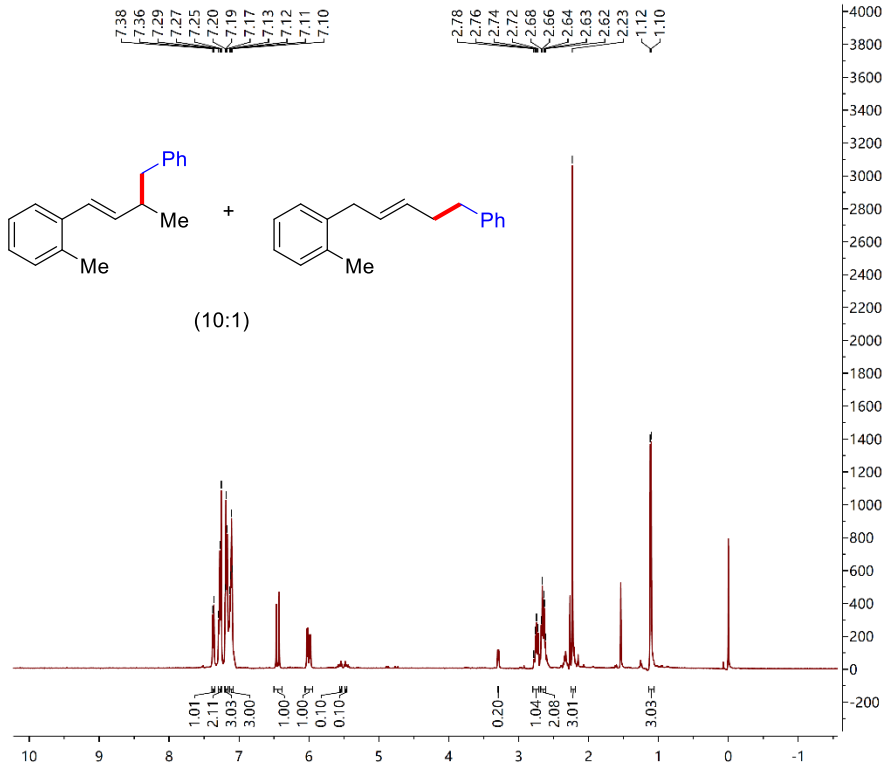
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氢烷基化反应/ 产物谱图/ 二烯部分底物/ c1-6-80-MeO/ C/ fid
2	Title	c1-6-80-MeO-0315
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	551.0
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	413
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-03-15T19:17:00
19	Modification Date	2019-03-15T19:24:00
20	Spectrometer Frequency	100.64
21	Spectral Width	29761.9
22	Lowest Frequency	-4817.6
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-1-methyl-3-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3h)

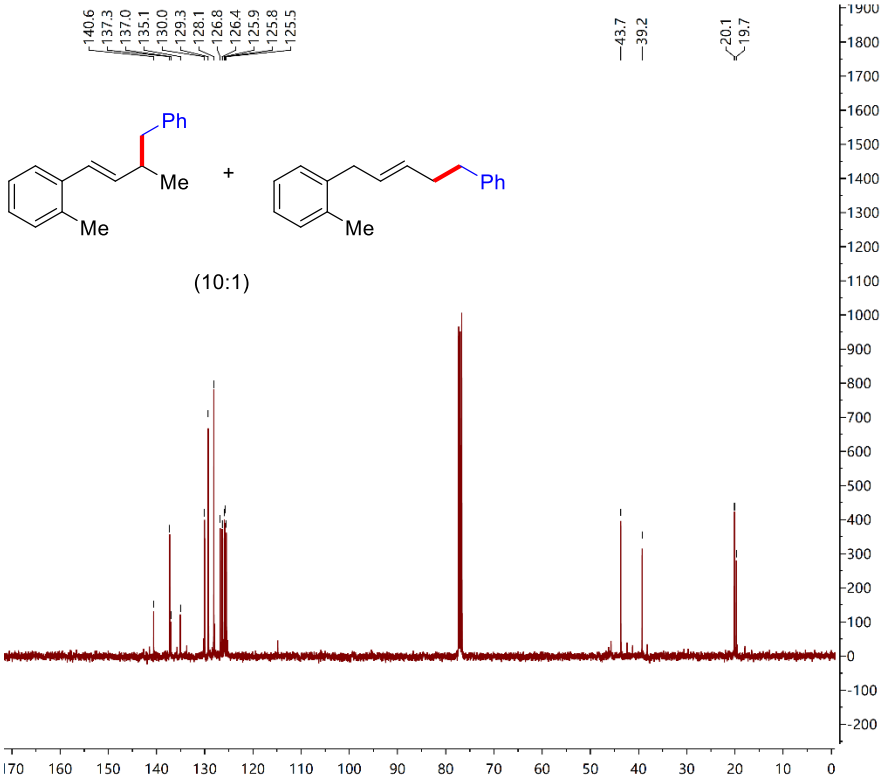




(*E*)-1-methyl-2-(3-methyl-4-phenylbut-1-en-1-yl)benzene (3i)

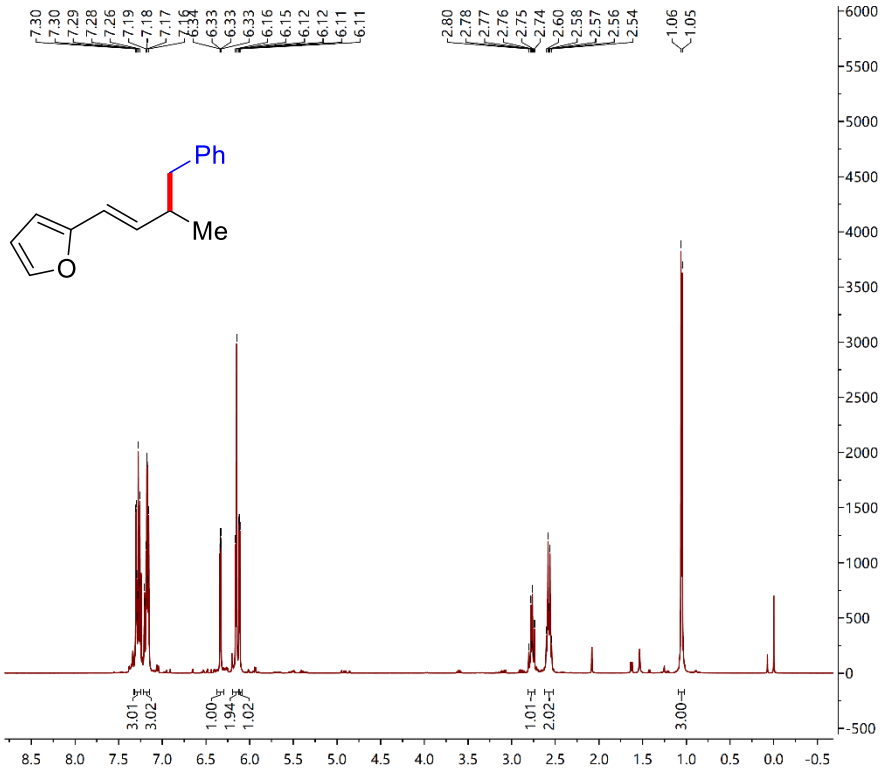


Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与脒的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl 6 76 0-Me/ H/ fid
2 Title	cl-6-76-o-Me-0319
3 Comment	PROTON
4 Origin	Bruker BioSpin GmbH
5 Owner	common
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	636.6
11 Pulse Sequence	zg30
12 Experiment	1D
13 Number of Scans	8
14 Receiver Gain	144
15 Relaxation Delay	1.0000
16 Pulse Width	13.5000
17 Acquisition Time	1.9923
18 Acquisition Date	2019-03-19T19:01:00
19 Modification Date	2019-03-19T19:01:00
20 Spectrometer Frequency	400.23
21 Spectral Width	8223.7
22 Lowest Frequency	-1640.3
23 Nucleus	1H
24 Acquired Size	16384
25 Spectral Size	32768

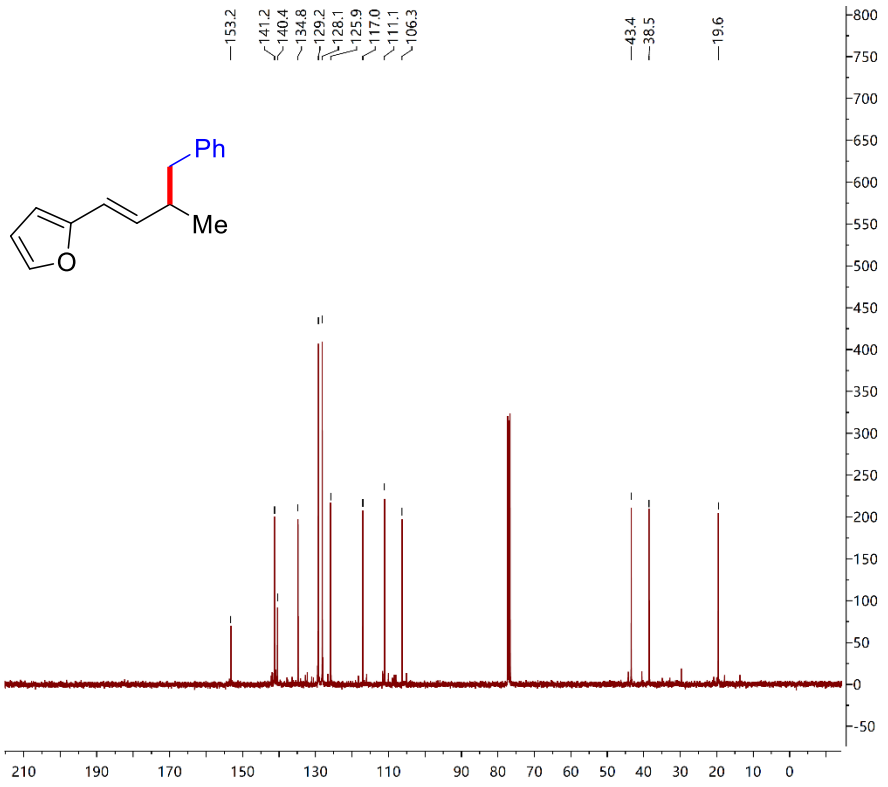


Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与脒的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl 6 76 0 Me/ 2/ fid
2 Title	cl 6 76 0 Me
3 Comment	C13CPD
4 Origin	Bruker BioSpin GmbH
5 Owner	nmr
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	297.0
11 Pulse Sequence	zgpg30
12 Experiment	1D
13 Number of Scans	485
14 Receiver Gain	77
15 Relaxation Delay	1.0000
16 Pulse Width	9.8000
17 Acquisition Time	0.4588
18 Acquisition Date	2019-02-25T20:49:52
19 Modification Date	2019-02-25T21:01:00
20 Spectrometer Frequency	100.61
21 Spectral Width	35714.3
22 Lowest Frequency	-7796.8
23 Nucleus	13C
24 Acquired Size	16384
25 Spectral Size	32768

(*E*)-2-(3-methyl-4-phenylbut-1-en-1-yl)furan (3j)

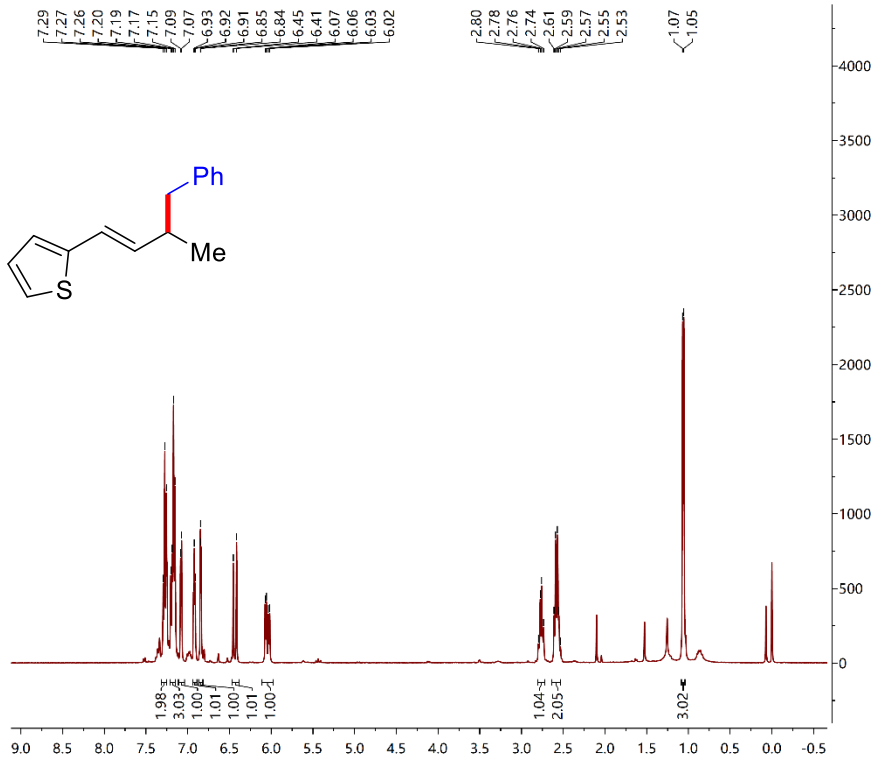


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氧硫基化反应/ 产物谱图/ 二烯部分底物/ cl-6-79-Furan/ 1/ fid
2	Title	cl-6-79-Furan
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	292.8
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	50
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	4.0894
18	Acquisition Date	2019-04-11T22:49:04
19	Modification Date	2019 04 11T22:49:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	1535.4
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

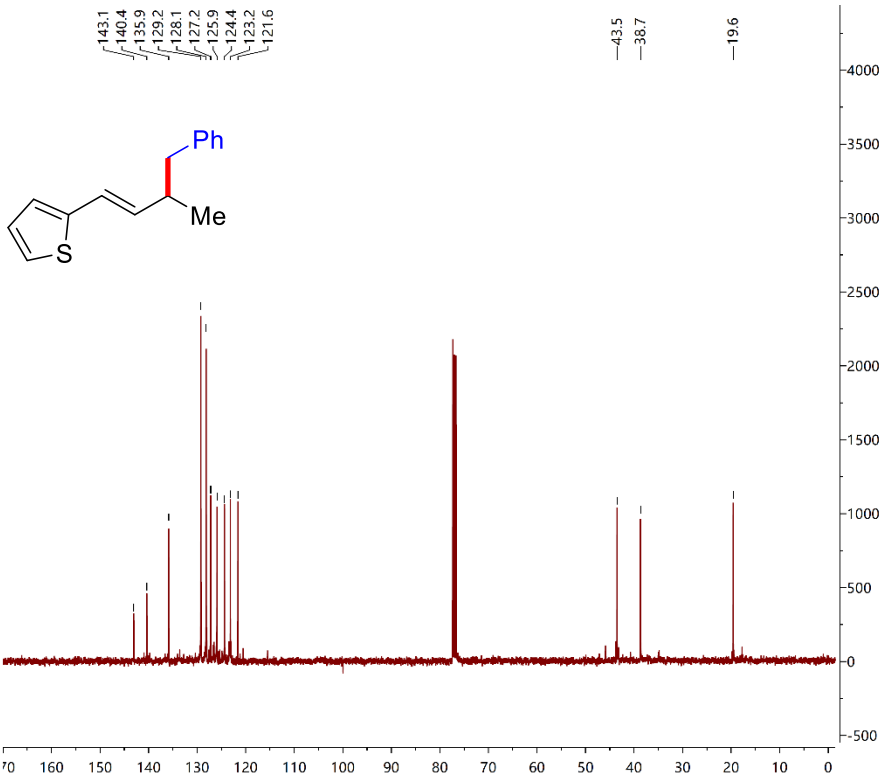


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氧硫基化反应/ 产物谱图/ 二烯部分底物/ cl-6-79-Furan/ 2/ fid
2	Title	cl-6-79-Furan
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	234
14	Receiver Gain	55
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.8039
18	Acquisition Date	2019 02 18T16:48:12
19	Modification Date	2019 02 18T16:54:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-10320.1
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-2-(3-methyl-4-phenylbut-1-en-1-yl)thiophene (3k)

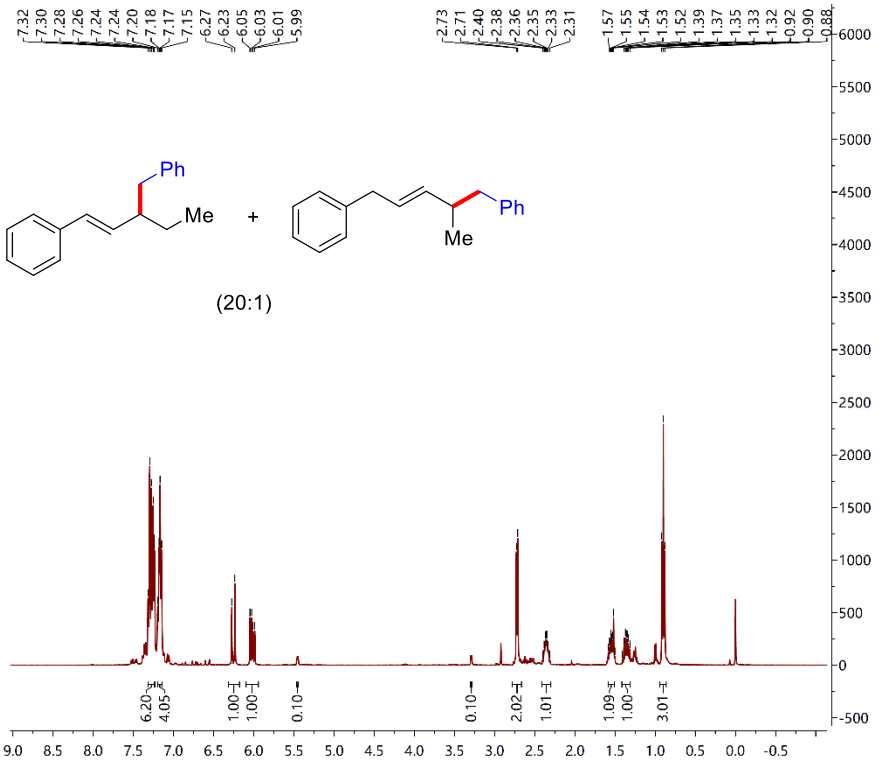


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-84-thio/ 1/ fid
2	Title	cl-6-84-thio 0314
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.2
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	13.7000
17	Acquisition Time	1.9999
18	Acquisition Date	2019 03 14T10: 14:00
19	Modification Date	2019 03 14T10: 14:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	1655.8
23	Nucleus	1H
24	Acquired Size	16446
25	Spectral Size	65536

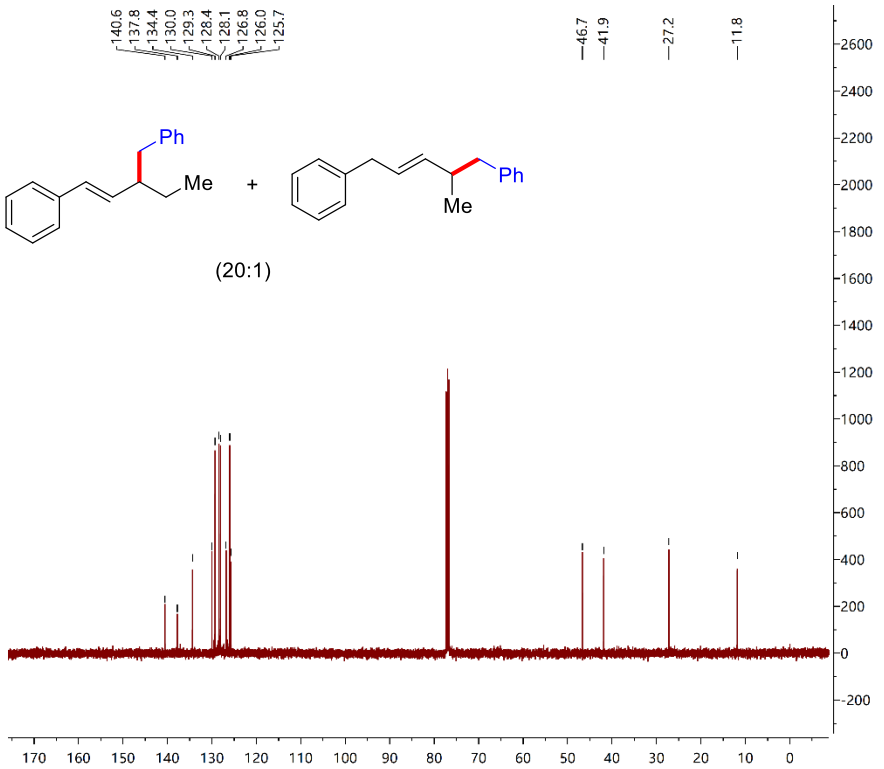


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与硫酚氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl 6 84 thio/ 2/ fid
2	Title	cl 6 84 thio 2
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	302.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	440
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.4588
18	Acquisition Date	2019 02 24T21: 00:00
19	Modification Date	2019 02 24T21: 07:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7795.9
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-(3-ethylbut-1-ene-1,4-diyl)dibenzene (3l)

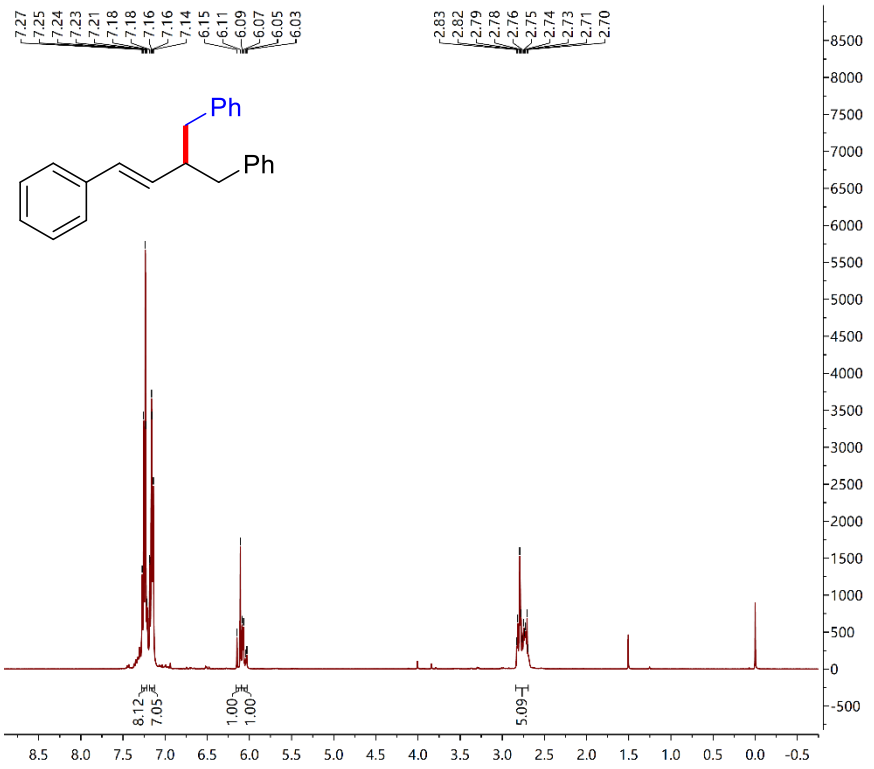


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-75-Me/ 1/ fid
2	Title	cl-6-75-Me
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.2
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	119
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019 03 14T09: 56:08
19	Modification Date	2019 03 14T09: 56:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	1574.7
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536

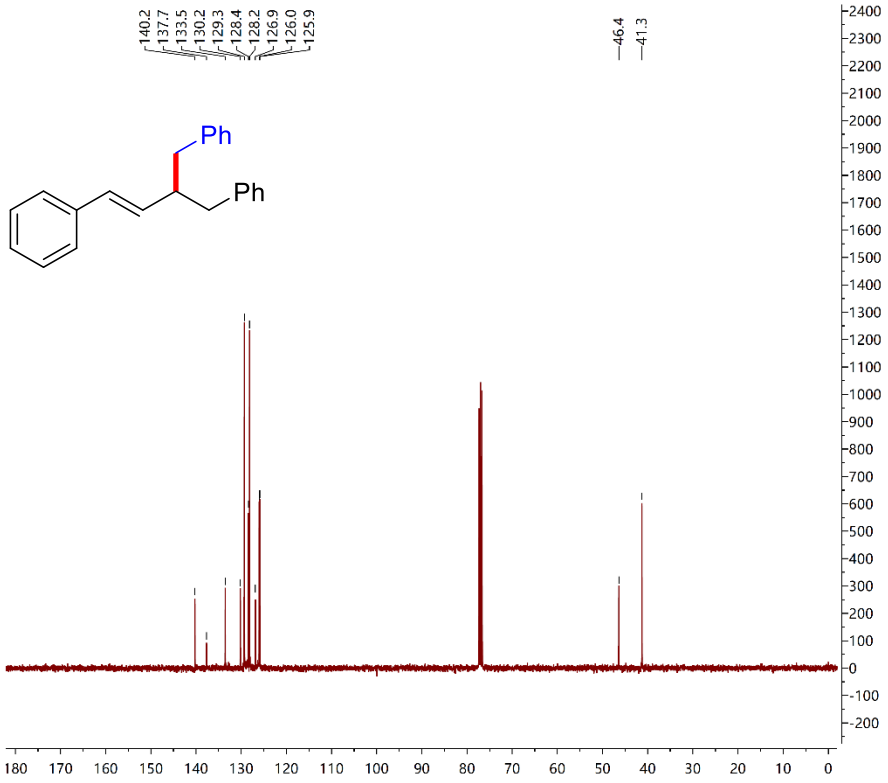


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-75-Me/ c/ fid
2	Title	cl 6 75 Me
3	Comment	13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	241
14	Receiver Gain	205
15	Relaxation Delay	1.0000
16	Pulse Width	9.3000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-03-14T18: 37:00
19	Modification Date	2019-03-14T18: 43:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-15349.8
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-(3-benzylbut-1-ene-1,4-diyl)dibenzene (3m)

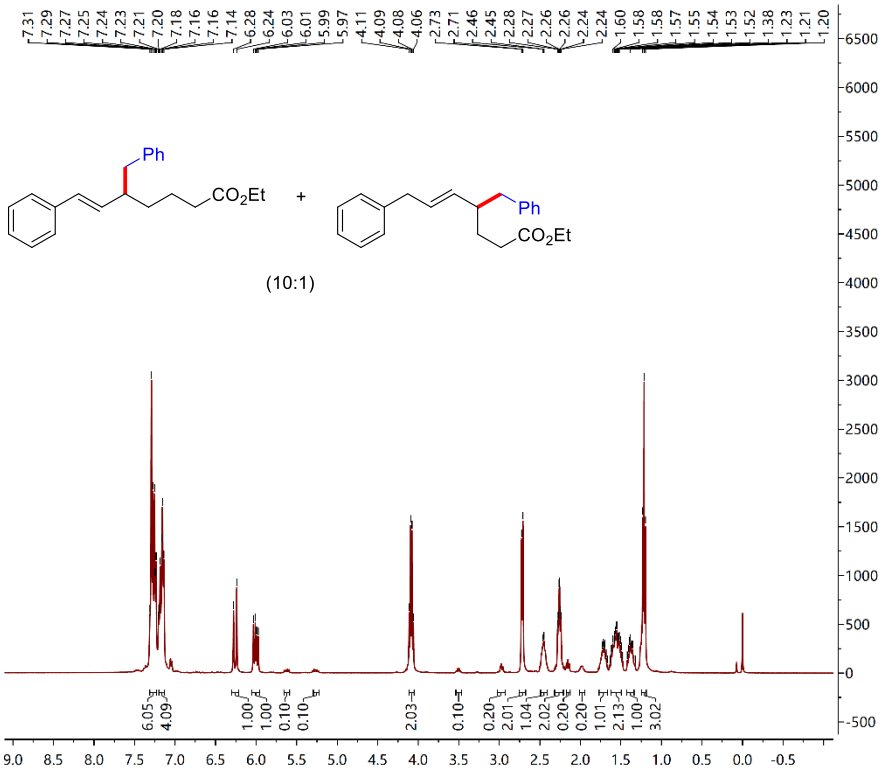


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烷的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl 6 79 Ph-Ph/ 1/ fid
2	Title	cl 6 79 Ph-Ph
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	119
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019-03-20T09: 04:20
19	Modification Date	2019-03-20T09: 04:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1552.9
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536

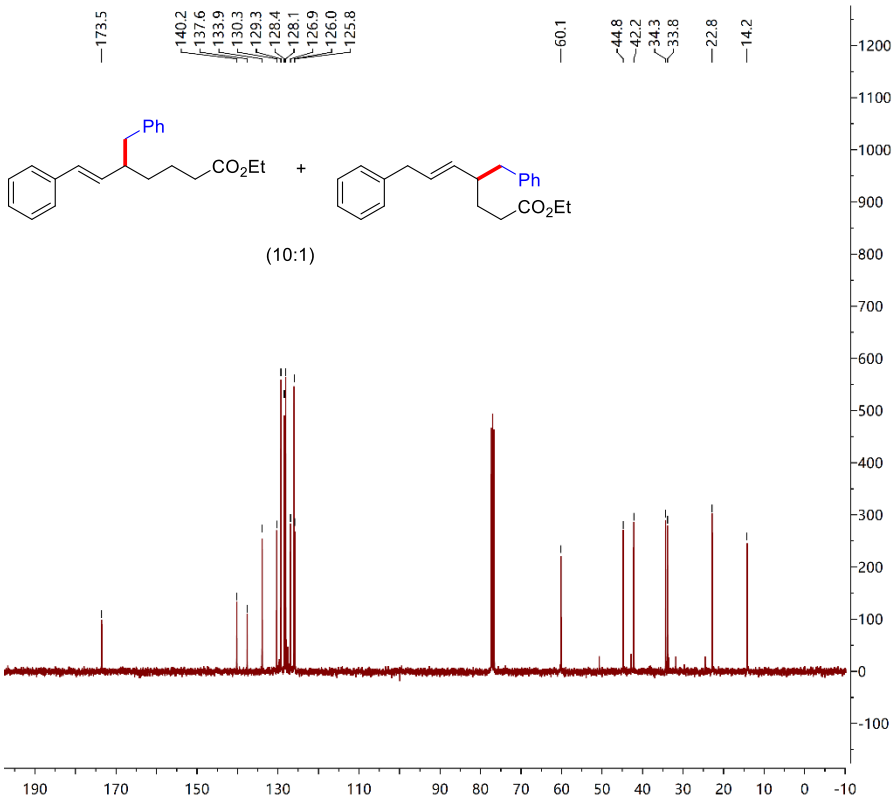


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烷的氧烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-79-Ph-Ph/ 2/ fid
2	Title	cl-6-79-Ph-Ph
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	331
14	Receiver Gain	87
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019 03 20T09: 10:32
19	Modification Date	2019 03 20T09: 15:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

Ethyl (*E*)-5-benzyl-7-phenylhept-6-enoate (3n)

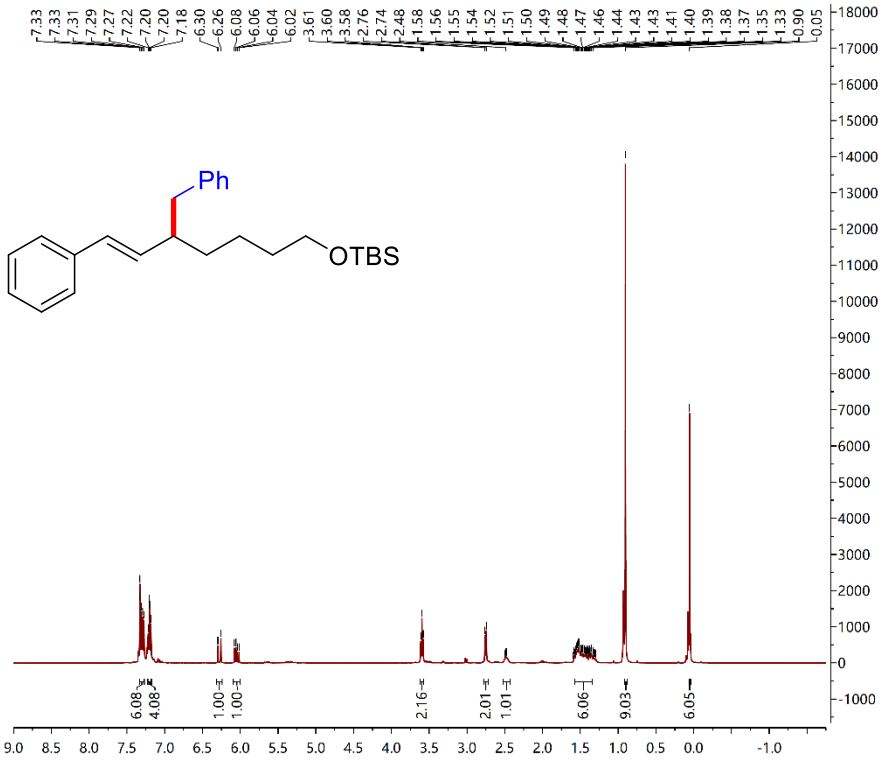


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-84-ester/ H/ fid
2	Title	cl 6 84 ester-3
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-552.4
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	114
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	1.9923
18	Acquisition Date	2019-02-25T14:24:00
19	Modification Date	2019-02-25T14:24:00
20	Spectrometer Frequency	400.23
21	Spectral Width	8223.7
22	Lowest Frequency	-1640.3
23	Nucleus	1H
24	Acquired Size	16384
25	Spectral Size	32768

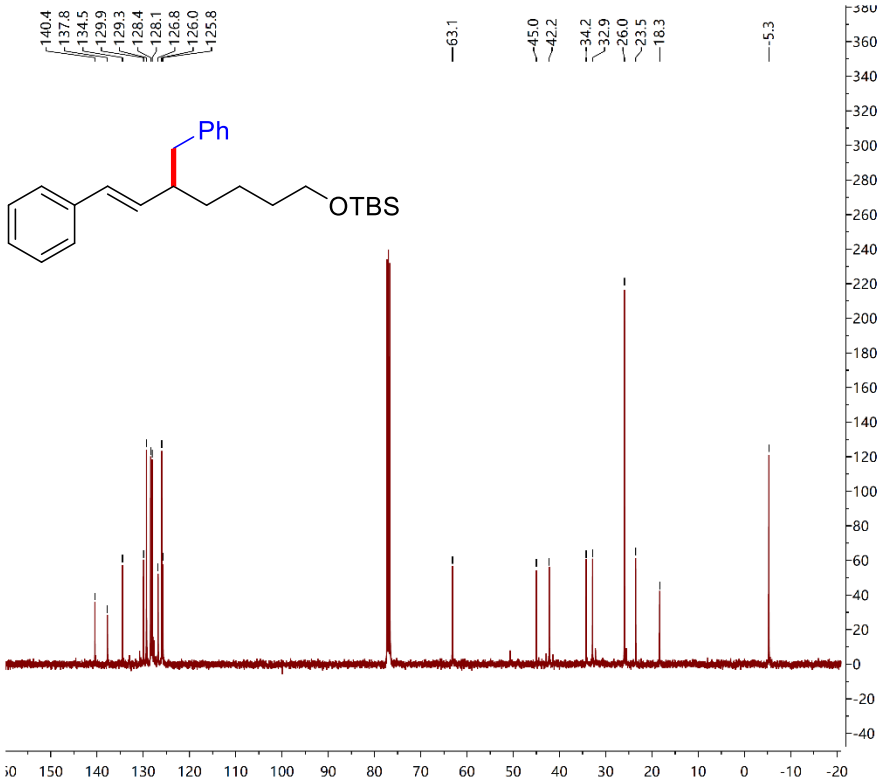


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-84-ester/ 2/ fid
2	Title	cl 6 84 ester
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	302.9
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	379
14	Receiver Gain	51
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-02-24T20:58:31
19	Modification Date	2019-02-24T21:06:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-((5-benzyl-7-phenylhept-6-en-1-yl)oxy)(tert-butyl)dimethylsilane (3o)

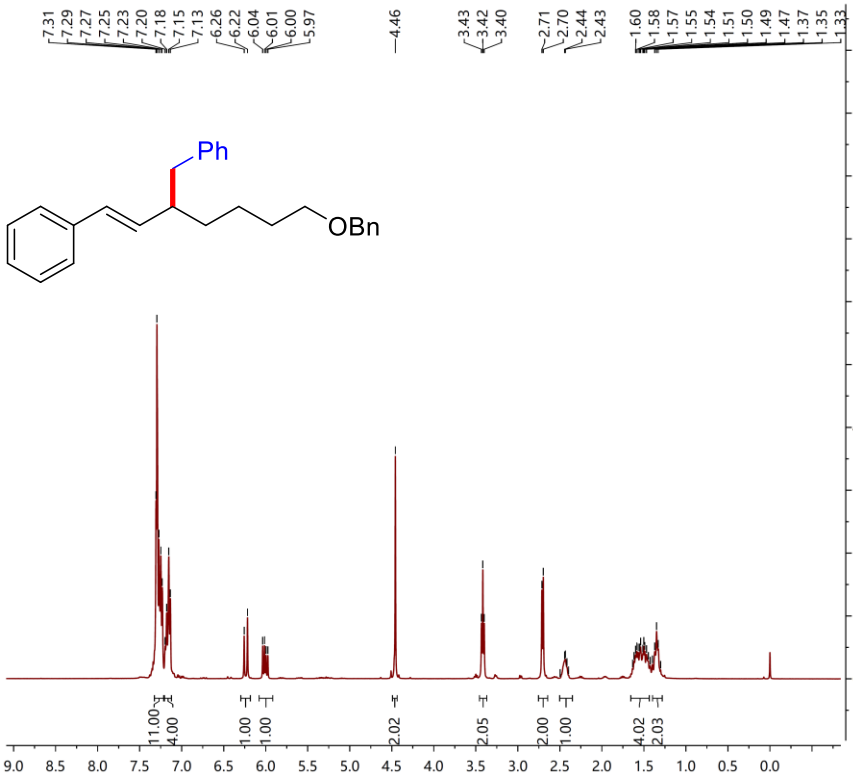


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氧烷基化反应/ 产物谱图/ 二烯部分底物/ c1-6-85-OTBS/ H/ fid
2	Title	c1-6-85-OTBS
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	292.9
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	32
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	4.0894
18	Acquisition Date	2019-03-11T19:05:43
19	Modification Date	2019-03-11T19:06:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1561.0
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

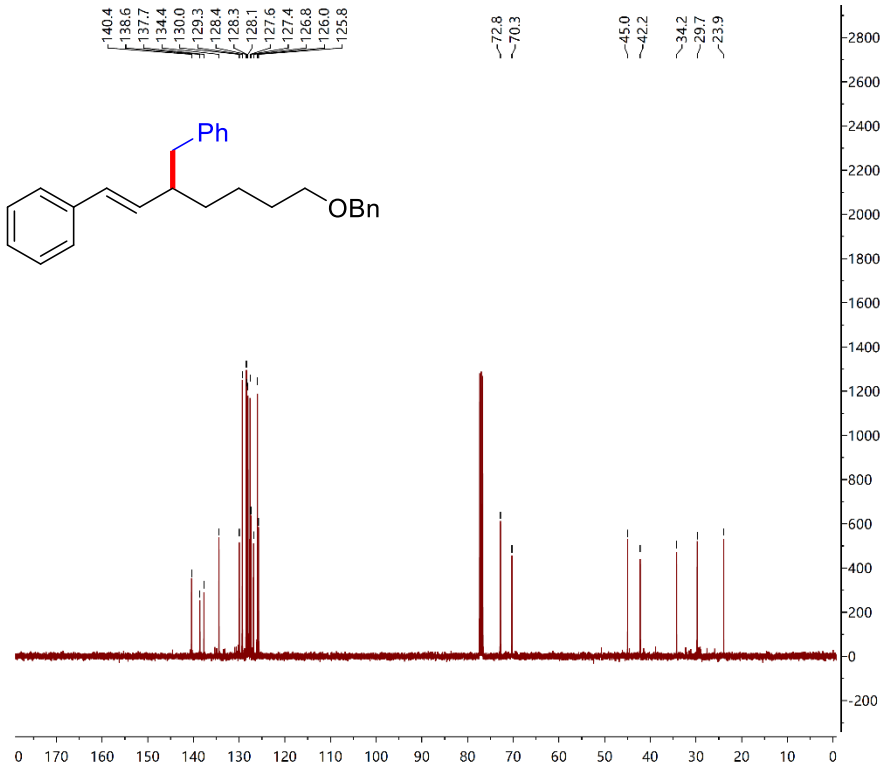


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氧烷基化反应/ 产物谱图/ 二烯部分底物/ c1-6-85-OTBS/ 2/ fid
2	Title	c1-6-85-OTBS
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.8
11	Pulse Sequence	zgdc30
12	Experiment	1D
13	Number of Scans	350
14	Receiver Gain	36
15	Relaxation Delay	1.0000
16	Pulse Width	9.4000
17	Acquisition Time	1.1010
18	Acquisition Date	2019-03-03T15:51:20
19	Modification Date	2019-03-03T16:03:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.6
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-(3-(4-(benzyloxy)butyl)but-1-ene-1,4-diyl)dibenzene (3p)

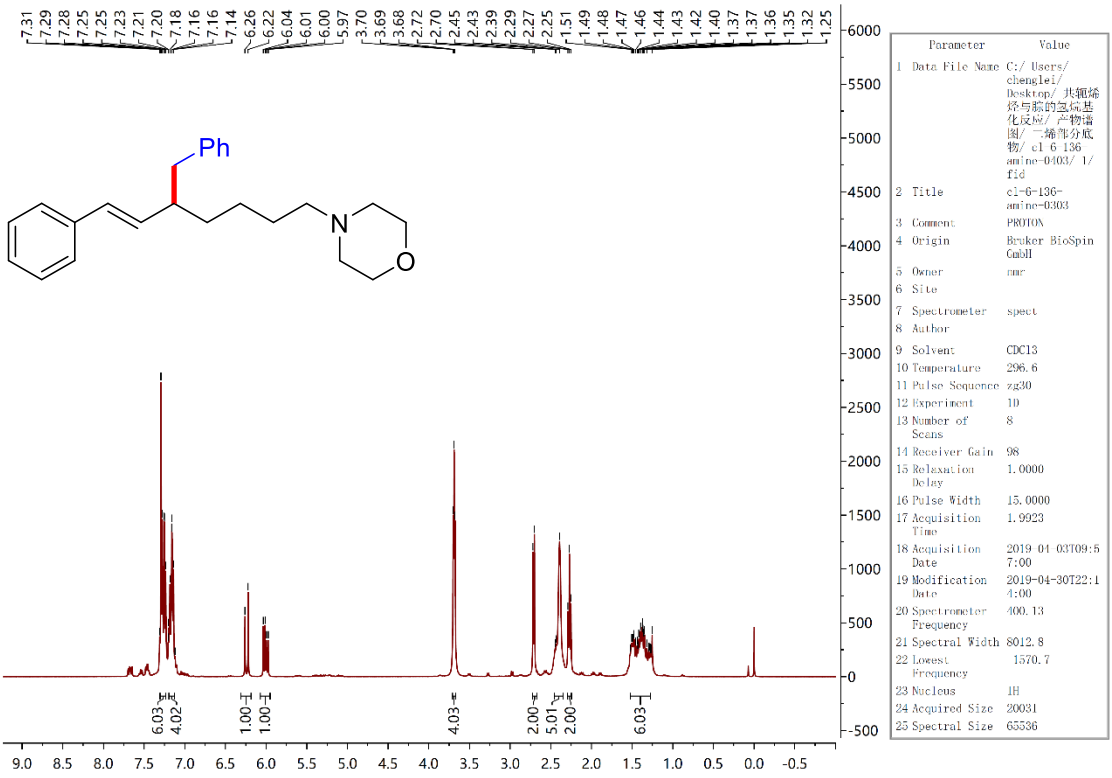


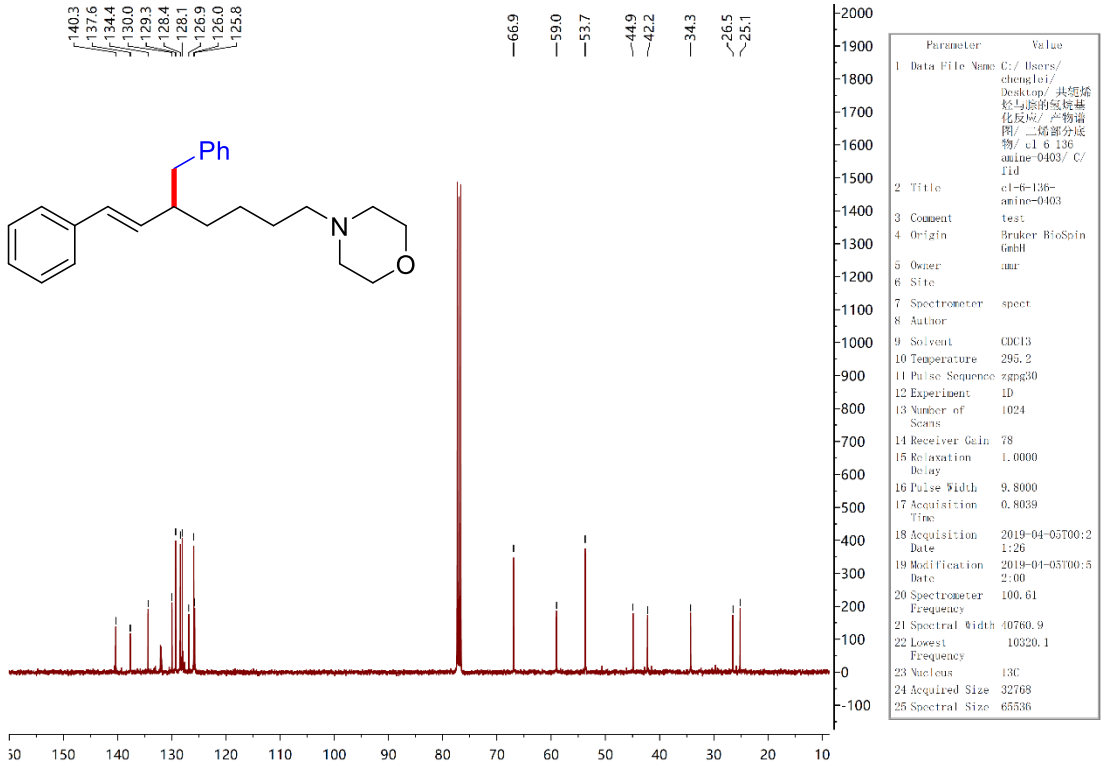
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氢烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-136-OBn-0403/ 1/ fid
2	Title	cl-6-136-OBn-0303
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-283.0
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	114
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	1.9923
18	Acquisition Date	2019-04-03T10:07:00
19	Modification Date	2019-04-03T10:07:00
20	Spectrometer Frequency	400.23
21	Spectral Width	8223.7
22	Lowest Frequency	-1663.1
23	Nucleus	1H
24	Acquired Size	16384
25	Spectral Size	32768



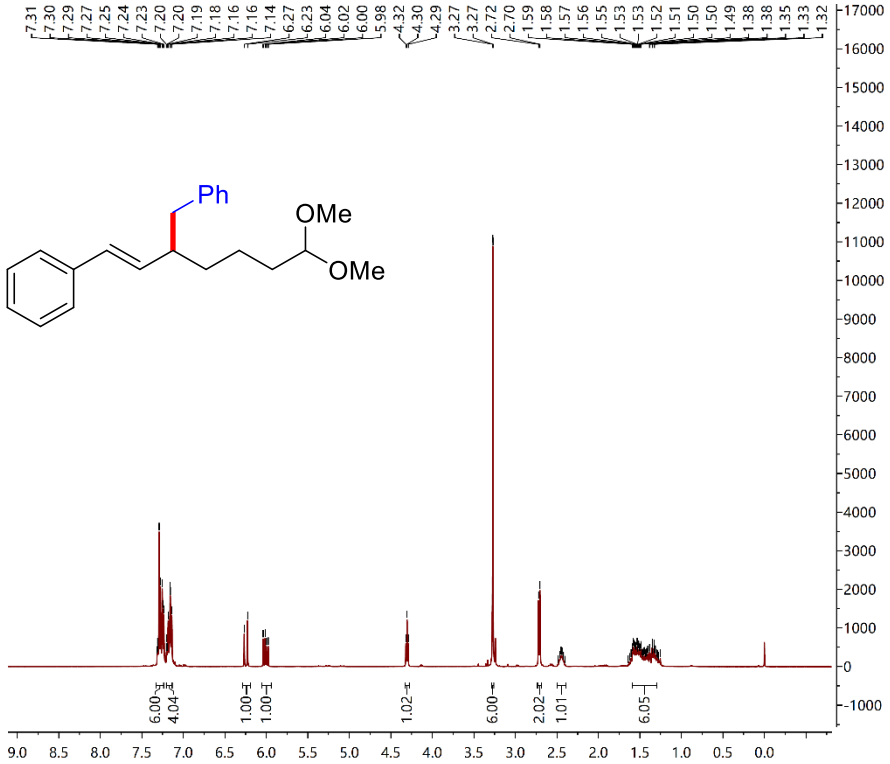
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氢烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-136-OBn-0403/ 2/ fid
2	Title	cl-6-136-OBn-0403
3	Comment	1D 13C with H decoupling
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	294.2
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	341
14	Receiver Gain	201
15	Relaxation Delay	1.0000
16	Pulse Width	10.0000
17	Acquisition Time	0.8999
18	Acquisition Date	2019-04-02T16:59:15
19	Modification Date	2019-04-02T16:59:00
20	Spectrometer Frequency	100.62
21	Spectral Width	29761.9
22	Lowest Frequency	3813.0
23	Nucleus	13C
24	Acquired Size	26784
25	Spectral Size	65536

(*E*)-4-(5-benzyl-7-phenylhept-6-en-1-yl)morpholine (3q)

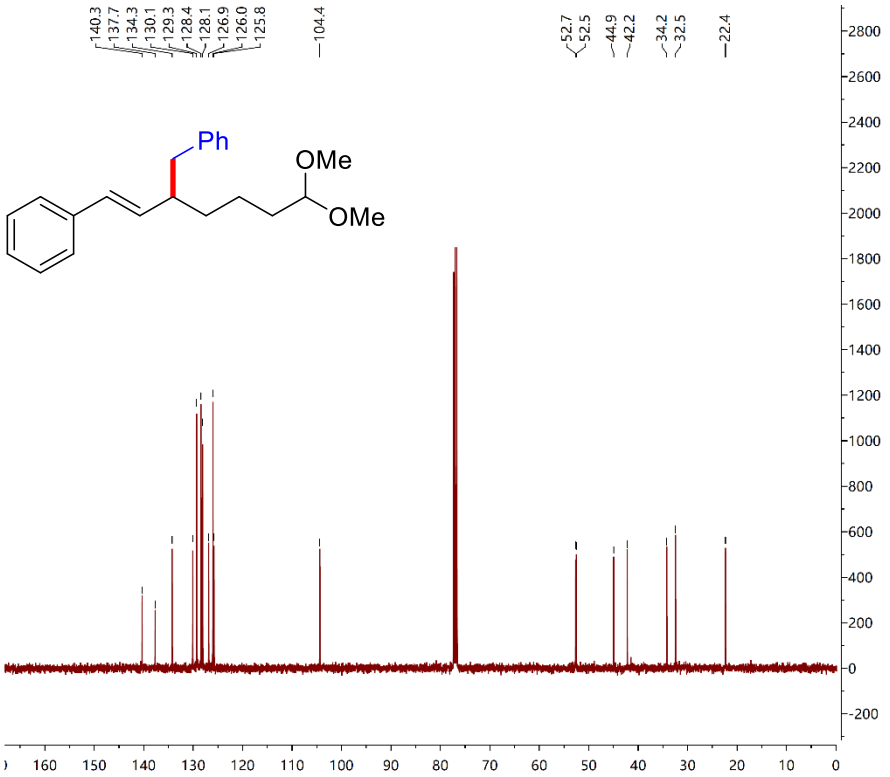




(*E*)-(3-(4,4-dimethoxybutyl)but-1-ene-1,4-diyl)dibenzene (3r)

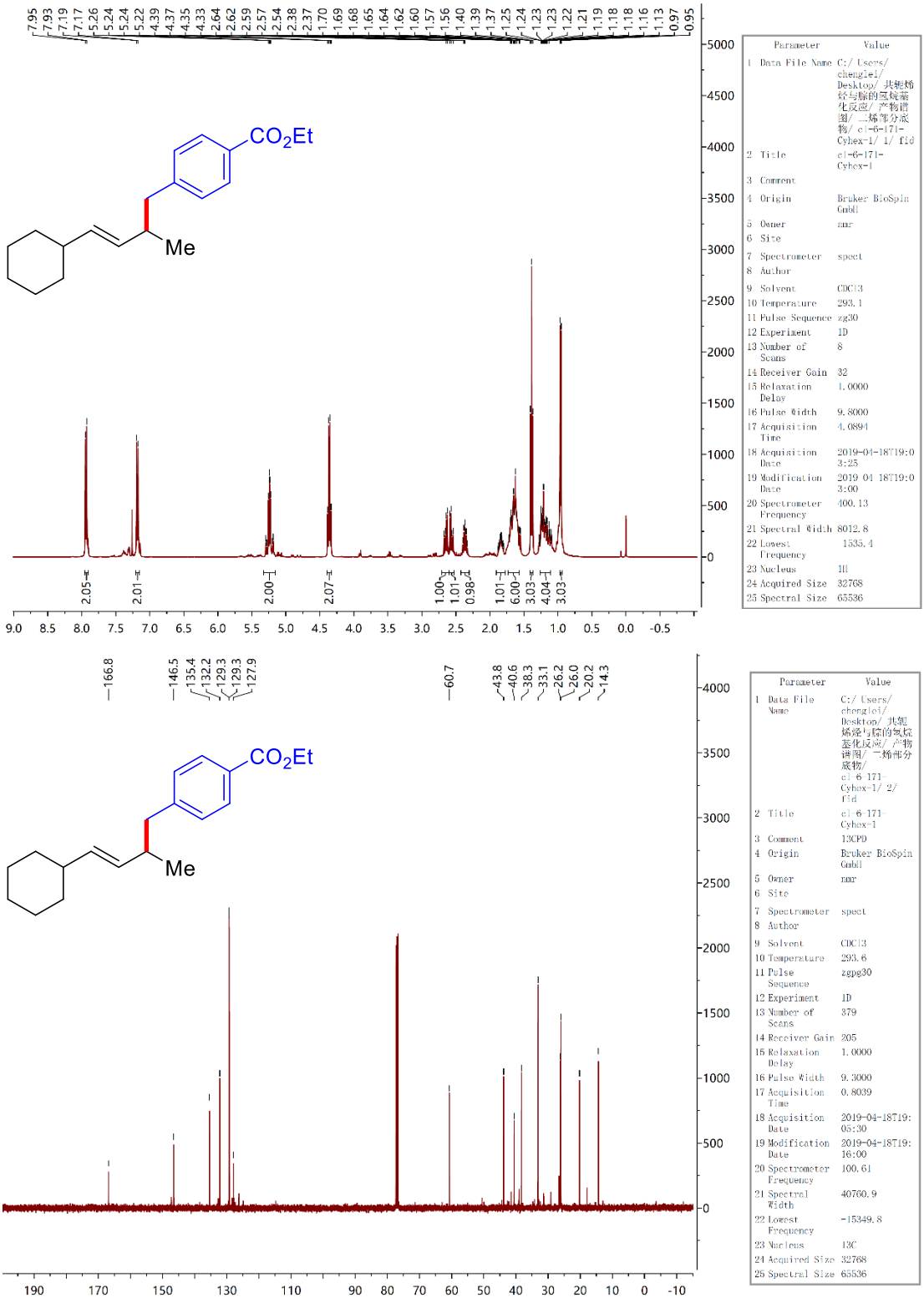


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烯的氢烷基化反应/ 产物谱图/ 二烯部分成物/ cl-6-136-OMe 0403/ 1/ fid
2	Title	cl 6 136 OMe-0303
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-2241.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	128
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	2.9999
18	Acquisition Date	2019-04-03T10:03:00
19	Modification Date	2019-04-03T10:03:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	-1656.1
23	Nucleus	1H
24	Acquired Size	24670
25	Spectral Size	65536

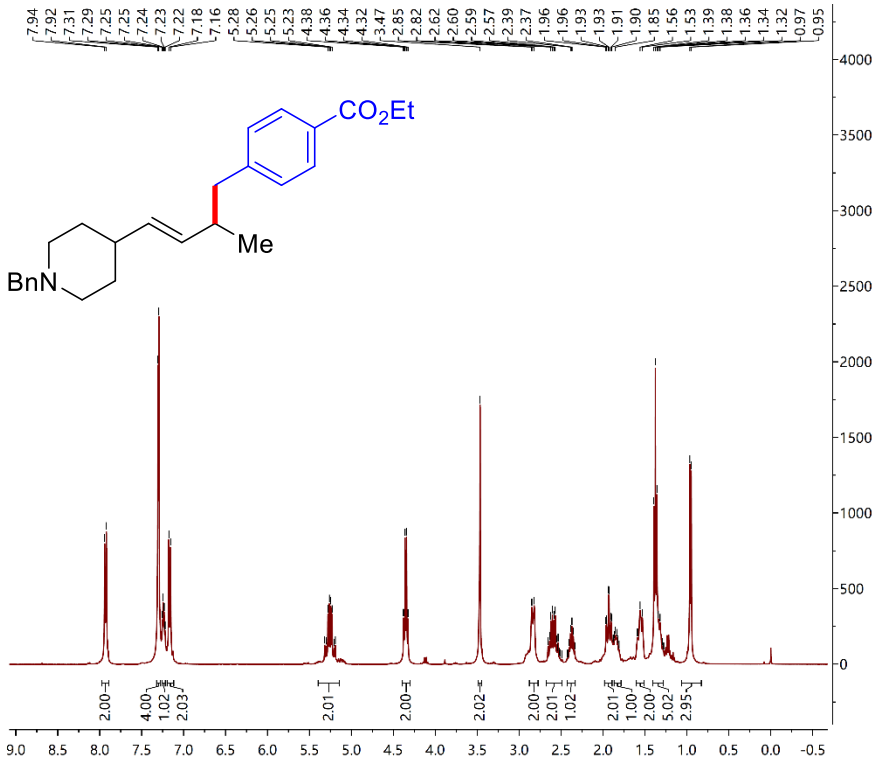


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与烯的氢烷基化反应/ 产物谱图/ 二烯部分成物/ cl-6-136-OMe-0403/ 3/ fid
2	Title	cl-6-136-OMe-0303
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	2493.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	399
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.5000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-04-03T10:08:00
19	Modification Date	2019-04-03T10:17:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.2
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

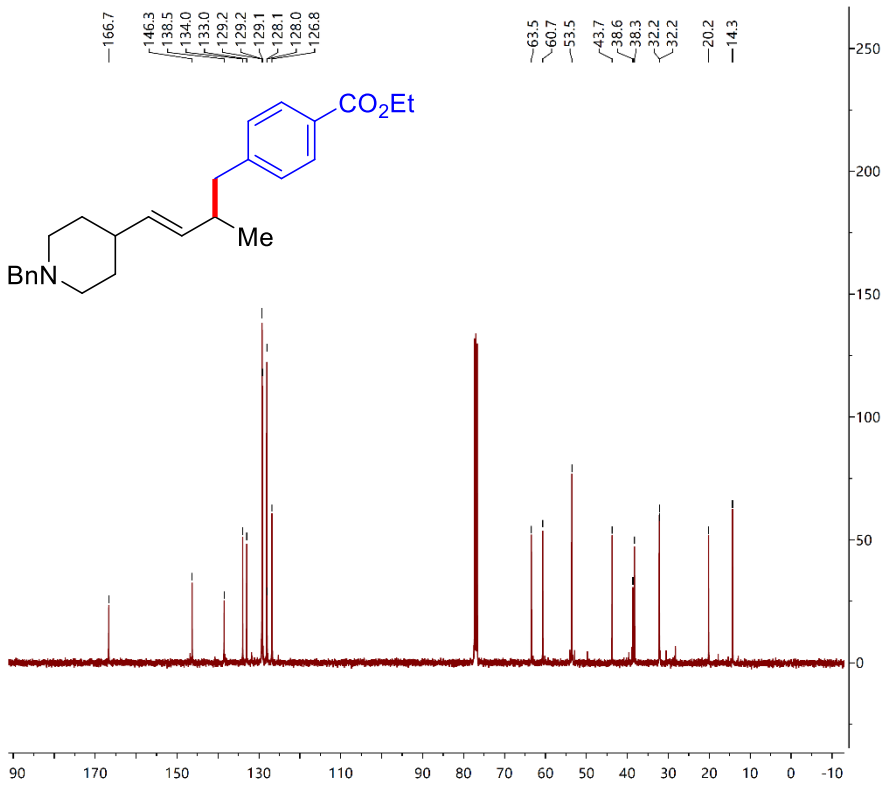
Ethyl (*E*)-4-(4-cyclohexyl-2-methylbut-3-en-1-yl)benzoate (3s)



Ethyl (*E*)-4-(4-(1-benzylpiperidin-4-yl)-2-methylbut-3-en-1-yl)benzoate (3t)

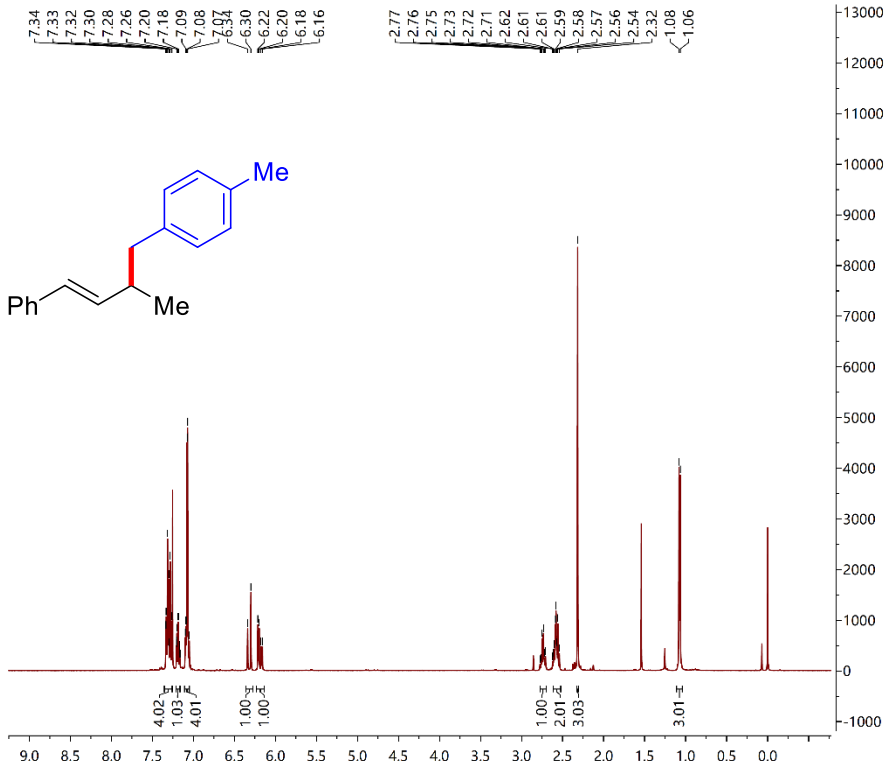


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 二烯部分底物/ cl-6-184-NBn/ 1/ fid
2	Title	cl-6-184-NBn
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	294.4
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	29
15	Relaxation Delay	1.0000
16	Pulse Width	9.1200
17	Acquisition Time	4.0894
18	Acquisition Date	2019-04-24T23:16:41
19	Modification Date	2019-04-24T23:17:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1550.8
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

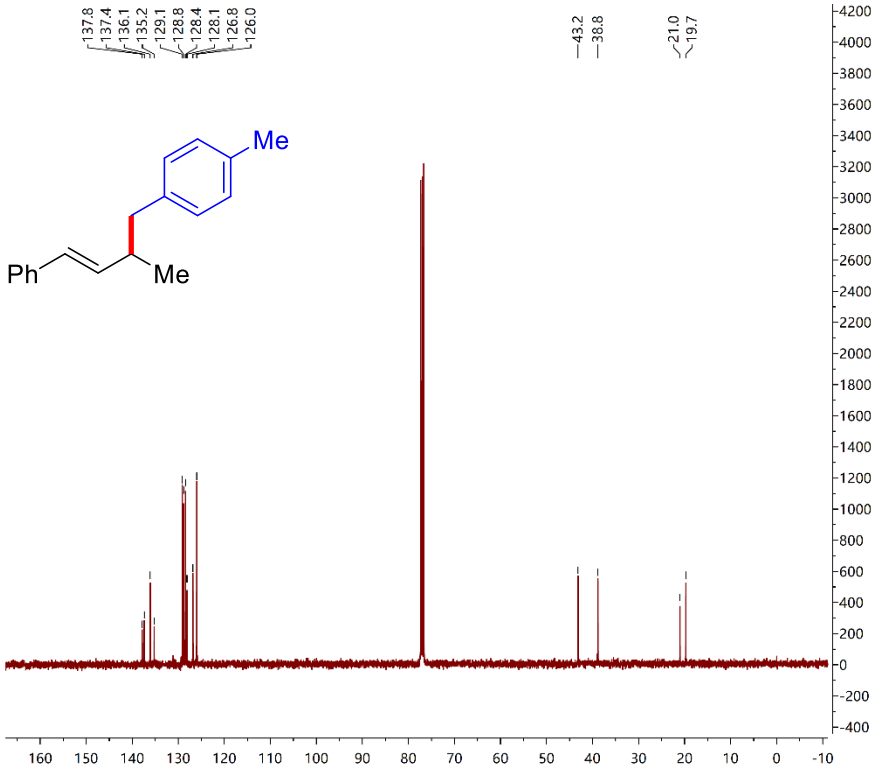


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 二烯部分底物/ cl 6 184 NBn/ 2/ fid
2	Title	cl 6 184 NBn
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	294.8
11	Pulse Sequence	zgdc30
12	Experiment	1D
13	Number of Scans	370
14	Receiver Gain	27
15	Relaxation Delay	1.0000
16	Pulse Width	9.4000
17	Acquisition Time	1.1010
18	Acquisition Date	2019-04-24T23:19:20
19	Modification Date	2019-04-24T23:31:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.6
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-1-methyl-4-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4a)

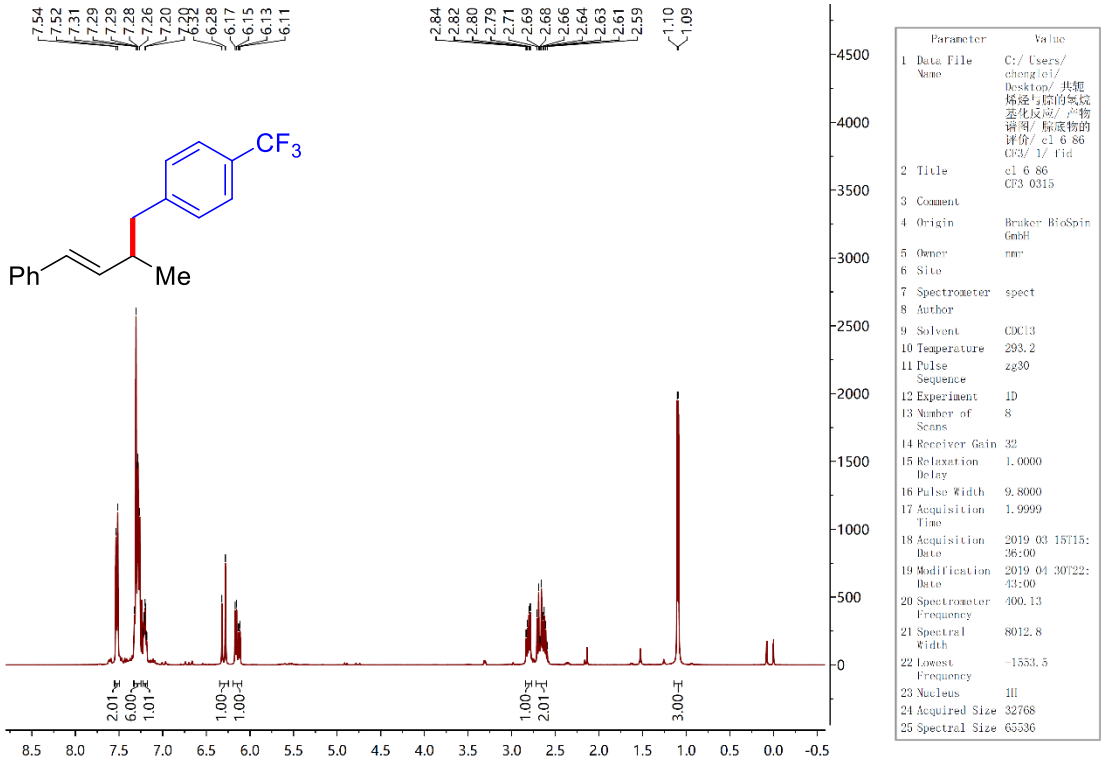


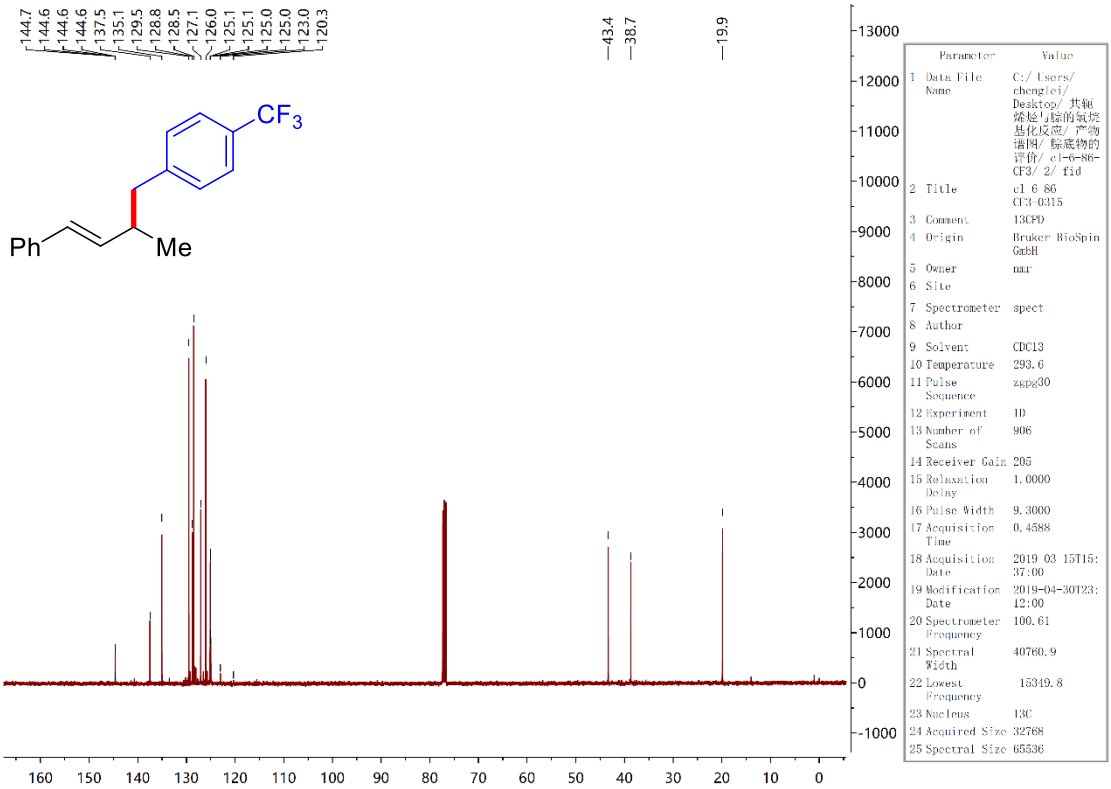
	Parameter	Value
1	Data File Name	Z:/ Data/ NMR/ 2019-04/ cl 6 p Me zone-re-0430/ 1/ fid
2	Title	cl-6-p-Me-zone-re-0430
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.9
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	194
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-04-30T22:20:00
19	Modification Date	2019-04-30T22:20:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768



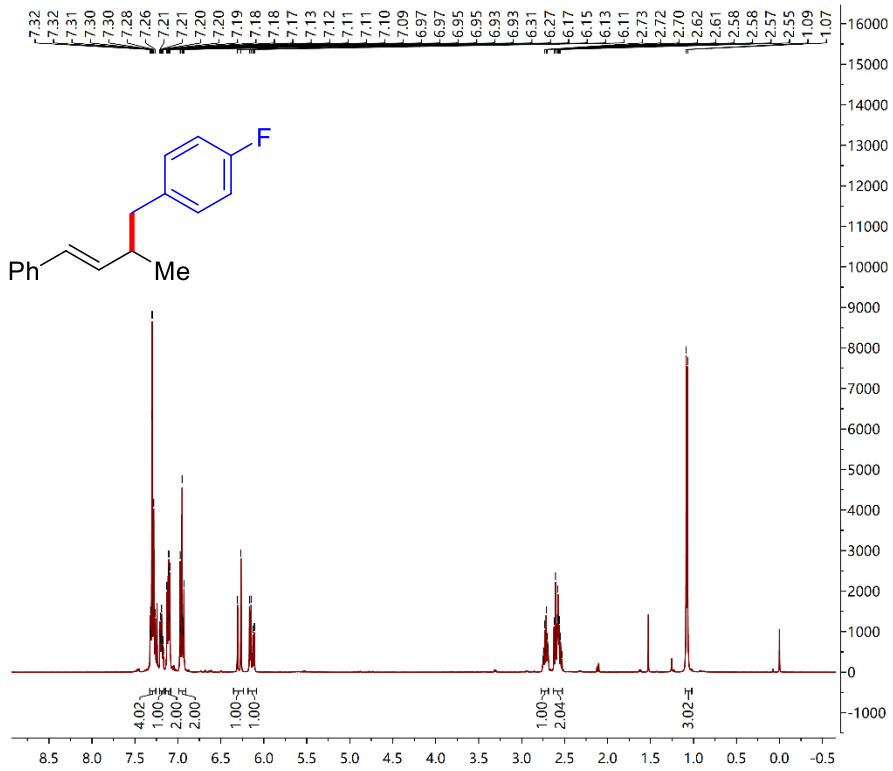
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧还光化反应/ 产物谱图/ 底物的评价/ cl-6-104-P-Me/ 2/ fid
2	Title	cl 6 105 p Me 0317
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	246.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	720
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.5000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-03-17T17:01:00
19	Modification Date	2019-03-17T17:20:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	4820.2
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(E)-1-(2-methyl-4-phenylbut-3-en-1-yl)-4-(trifluoromethyl)benzene (4b)





(*E*)-1-fluoro-4-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4c)



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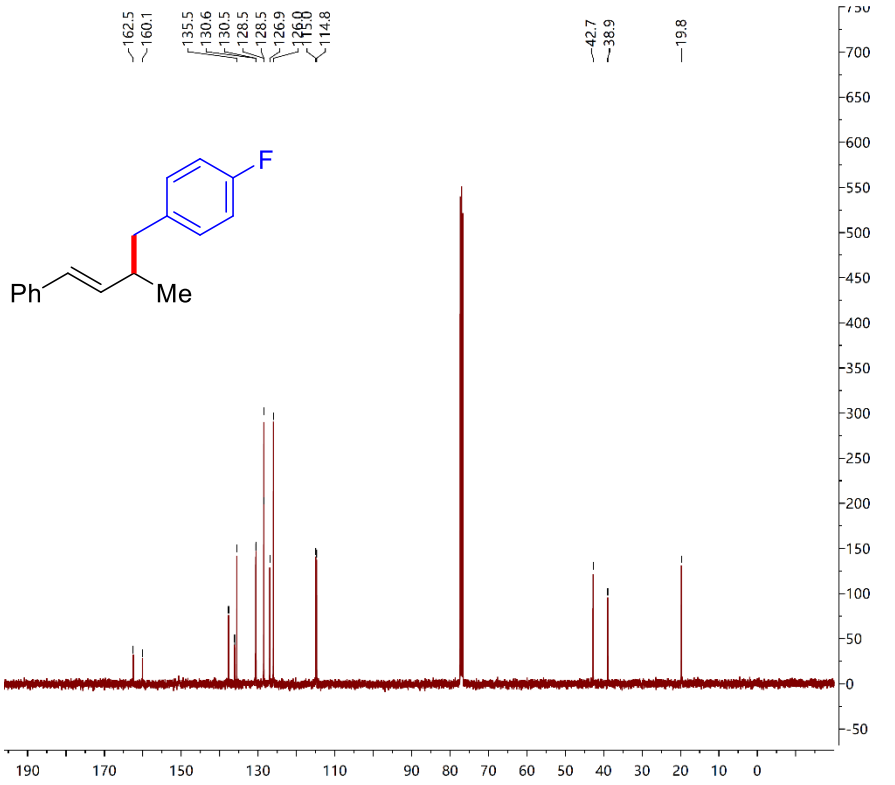
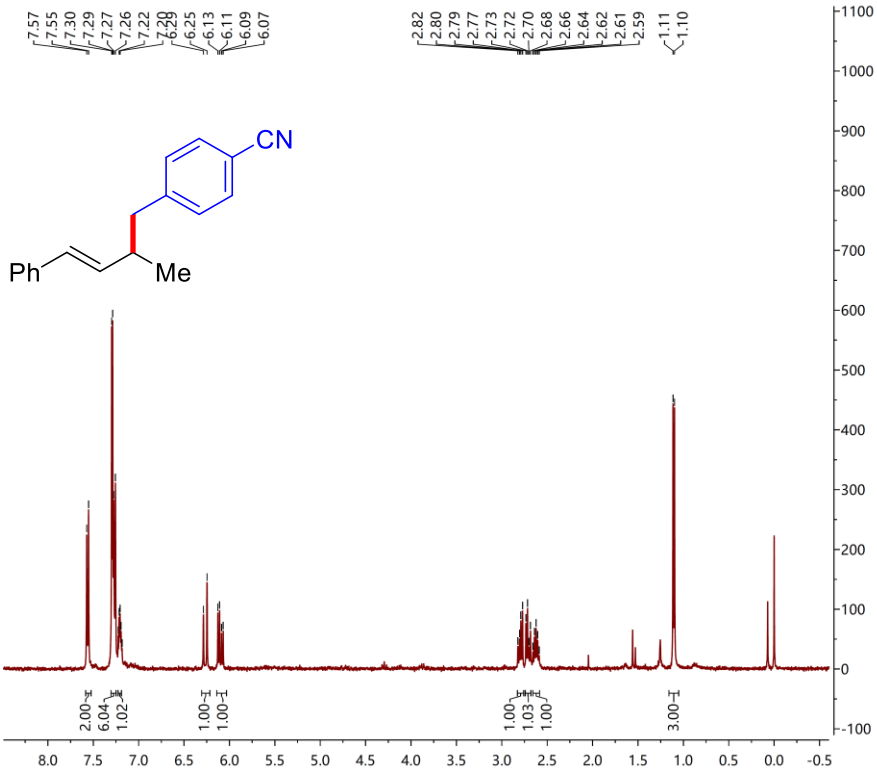
1	Data File Name	Z:/ Data/ NMR/ 2019-04/ cl-6-p-F-zone-0430/ 1/ fid
2	Title	cl 6 p F zone-0430
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.9
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	97
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-04-30T2 2:25:15
19	Modification Date	2019 04 30T2 2:25:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1551.9
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768

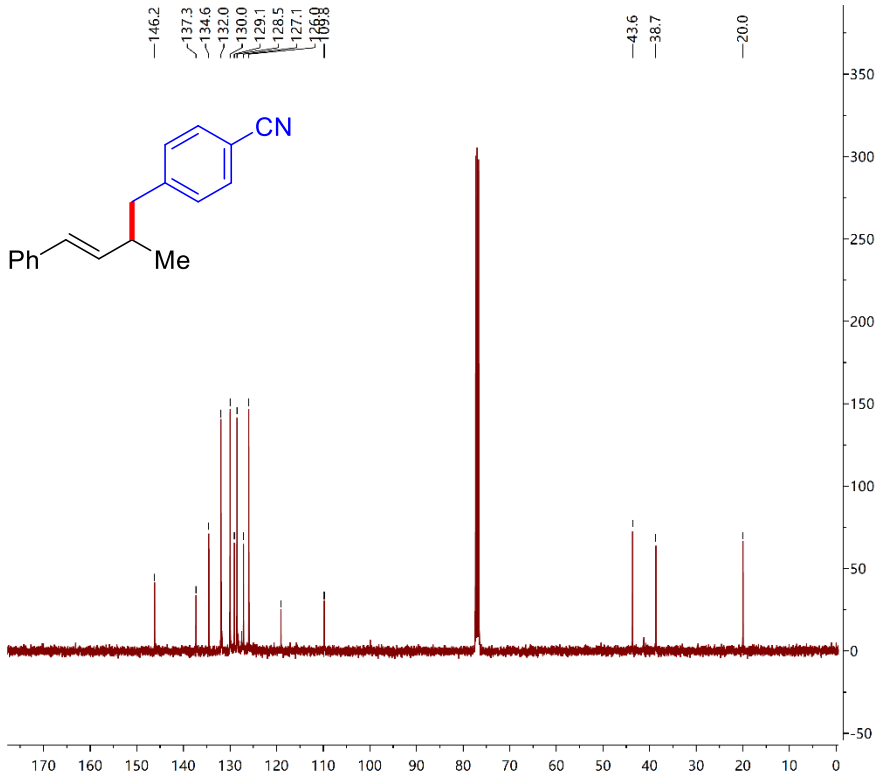


	Parameter	Value
1	Data File Name	Z:/ Data/ NMR/ 2019 04/ cl 6 p F zone-0430/ 2/ fid
2	Title	cl-6-p-F-zone-0430
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.2
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	448
14	Receiver Gain	78
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-04-30T22 :26:40
19	Modification Date	2019-04-30T22 :39:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-10320.1
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-4-(2-methyl-4-phenylbut-3-en-1-yl)benzonitrile (4d)

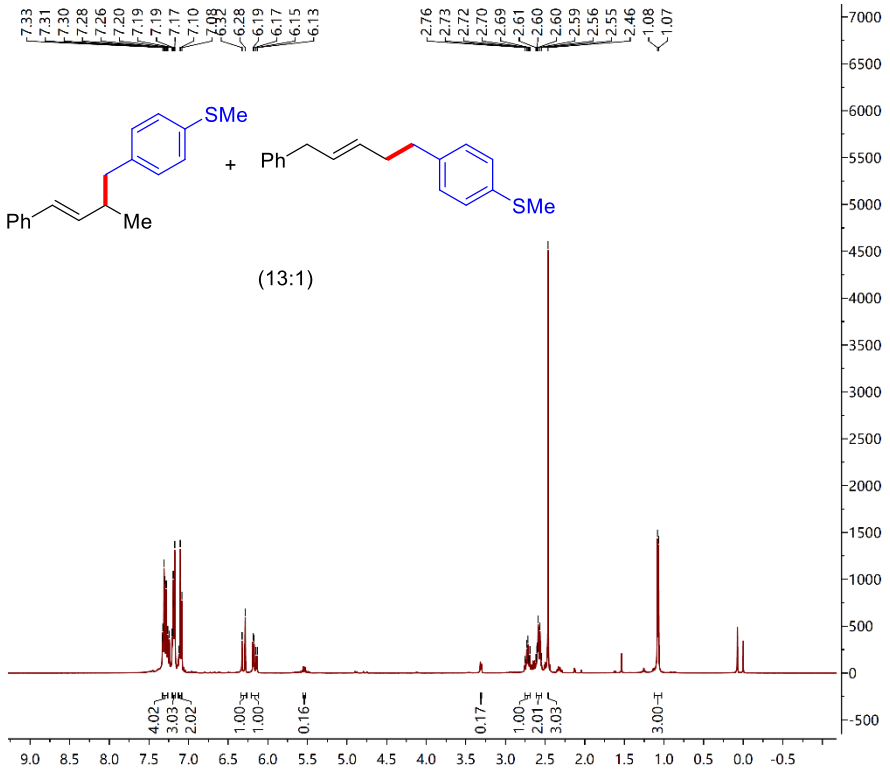


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-89-cn/ H/ fid
2	Title	cl-6-89-cn
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.2
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	194
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-03-11T20:51:52
19	Modification Date	2019-03-11T20:51:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768

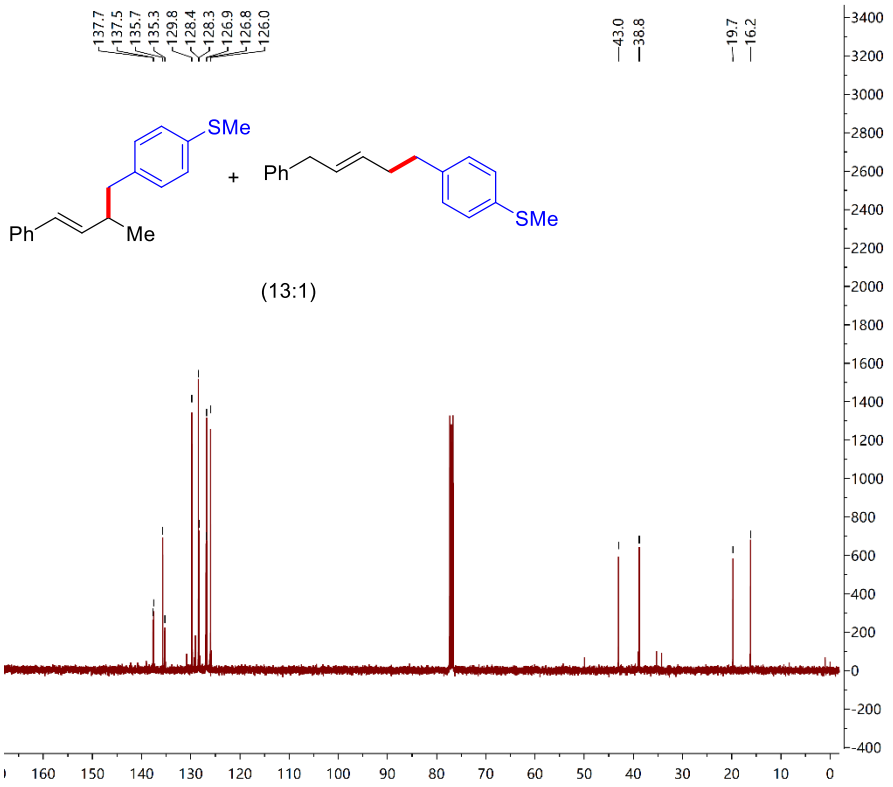


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-89-cn/ 2/ fid
2	Title	cl-6-89-cn
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.7
11	Pulse Sequence	zgdc30
12	Experiment	1D
13	Number of Scans	310
14	Receiver Gain	57
15	Relaxation Delay	1.0000
16	Pulse Width	9.4000
17	Acquisition Time	1.1010
18	Acquisition Date	2019-03-03T15:34:53
19	Modification Date	2019-03-03T15:45:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.6
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-methyl(4-(2-methyl-4-phenylbut-3-en-1-yl)phenyl)sulfane (4f)

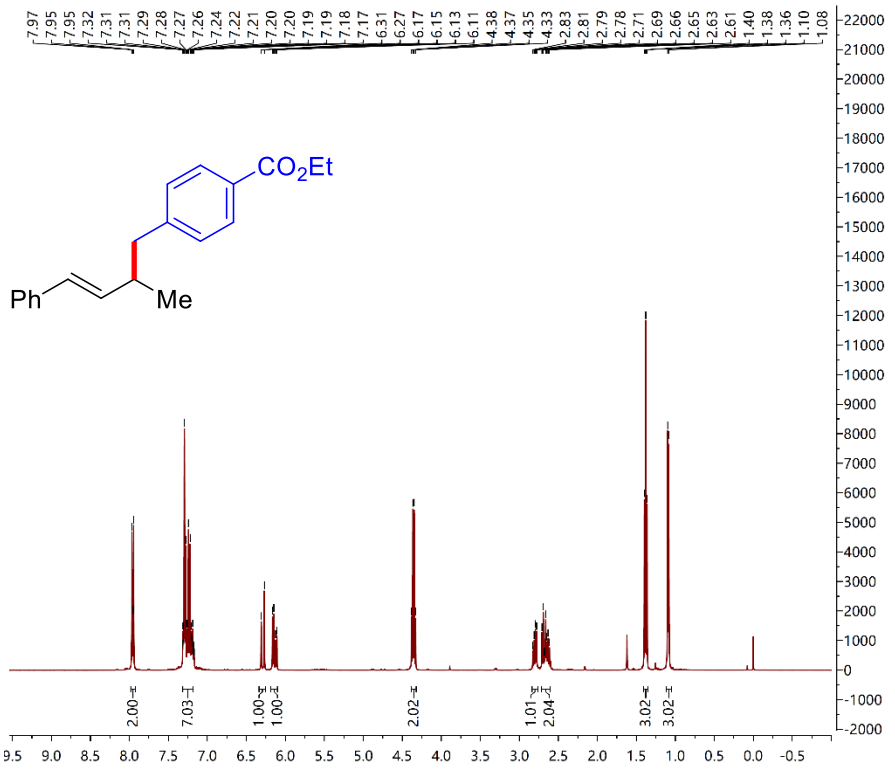


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 标底物的评价/ cl-6-104-SM/ 1/ fid
2	Title	cl 6 104 SM
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	292.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	32
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	4.0894
18	Acquisition Date	2019-03-18T14:16:41
19	Modification Date	2019-03-18T14:16:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1582.0
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

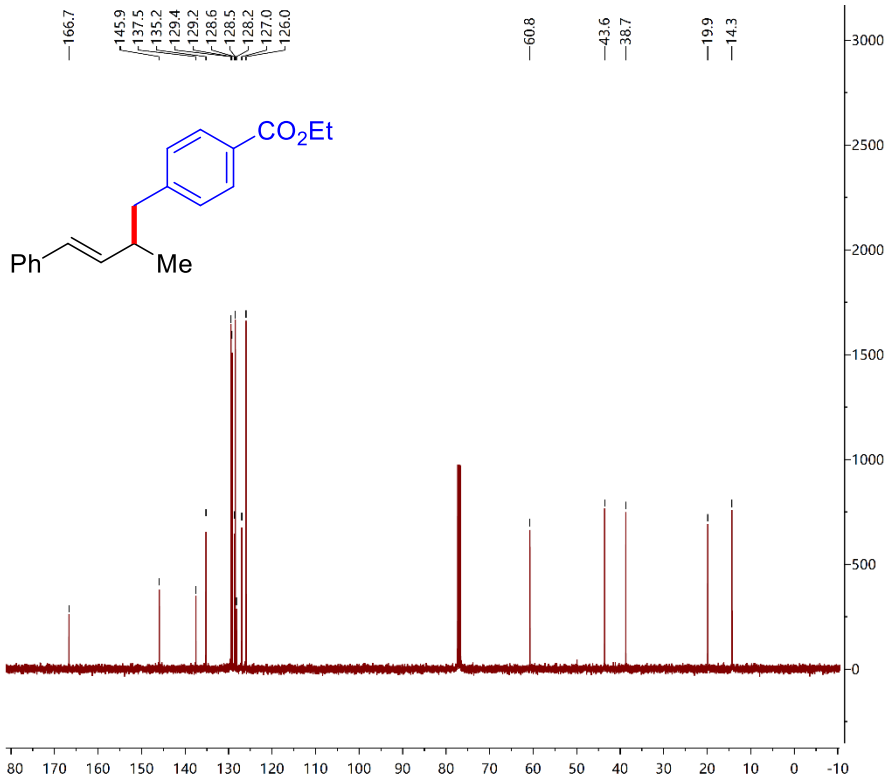


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 标底物的评价/ cl-6-104-SM/ C/ fid
2	Title	cl-6-104-SM
3	Comment	13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.3
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	288
14	Receiver Gain	205
15	Relaxation Delay	1.0000
16	Pulse Width	9.3000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-03-18T14:19:32
19	Modification Date	2019-03-18T14:26:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-15349.8
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

Ethyl (*E*)-4-(2-methyl-4-phenylbut-3-en-1-yl)benzoate (4g)

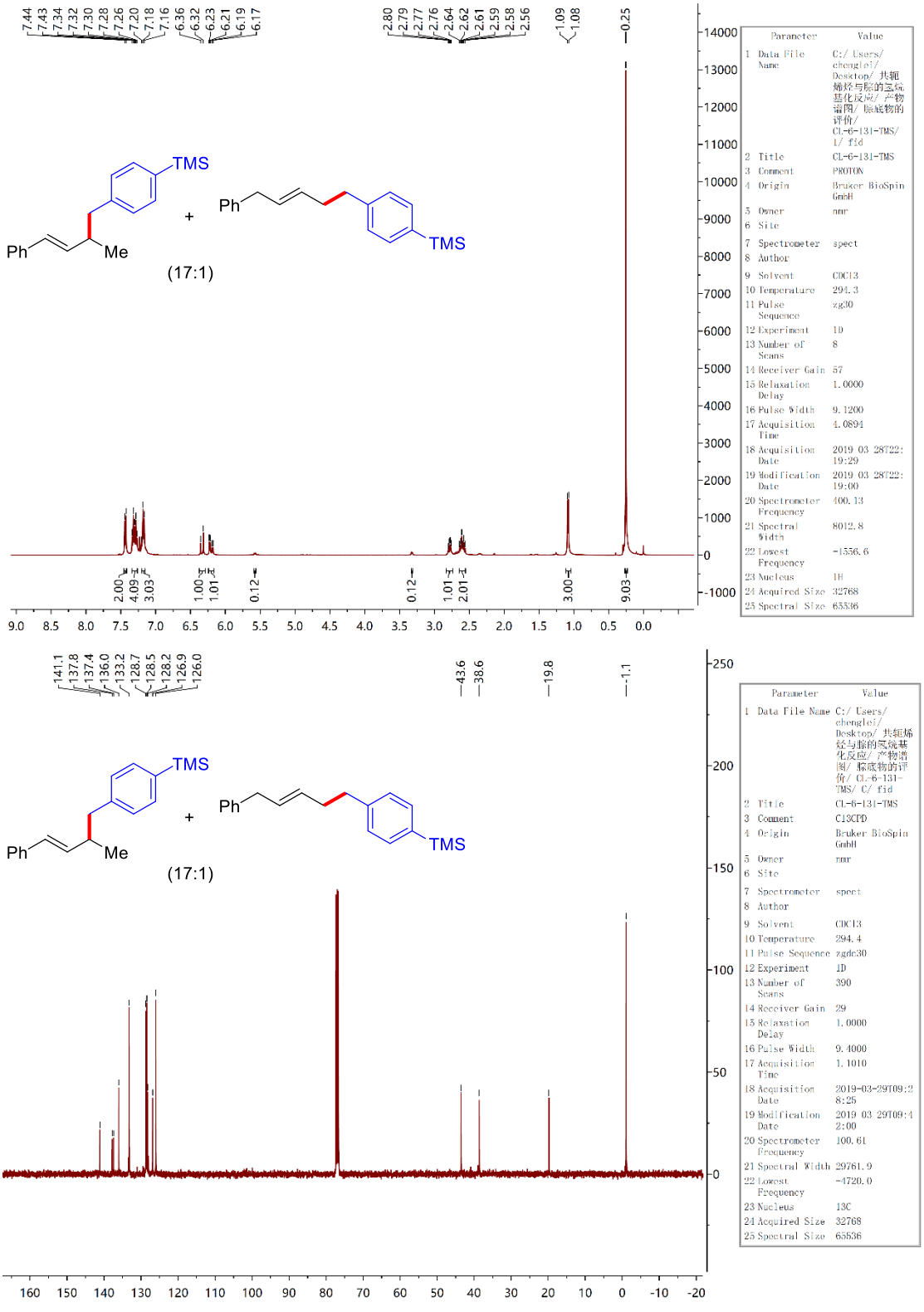


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氧烷基化反应/ 产物谱图/ 底物的评价/ cl 6 93 ester-1/ 1/ fid
2	Title	cl-6-93-ester-1
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	294.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	71
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-04-27T19:23:35
19	Modification Date	2019-04-27T19:23:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768

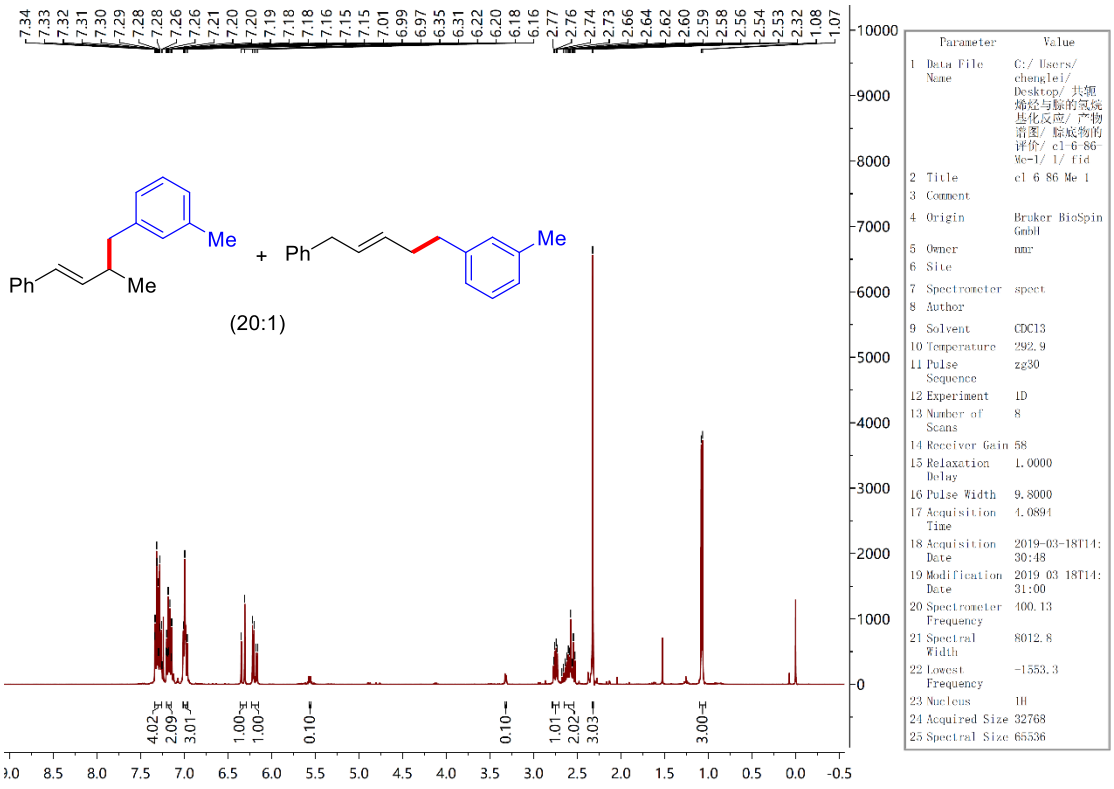


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氧烷基化反应/ 产物谱图/ 底物的评价/ cl-6-93-ester-1/ C/ fid
2	Title	cl-6-93-ester 1
3	Comment	13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.7
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	236
14	Receiver Gain	205
15	Relaxation Delay	1.0000
16	Pulse Width	9.3000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-04-27T22:05:31
19	Modification Date	2019-04-27T22:11:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-15349.8
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

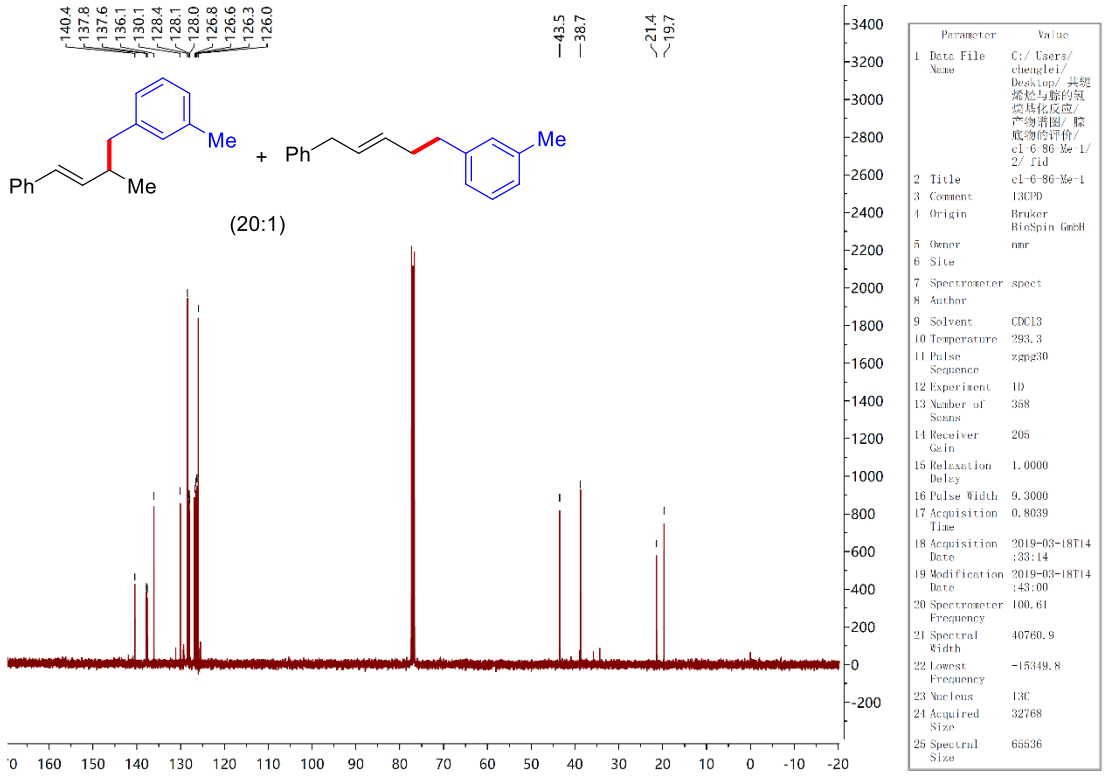
(*E*)-trimethyl(4-(2-methyl-4-phenylbut-3-en-1-yl)phenyl)silane (4h)



(*E*)-1-methyl-3-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4i)

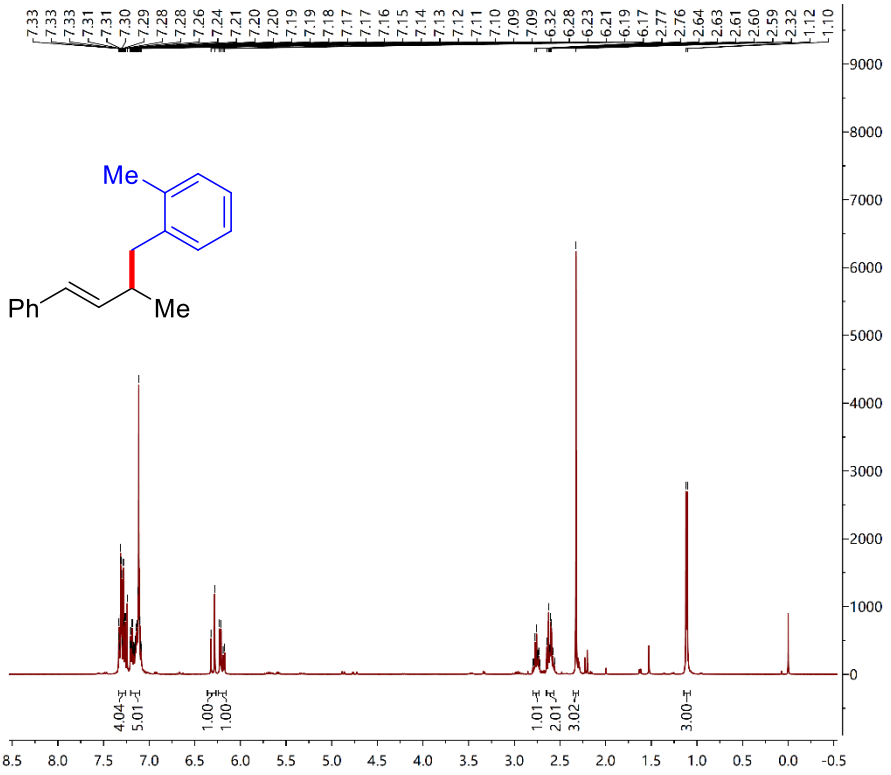


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与酚的氧烷基化反应/ 产物谱图/ 酚底物的评价/ cl-6-86-Me-1/ 1/ fid
2	Title	cl 6 86 Me 1
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	292.9
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	58
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	4.0894
18	Acquisition Date	2019-03-18T14:30:48
19	Modification Date	2019 03 18T14:31:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1553.3
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

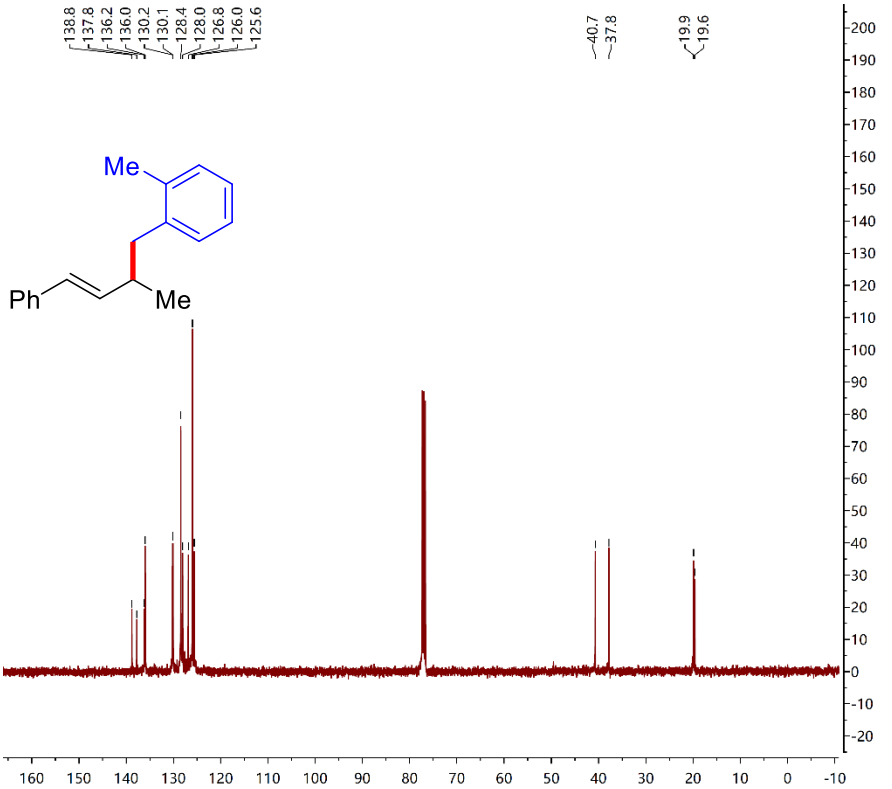


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与酚的氧烷基化反应/ 产物谱图/ 酚底物的评价/ cl-6-86-Me-1/ 2/ fid
2	Title	cl-6-86-Me-1
3	Comment	13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.3
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	358
14	Receiver Gain	205
15	Relaxation Delay	1.0000
16	Pulse Width	9.3000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-03-18T14:33:14
19	Modification Date	2019-03-18T14:43:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-15349.8
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-1-methyl-2-(2-methyl-4-phenylbut-3-en-1-yl)benzene (4j)

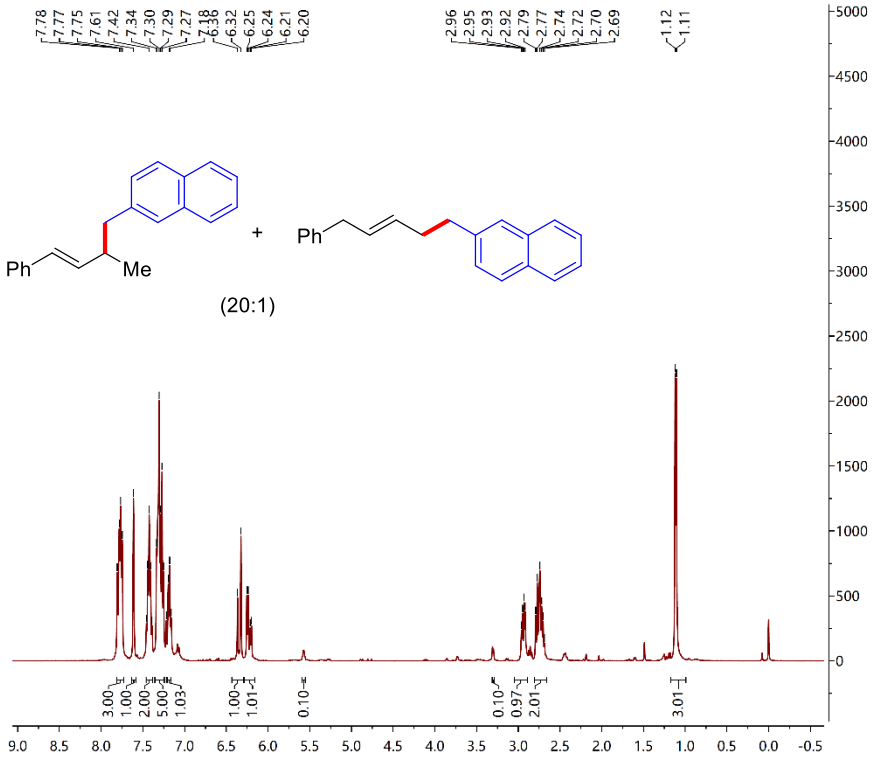


Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与酯的氢炔基化反应/ 产物谱图/ 踪底物的评价/ cl-6-104-o-Me/ 1/ fid
2 Title	cl-6-104-o-Me
3 Comment	
4 Origin	Bruker BioSpin GmbH
5 Owner	nmr
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	292.8
11 Pulse Sequence	zg30
12 Experiment	1D
13 Number of Scans	8
14 Receiver Gain	58
15 Relaxation Delay	1.0000
16 Pulse Width	9.8000
17 Acquisition Time	4.0894
18 Acquisition Date	2019-04-11T22:40:52
19 Modification Date	2019-04-11T22:40:00
20 Spectrometer Frequency	400.13
21 Spectral Width	8012.8
22 Lowest Frequency	-1535.4
23 Nucleus	1H
24 Acquired Size	32768
25 Spectral Size	65536

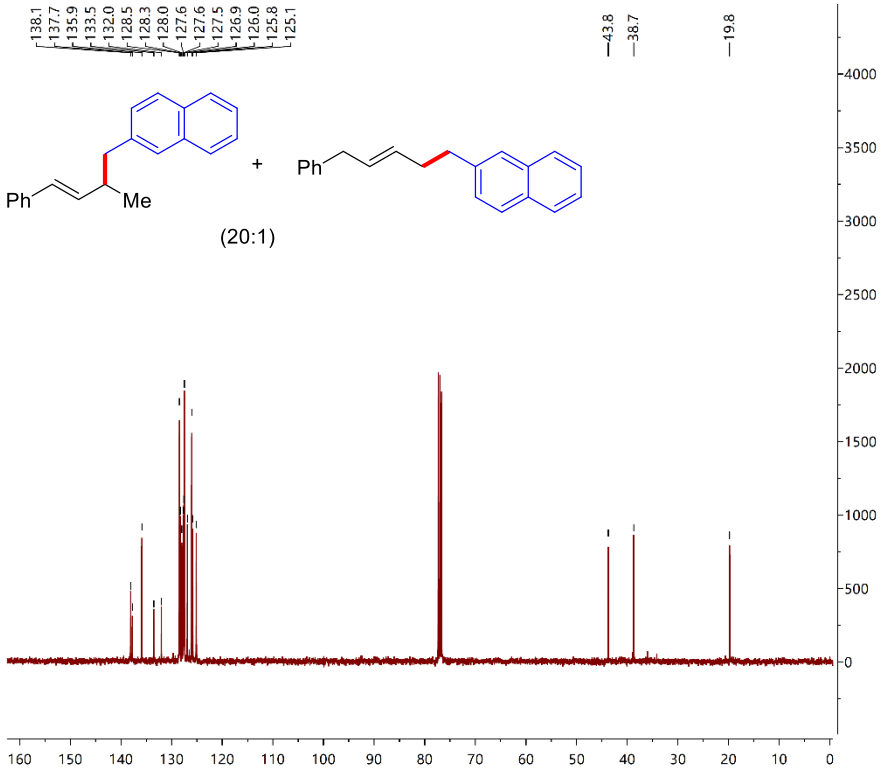


Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与酯的氢炔基化反应/ 产物谱图/ 踪底物的评价/ cl-6-104-o-Me/ C/ fid
2 Title	cl-6-104-o-Me
3 Comment	C13CPD
4 Origin	Bruker BioSpin GmbH
5 Owner	nmr
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	296.0
11 Pulse Sequence	zgdc30
12 Experiment	1D
13 Number of Scans	236
14 Receiver Gain	33
15 Relaxation Delay	1.0000
16 Pulse Width	9.4000
17 Acquisition Time	1.1010
18 Acquisition Date	2019-03-11T16:00:55
19 Modification Date	2019-03-11T16:07:00
20 Spectrometer Frequency	100.61
21 Spectral Width	29761.9
22 Lowest Frequency	-4820.6
23 Nucleus	13C
24 Acquired Size	32768
25 Spectral Size	65536

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)naphthalene (4k)

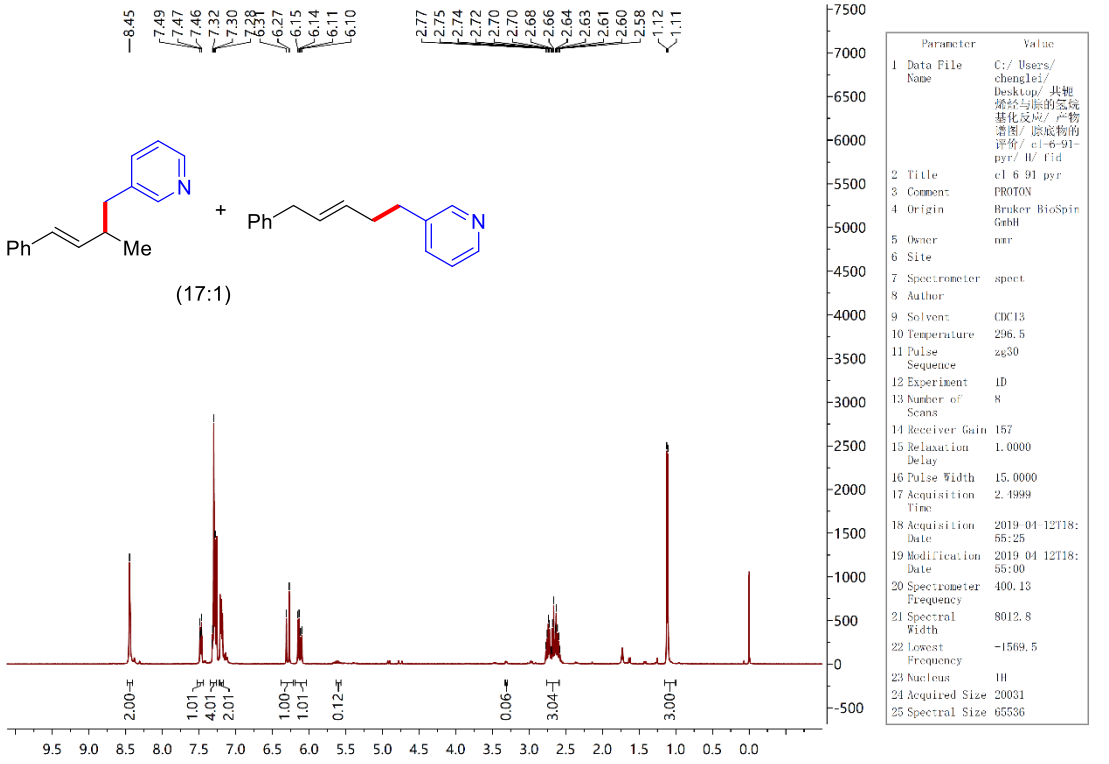


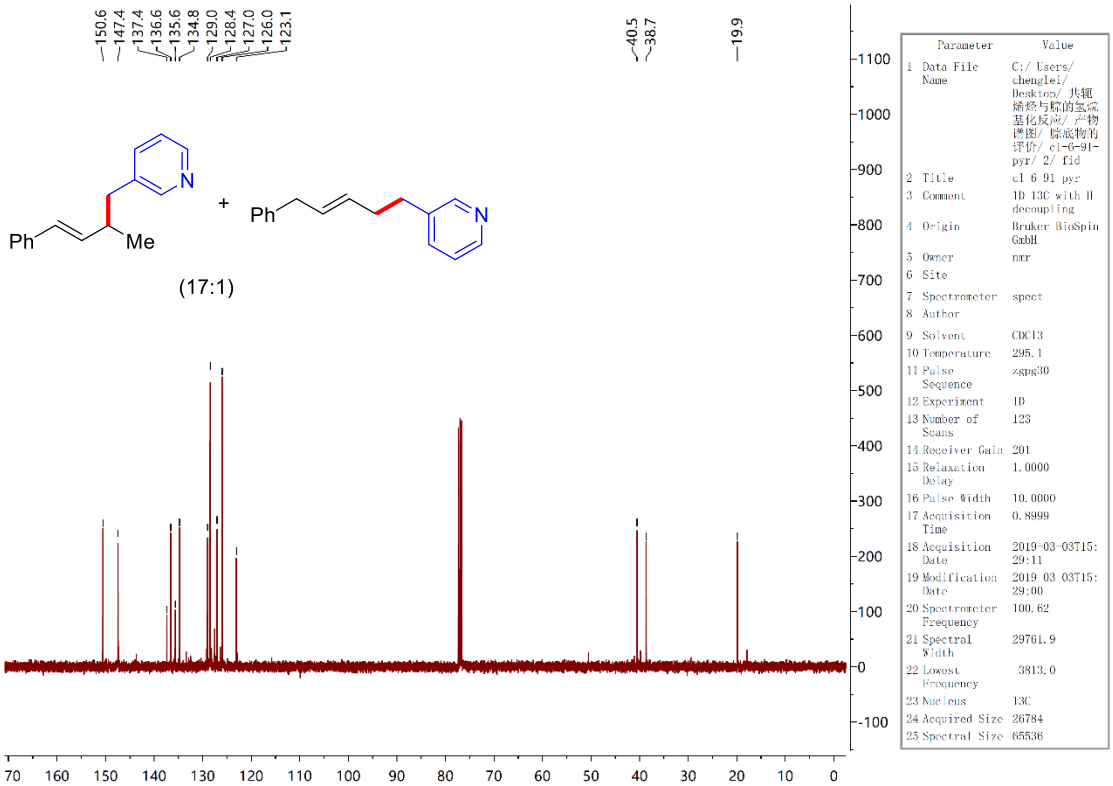
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 底物的评价/ cl 6 91 nap/ 1/ fid
2	Title	cl-6-91-NAP-0315
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	128
15	Relaxation Delay	1.0000
16	Pulse Width	13.7000
17	Acquisition Time	1.9999
18	Acquisition Date	2019 03 15T15:47:00
19	Modification Date	2019-03-15T15:47:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	1640.9
23	Nucleus	1H
24	Acquired Size	16416
25	Spectral Size	65536



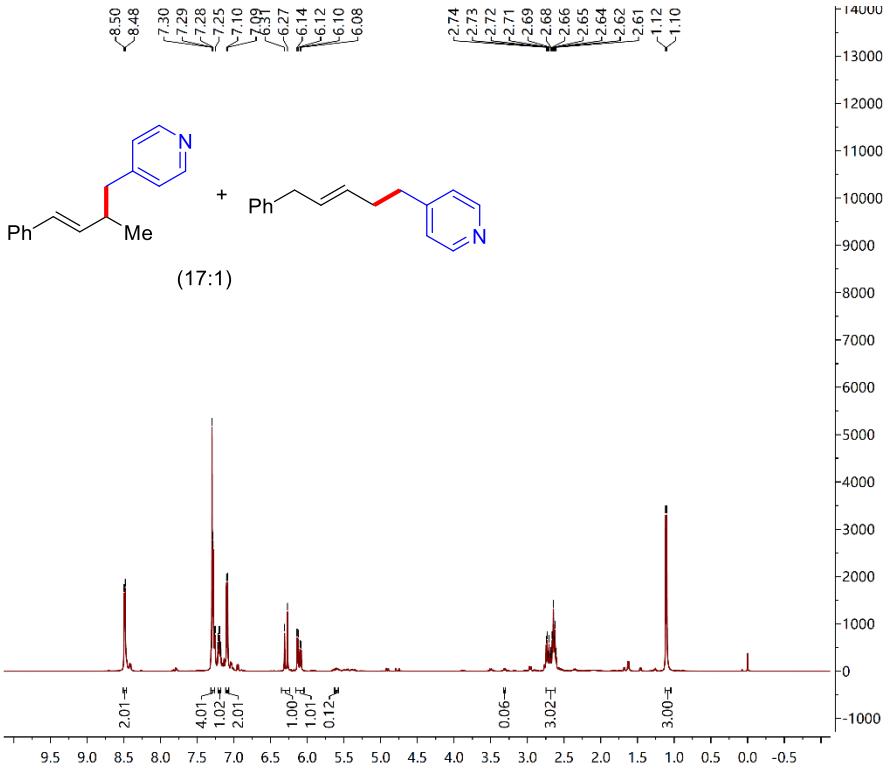
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 底物的评价/ cl 6 91 nap/ 2/ fid
2	Title	cl-6-91-NAP 0315
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.8
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	348
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-03-15T15:48:00
19	Modification Date	2019 03 15T15:56:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	7795.9
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-3-(2-methyl-4-phenylbut-3-en-1-yl)pyridine (4l)





(*E*)-4-(2-methyl-4-phenylbut-3-en-1-yl)pyridine (4m)



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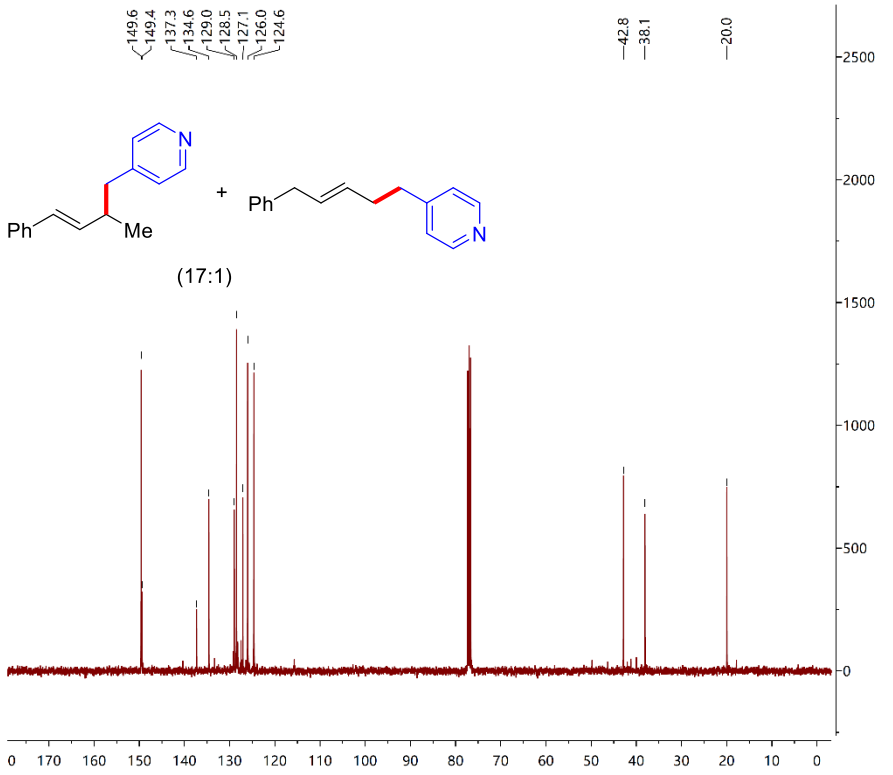
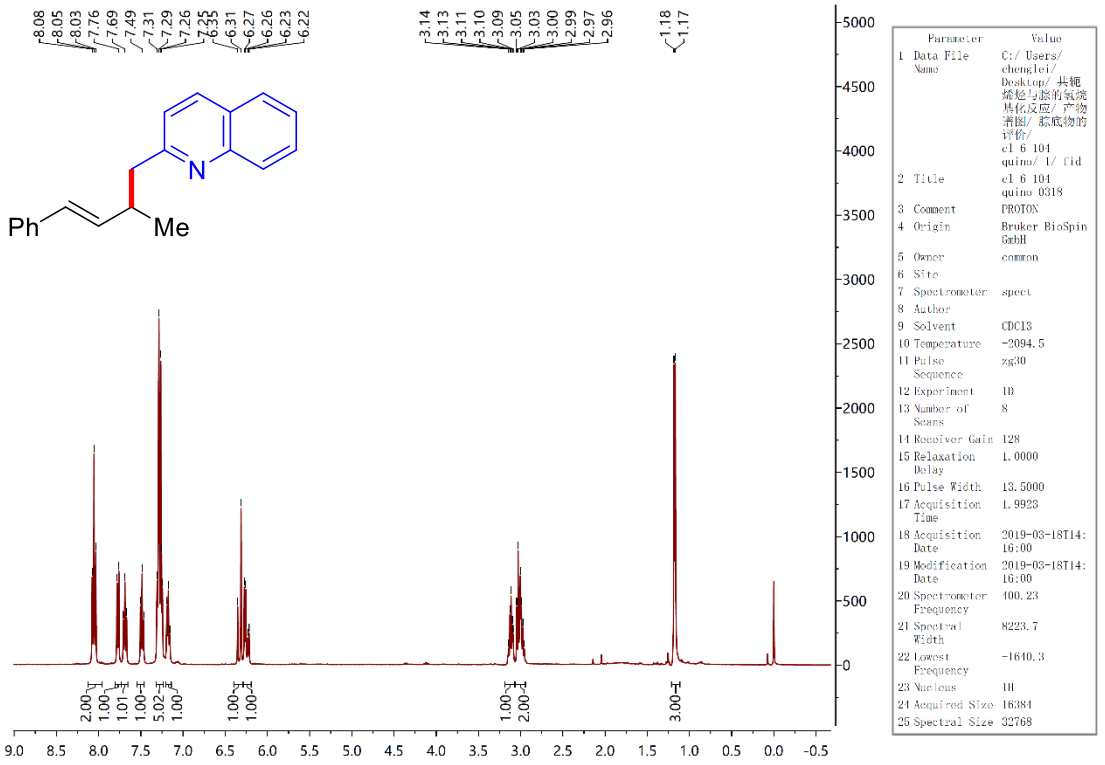
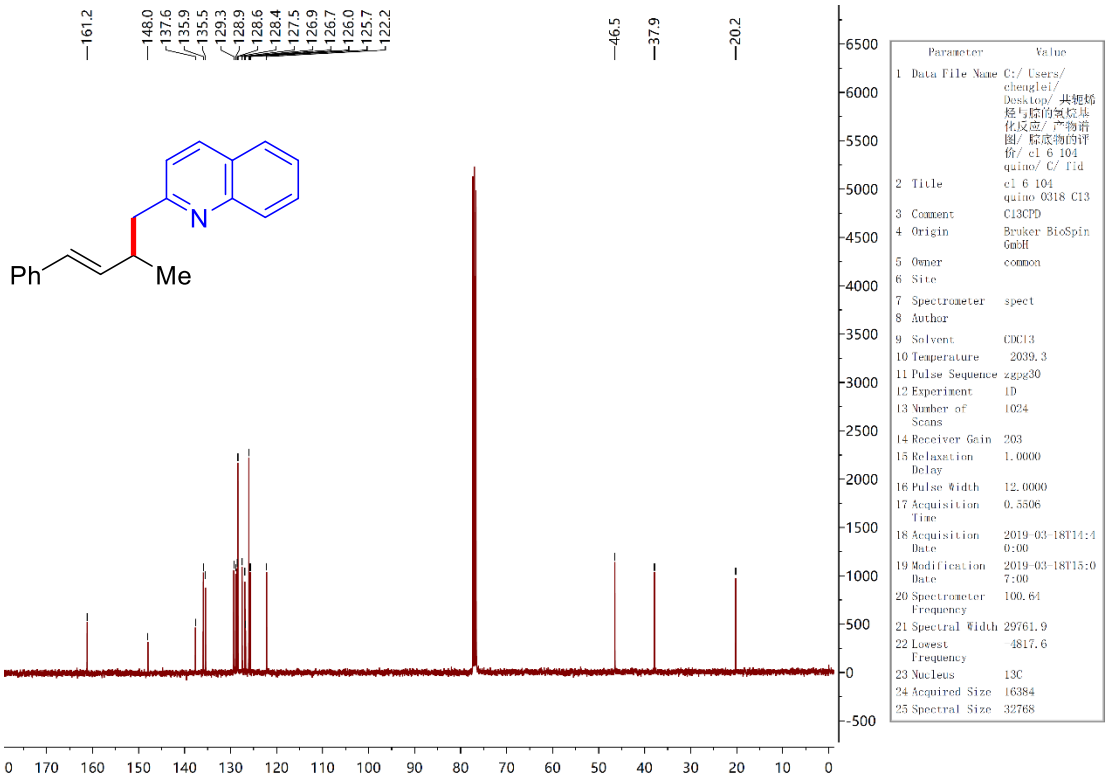
1	Data File Name	Z:/ Data/ NMR/ 2019 05/ cl-6-4-PYR-0501/ 1/ fid
2	Title	cl-6-4-PYR 0501
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.5
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	98
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019-05-01T20:30:34
19	Modification Date	2019-05-01T20:30:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1570.7
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536



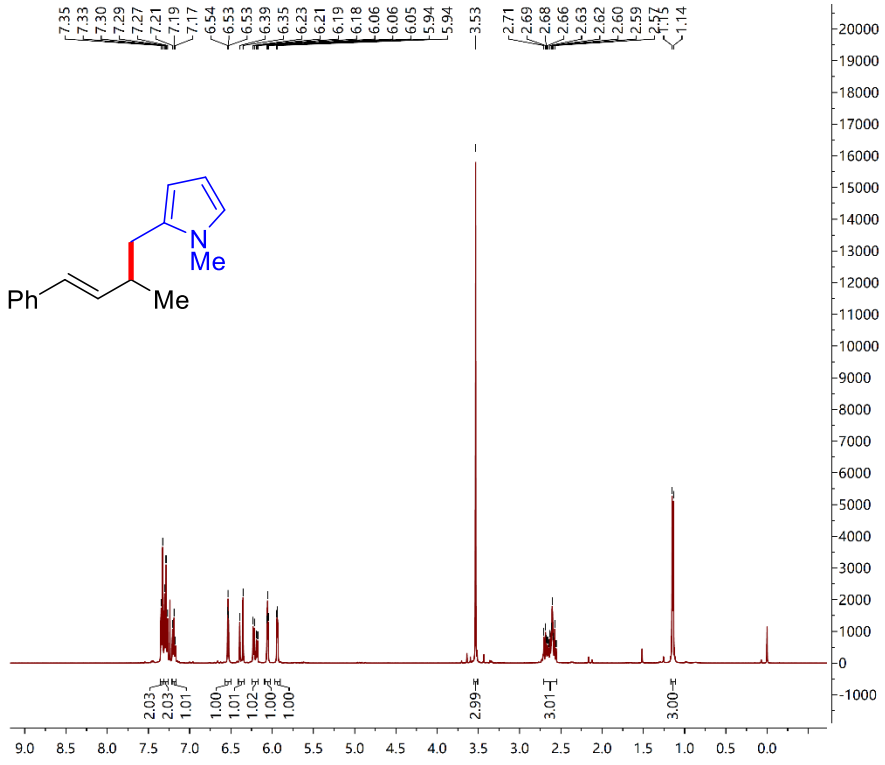
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 底物的评价/ cl-6-145-pyr-1/ 2/ fid
2	Title	cl 6 145 pyr 1
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	297.1
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	358
14	Receiver Gain	111
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.8606
18	Acquisition Date	2019-04-06T09:05:00
19	Modification Date	2019-05-01T20:40:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)quinoline (4n)

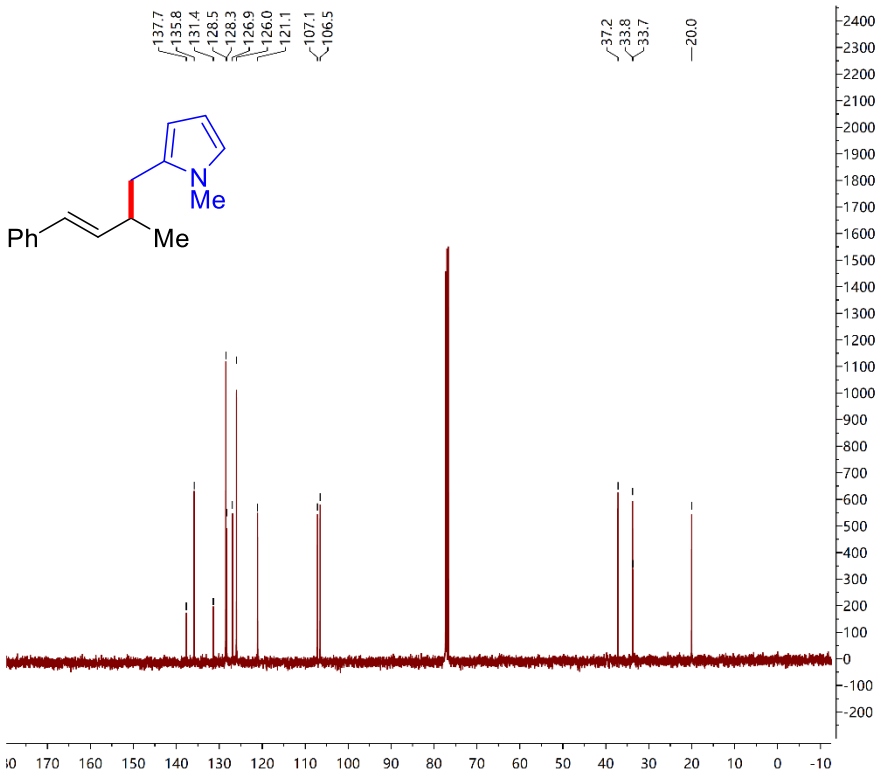




(*E*)-1-methyl-2-(2-methyl-4-phenylbut-3-en-1-yl)-1H-pyrrole (4o)

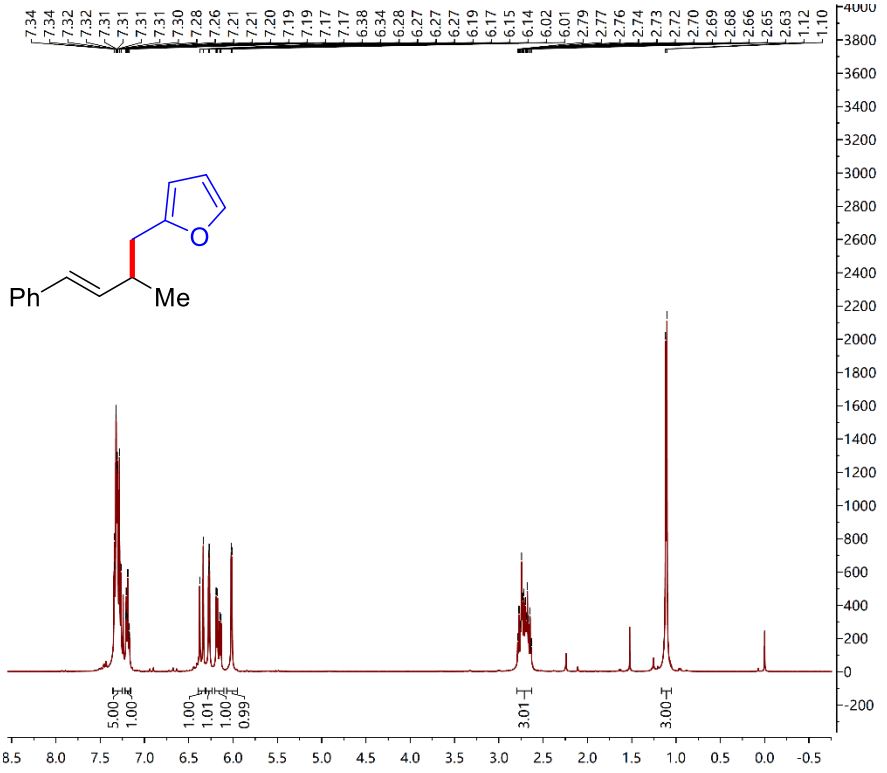


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 底底物的评价/ cl-6-121-pyr/ 1/ fid
2	Title	cl-6-121-pyr
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.5
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	97
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-03-21T16: 35:27
19	Modification Date	2019-03-21T16: 35:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768

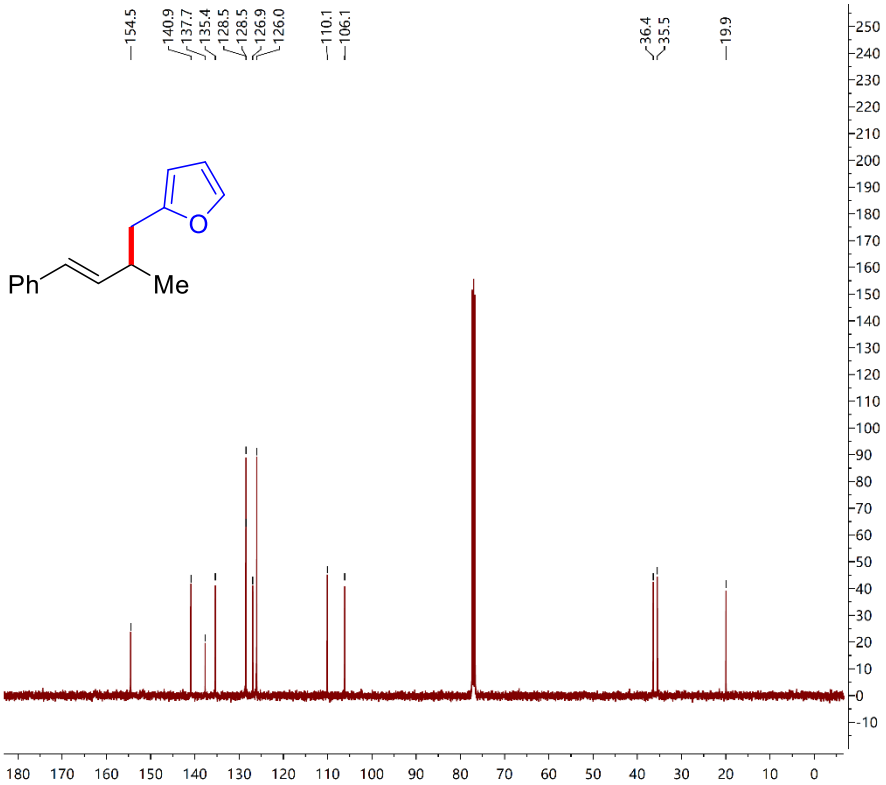


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 底底物的评价/ cl-6-121-pyr/ 2/ fid
2	Title	cl-6-112-pyr-C
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-1683.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	430
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-03-21T17: 03:00
19	Modification Date	2019-03-21T17: 03:00
20	Spectrometer Frequency	100.64
21	Spectral Width	29761.9
22	Lowest Frequency	-4817.6
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)furan (4p)

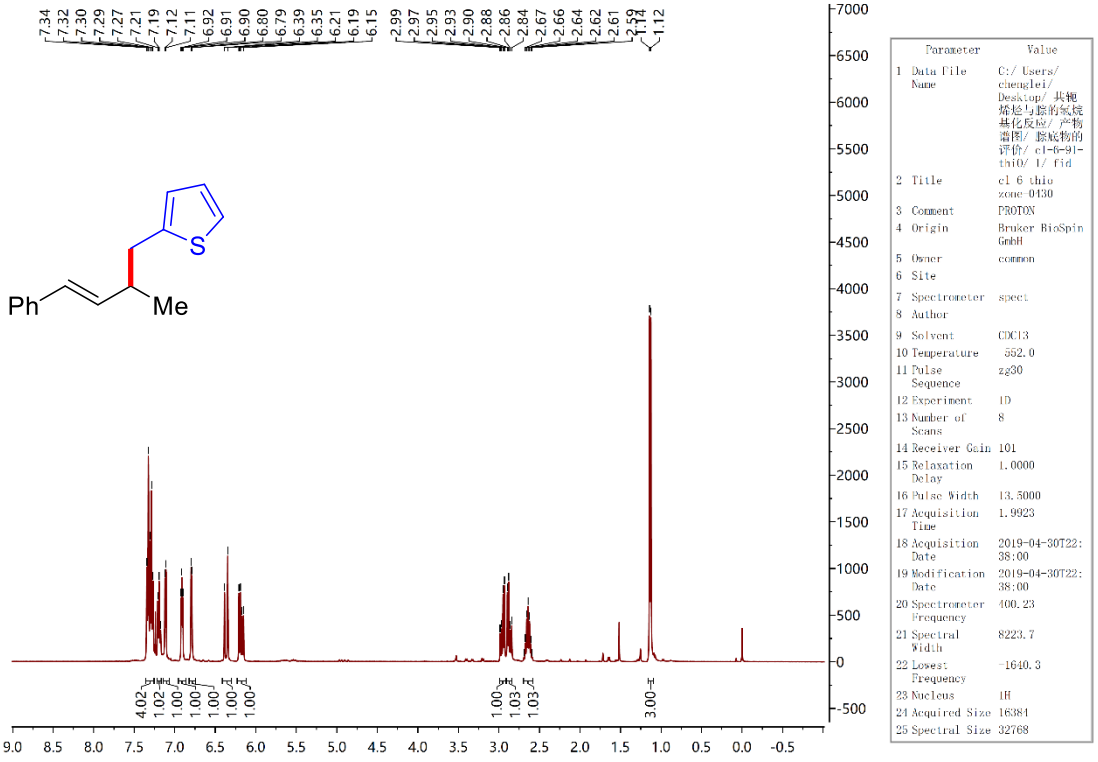


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与脂的氢烷羰化反应/ 产物谱图/ 底底物的评价/ cl 6 105 furan/ 1/ fid
2	Title	cl-6-105-furan
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.8
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	64
15	Relaxation Delay	1.0000
16	Pulse Width	9.1200
17	Acquisition Time	4.0894
18	Acquisition Date	2019-05-01T20:15:21
19	Modification Date	2019-05-01T20:15:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1552.9
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536

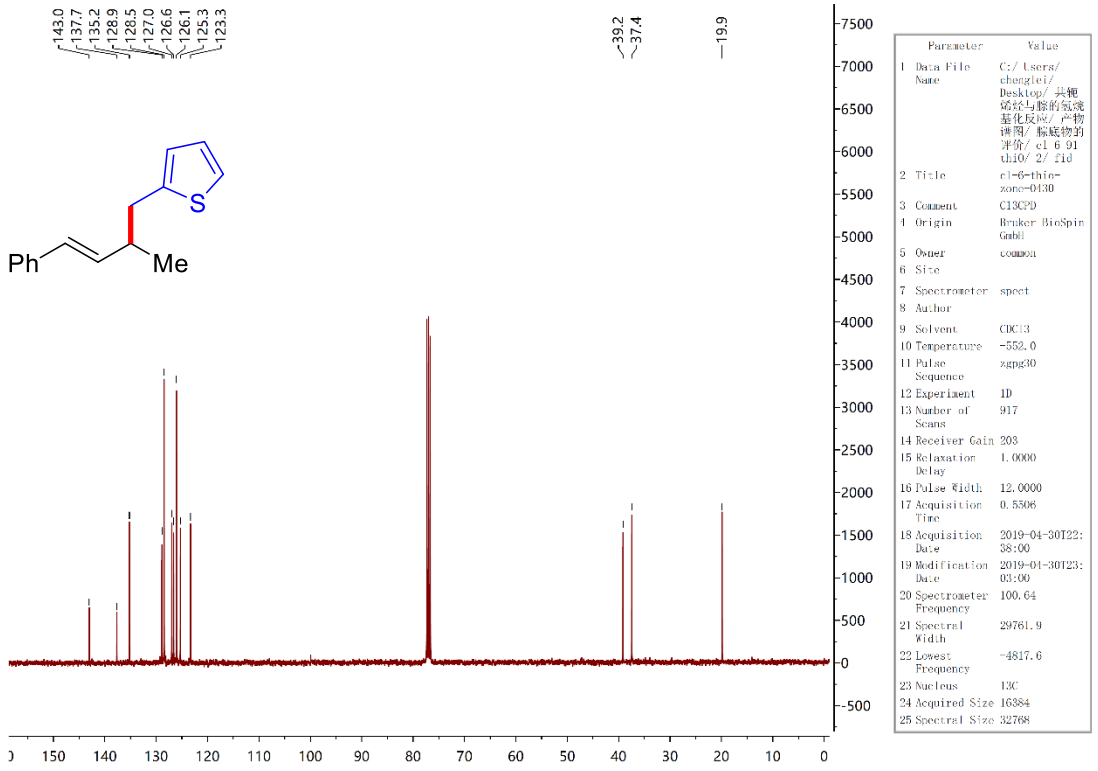


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与脂的氧炉基化反应/ 产物谱图/ 脂底物的评价/ cl-6-105-furan/ 2/ fid
2	Title	cl-6-105-furan
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	294.3
11	Pulse Sequence	zgdc30
12	Experiment	1D
13	Number of Scans	512
14	Receiver Gain	27
15	Relaxation Delay	1.0000
16	Pulse Width	9.4000
17	Acquisition Time	1.1010
18	Acquisition Date	2019-05-01T20:18:40
19	Modification Date	2019-05-01T20:34:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	4820.6
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-2-(2-methyl-4-phenylbut-3-en-1-yl)thiophene (4q)

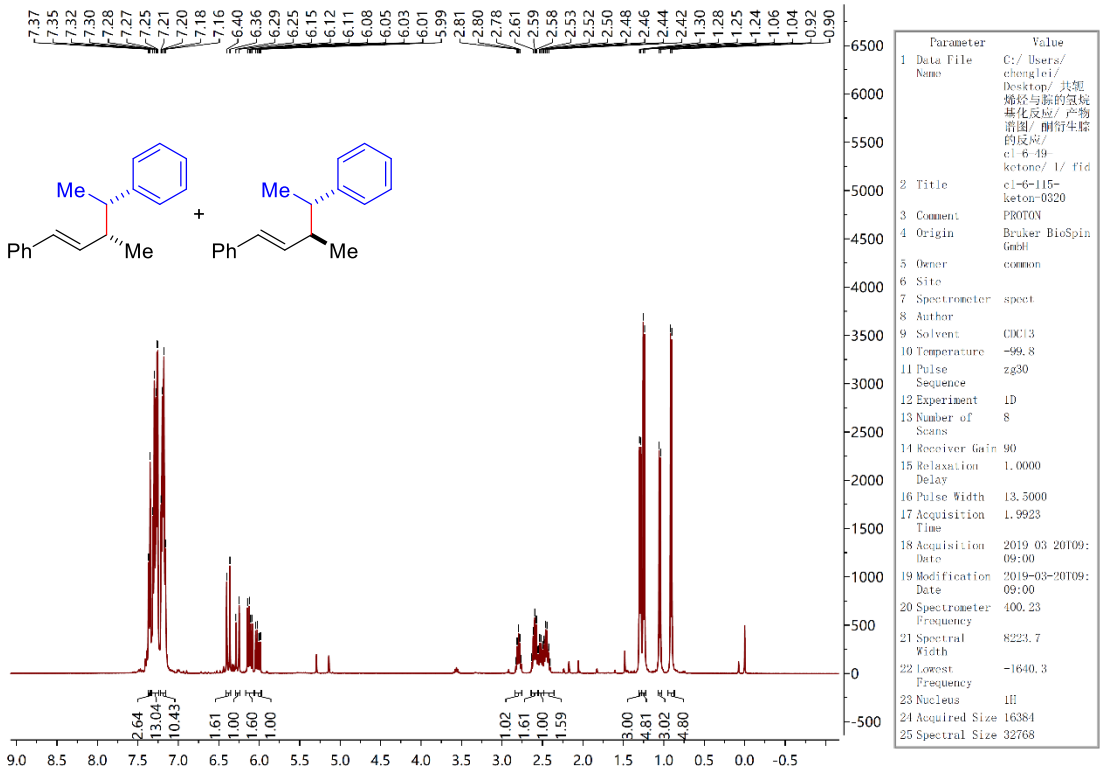


Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-91-thi0/ 1/ fid
2 Title	cl 6 thio zone-0430
3 Comment	PROTON
4 Origin	Bruker BioSpin GmbH
5 Owner	common
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	552.0
11 Pulse Sequence	zg30
12 Experiment	1D
13 Number of Scans	8
14 Receiver Gain	101
15 Relaxation Delay	1.0000
16 Pulse Width	13.5000
17 Acquisition Time	1.9923
18 Acquisition Date	2019-04-30T22:38:00
19 Modification Date	2019-04-30T22:38:00
20 Spectrometer Frequency	400.23
21 Spectral Width	8223.7
22 Lowest Frequency	-1640.3
23 Nucleus	1H
24 Acquired Size	16384
25 Spectral Size	32768

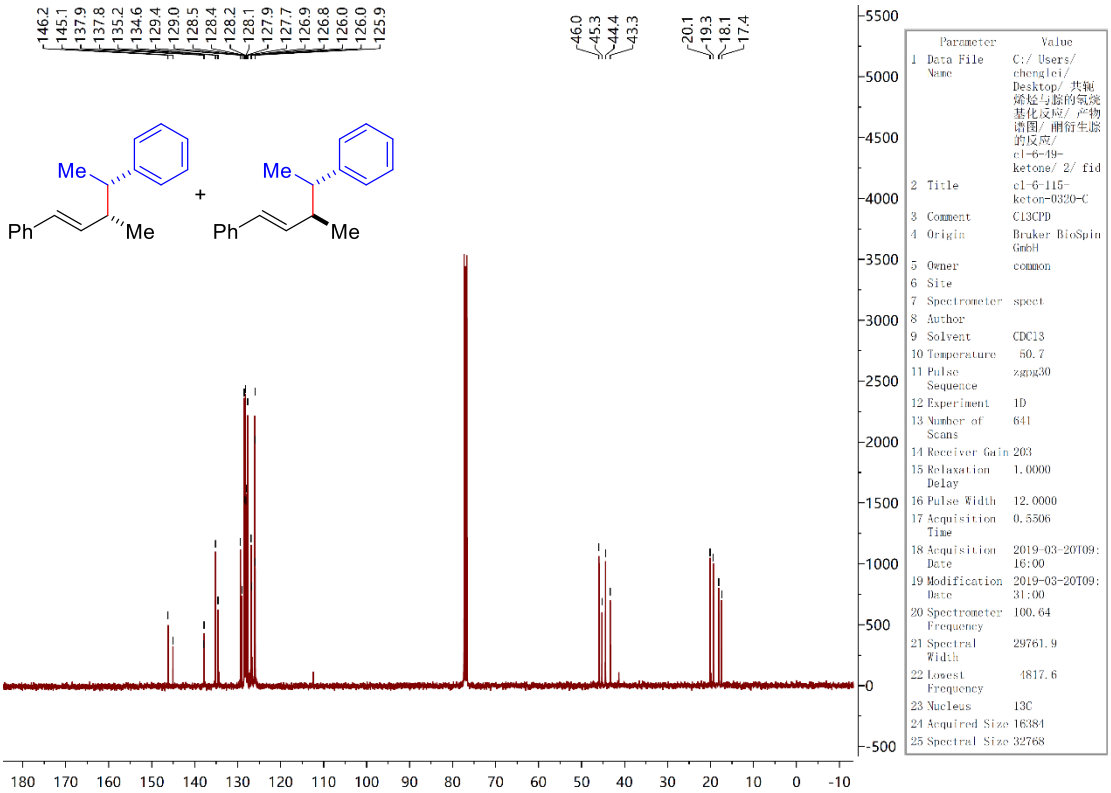


Parameter	Value
1 Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 胺底物的评价/ cl 6 91 thi0/ 2/ fid
2 Title	cl-6-thio-zone-0430
3 Comment	C13CPD
4 Origin	Bruker BioSpin GmbH
5 Owner	common
6 Site	
7 Spectrometer	spect
8 Author	
9 Solvent	CDCl3
10 Temperature	-552.0
11 Pulse Sequence	zgpg30
12 Experiment	1D
13 Number of Scans	917
14 Receiver Gain	203
15 Relaxation Delay	1.0000
16 Pulse Width	12.0000
17 Acquisition Time	0.5506
18 Acquisition Date	2019-04-30T22:38:00
19 Modification Date	2019-04-30T23:03:00
20 Spectrometer Frequency	100.64
21 Spectral Width	29761.9
22 Lowest Frequency	-4817.6
23 Nucleus	13C
24 Acquired Size	16384
25 Spectral Size	32768

(*E*)-(3-methylpent-1-ene-1,4-diyl)dibenzene (4r)

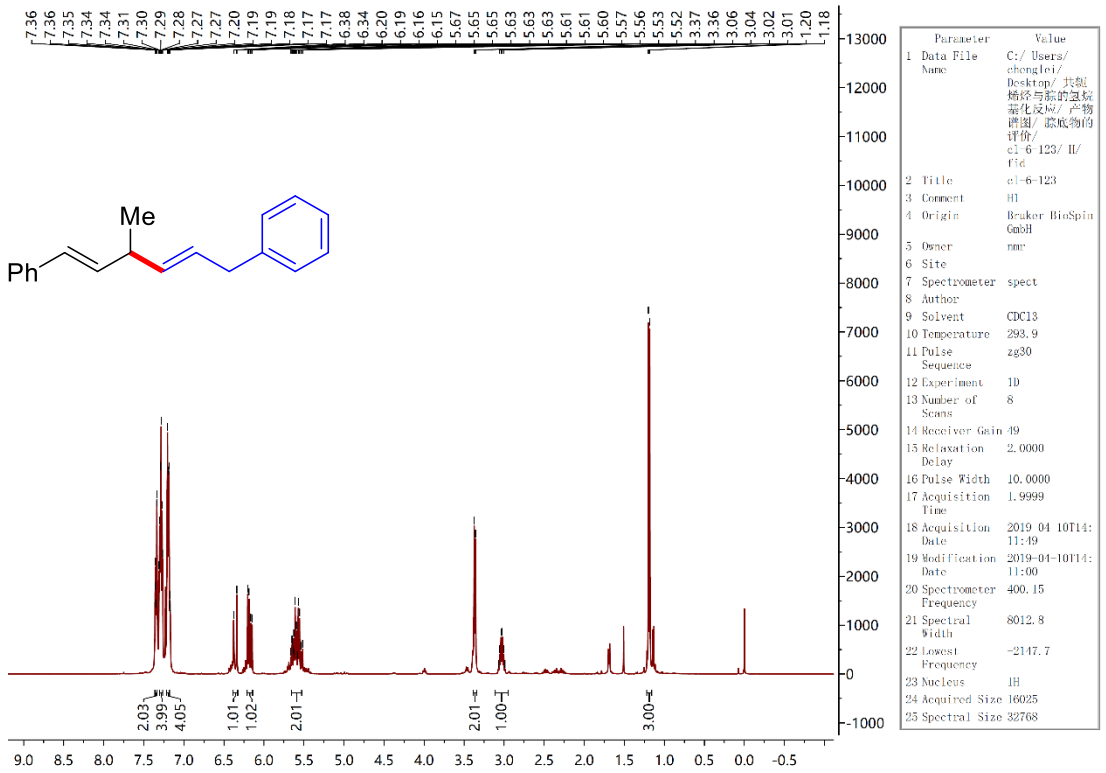


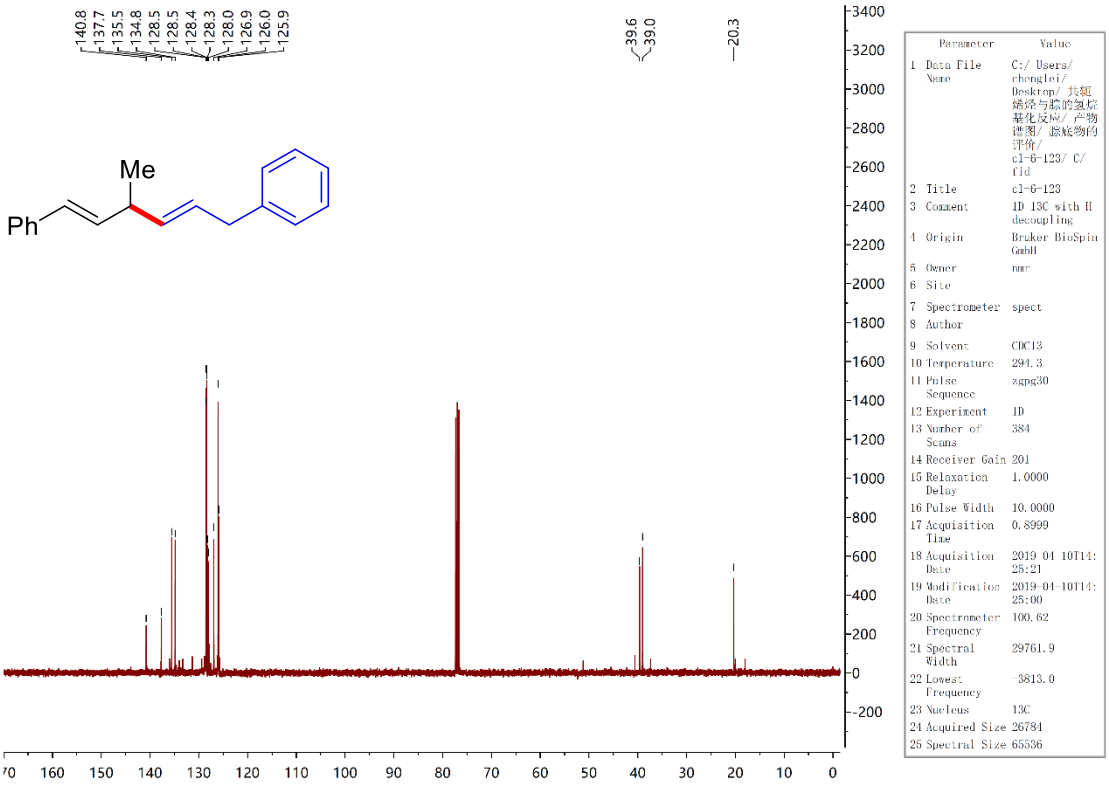
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氢烷基化反应/ 产物谱图/ 酮衍生醇的反应/ c1-6-49-ketone/ 1/ fid
2	Title	c1-6-115-keton-0320
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-99.8
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	90
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	1.9923
18	Acquisition Date	2019 03 20T09:09:00
19	Modification Date	2019-03-20T09:09:00
20	Spectrometer Frequency	400.23
21	Spectral Width	8223.7
22	Lowest Frequency	-1640.3
23	Nucleus	1H
24	Acquired Size	16384
25	Spectral Size	32768



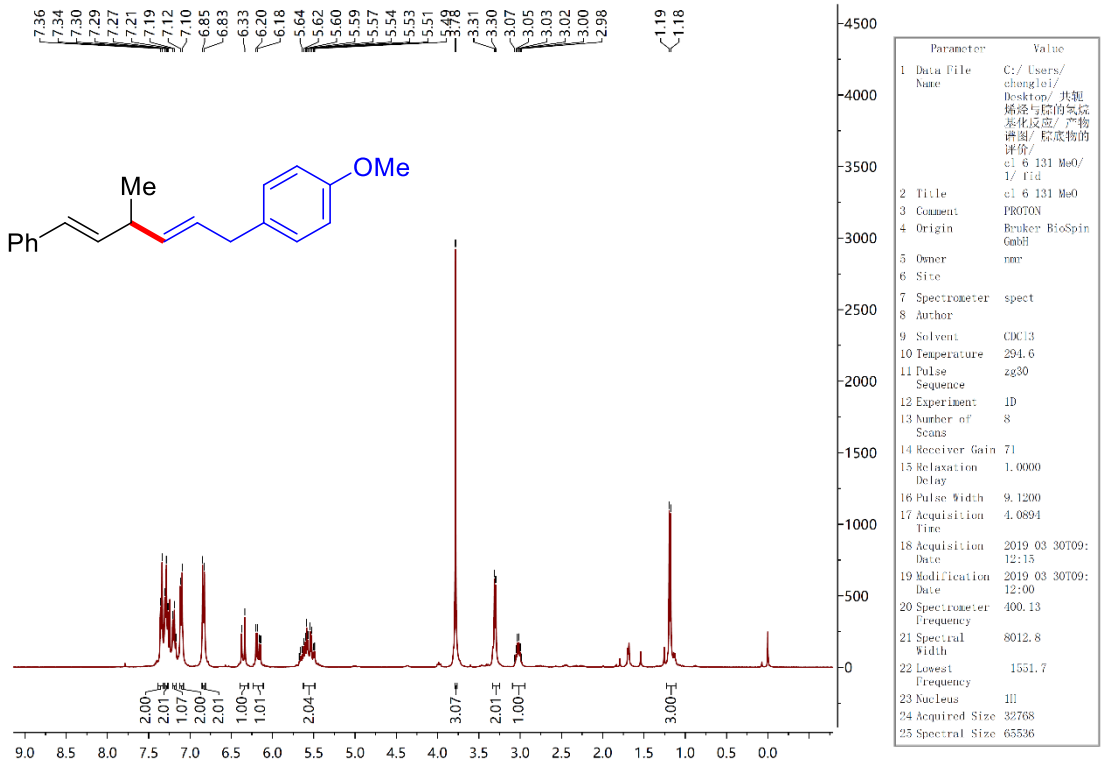
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醇的氢烷基化反应/ 产物谱图/ 酮衍生醇的反应/ c1-6-49-ketone/ 2/ fid
2	Title	c1-6-115-keton-0320-C
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	50.7
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	641
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-03-20T09:16:00
19	Modification Date	2019-03-20T09:31:00
20	Spectrometer Frequency	100.64
21	Spectral Width	29761.9
22	Lowest Frequency	4817.6
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

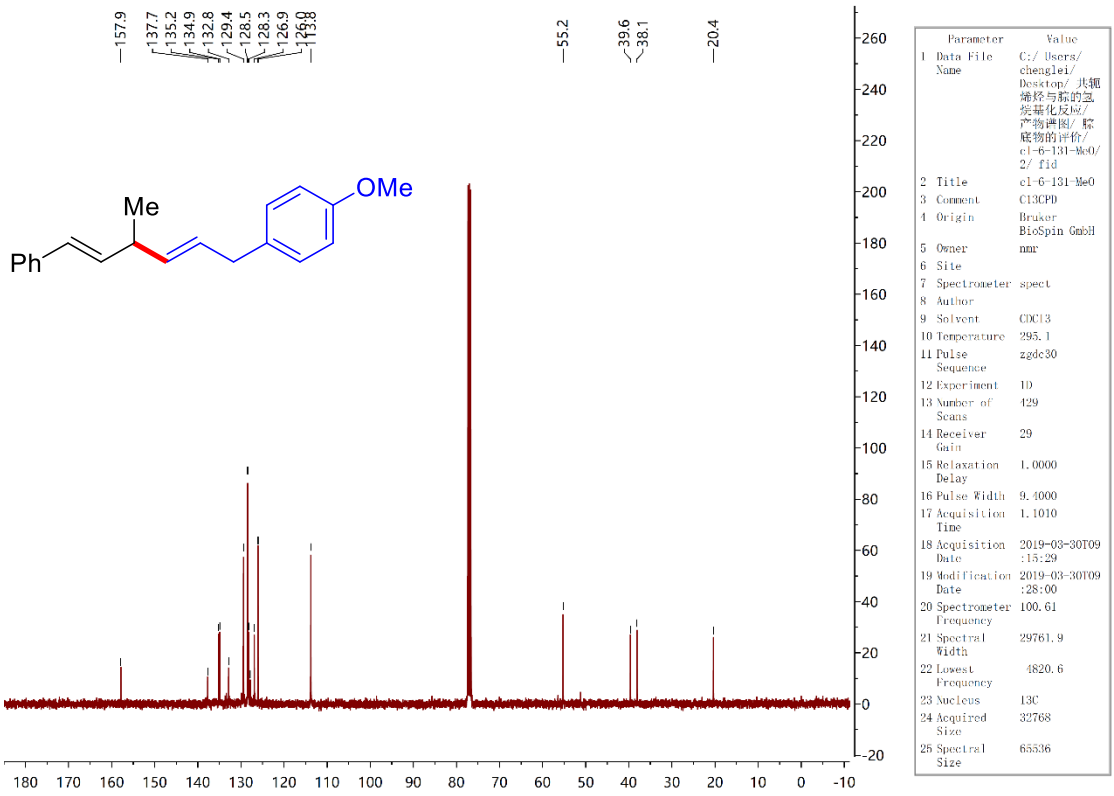
((1*E*,4*E*)-3-methylhexa-1,4-diene-1,6-diyl)dibenzene (6a)



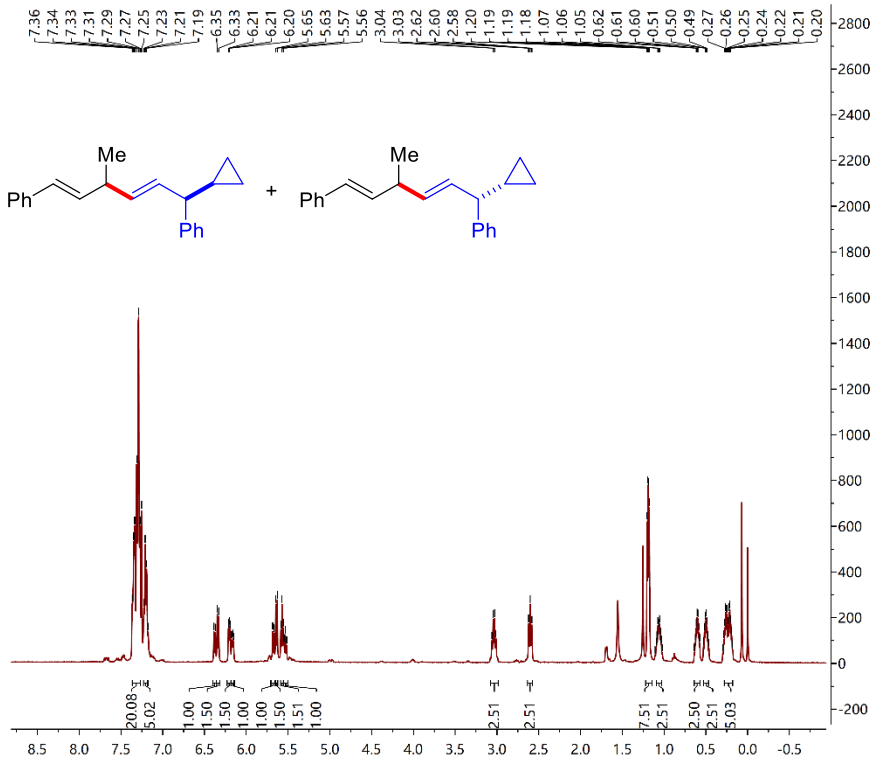


1-methoxy-4-((2*E*,5*E*)-4-methyl-6-phenylhexa-2,5-dien-1-yl)benzene (6b)

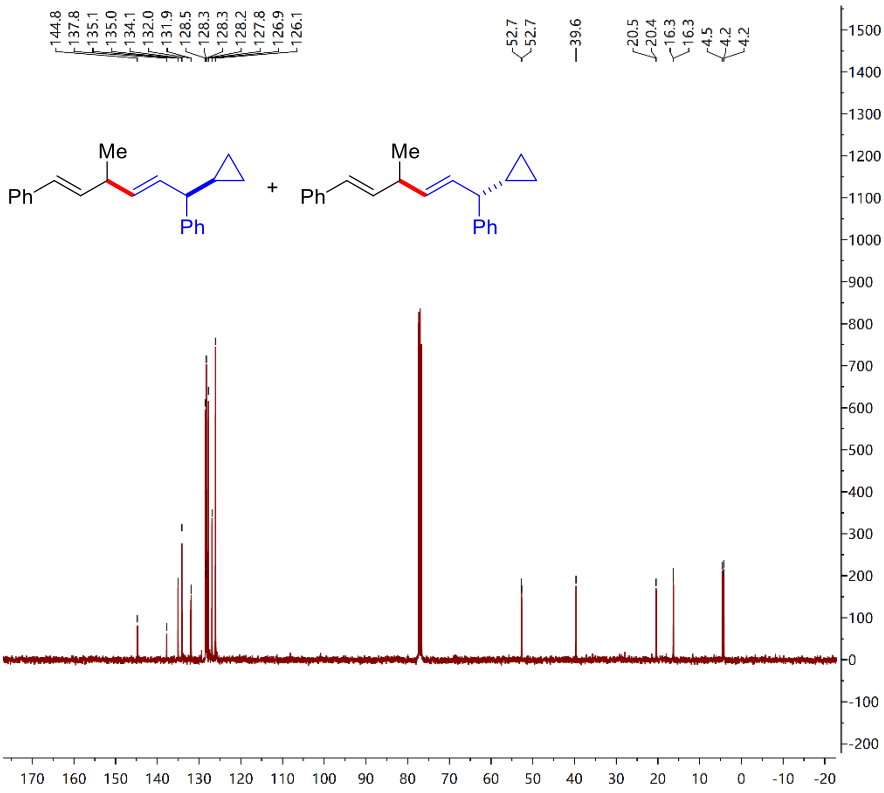




((1*E*,4*E*)-6-cyclopropyl-3-methylhexa-1,4-diene-1,6-diyl)dibenzene (6c)

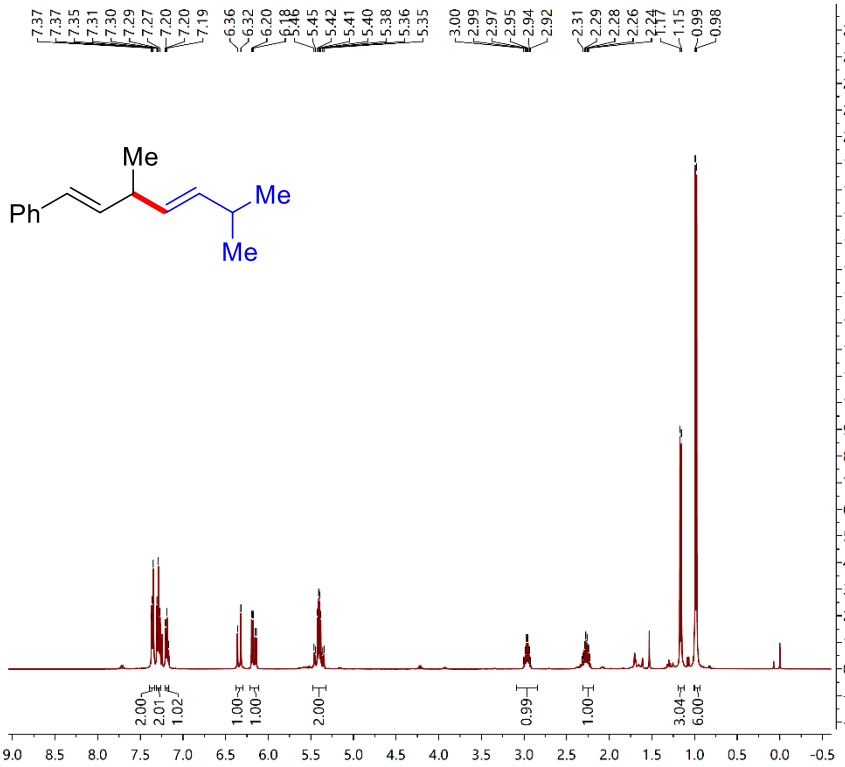


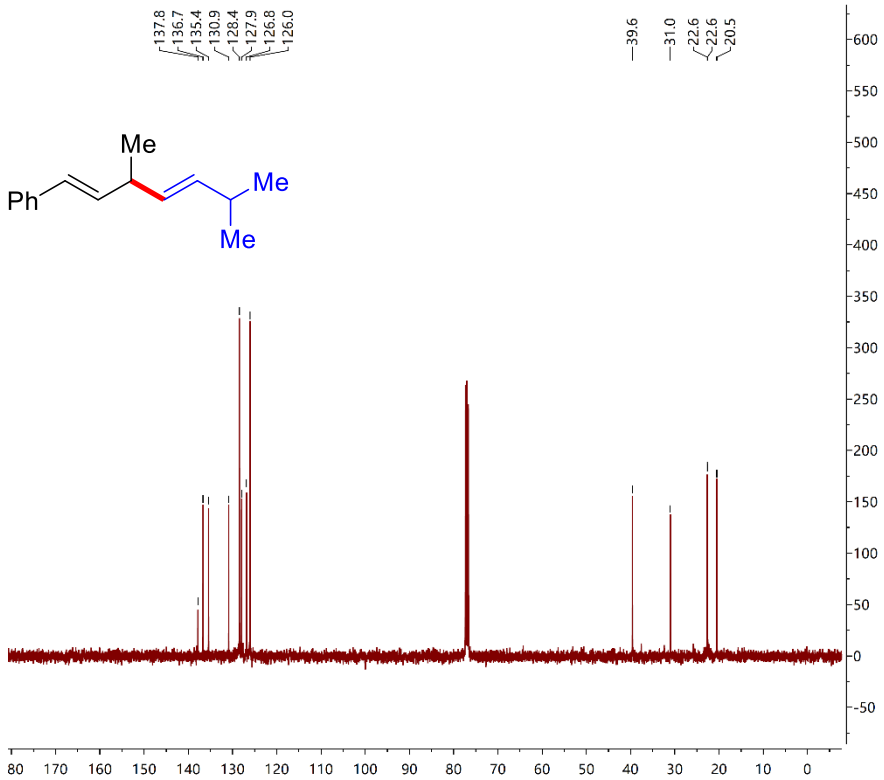
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 胺底物的评价/ CL-6-180/ 1/ fid
2	Title	cl-6-180-p-0422
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	548.3
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	128
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	1.9923
18	Acquisition Date	2019-04-24T23:06:00
19	Modification Date	2019-04-24T23:06:00
20	Spectrometer Frequency	400.23
21	Spectral Width	8223.7
22	Lowest Frequency	1640.3
23	Nucleus	1H
24	Acquired Size	16384
25	Spectral Size	32768



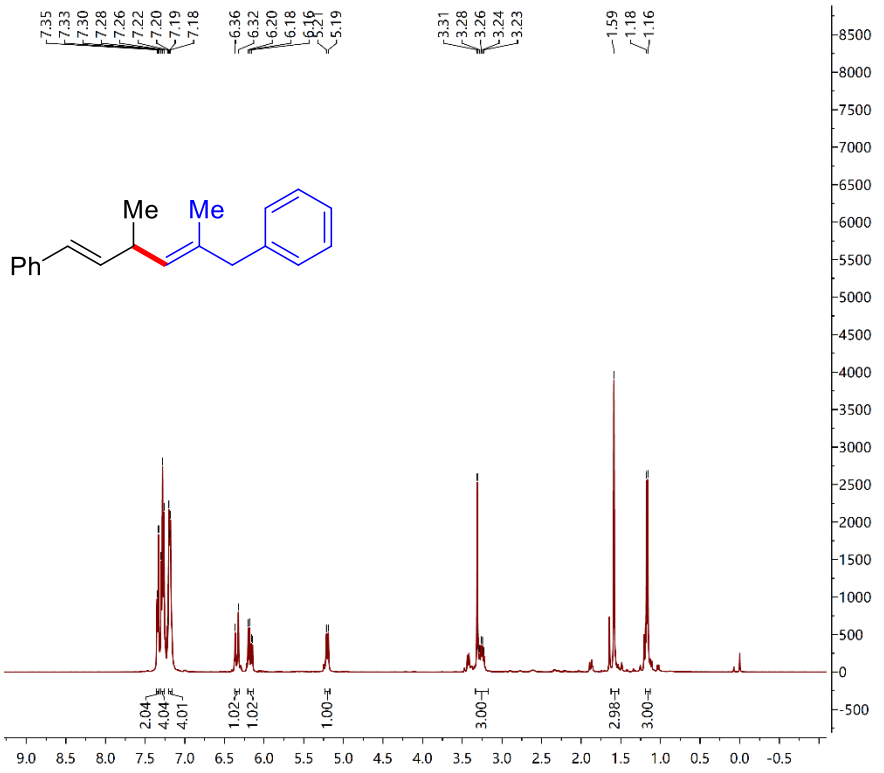
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 胺底物的评价/ CL-6-180/ 2/ fid
2	Title	CL-6-180
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	299.2
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	533
14	Receiver Gain	47
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-04-22T14:19:06
19	Modification Date	2019-04-22T14:30:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

((1*E*,4*E*)-3,6-dimethylhepta-1,4-dien-1-yl)benzene (6d)

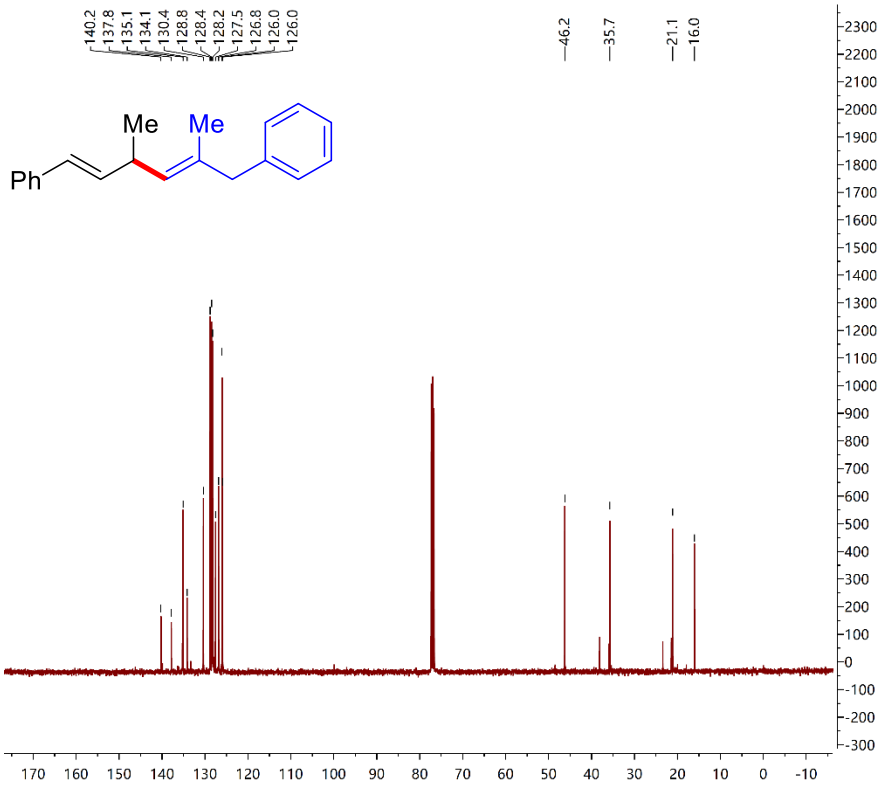




((1*E*,4*E*)-3,5-dimethylhexa-1,4-diene-1,6-diyl)dibenzene (6e)

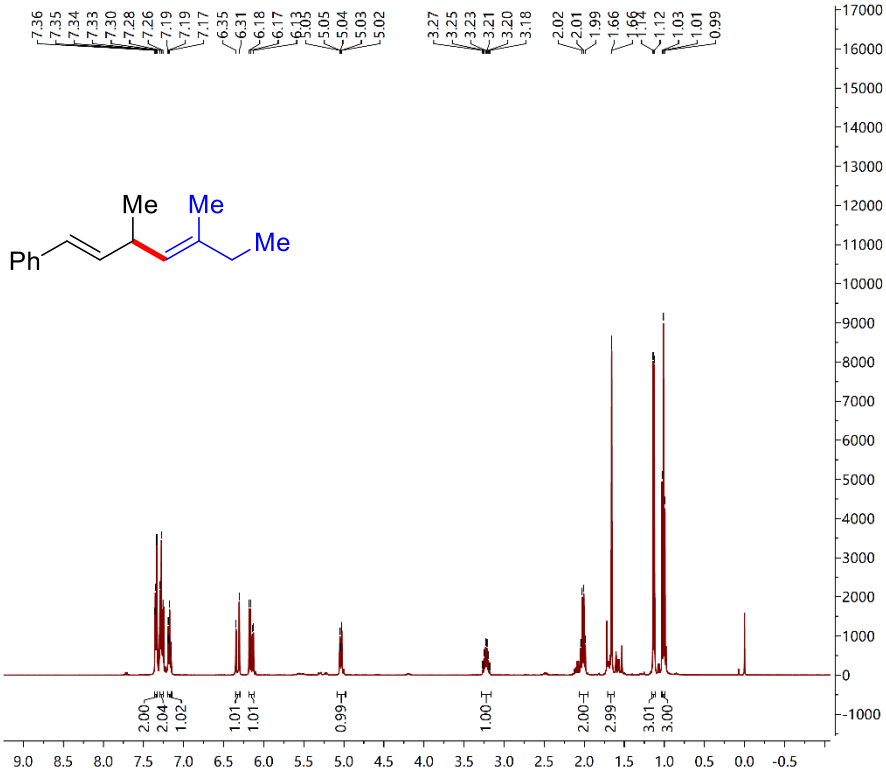


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧统基化反应/ 产物谱图/ 底底物的评价/ cl 6 145 Ph 1/ 1/ fid
2	Title	cl-6-145-Ph-1
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	296.6
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	71
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019-04-06T08:50:40
19	Modification Date	2019-04-06T08:50:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1378.4
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536

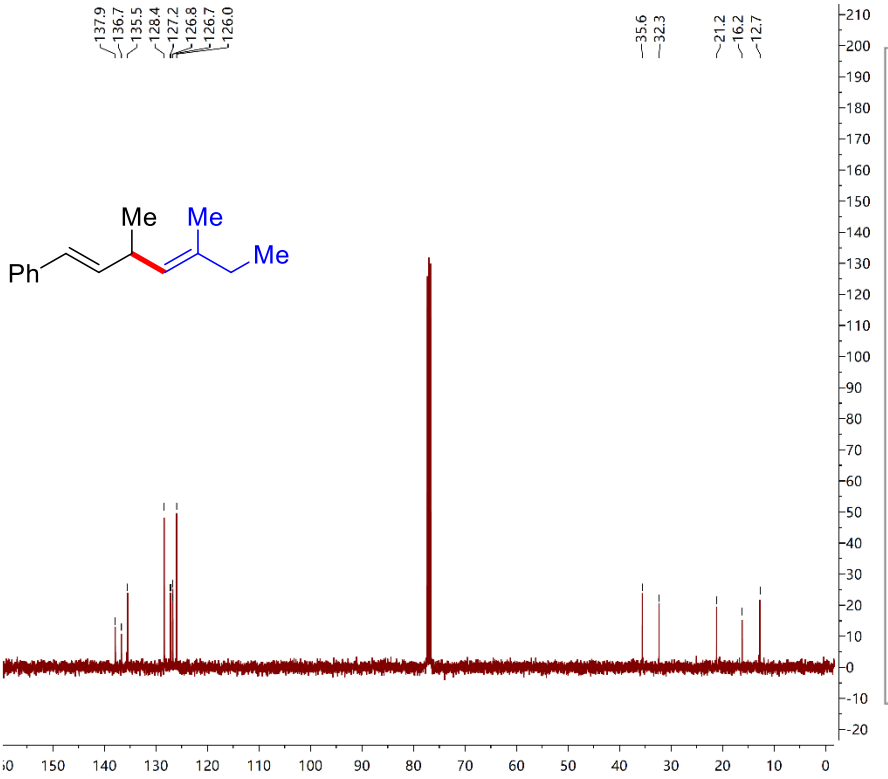


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧统基化反应/ 产物谱图/ 底底物的评价/ cl-6-145-Ph 1/ 2/ fid
2	Title	cl-6-145-Ph-1
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	297.3
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	466
14	Receiver Gain	71
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-04-06T08:55:22
19	Modification Date	2019-04-06T09:03:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

((1*E*,4*E*)-3,5-dimethylhepta-1,4-dien-1-yl)benzene (6f)

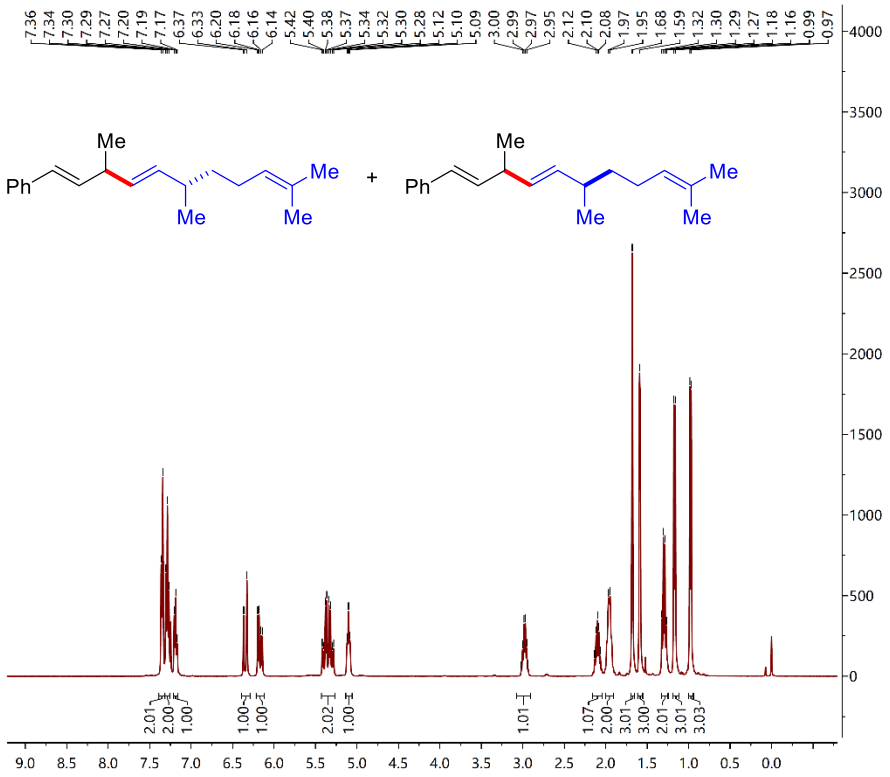


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氧烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-165-2-Me-1/ 1/ fid
2	Title	cl-6-165-2-Me 1
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.3
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	87
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019 04 17T09: 20:54
19	Modification Date	2019 04 17T09: 20:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768

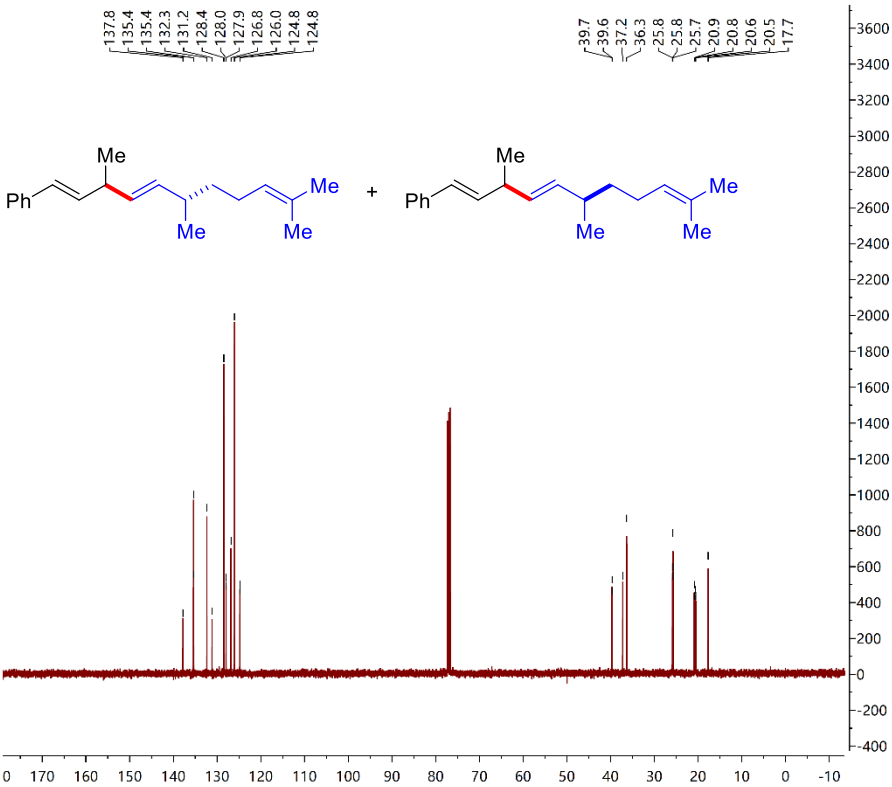


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-165-2-Me-1/ 2/ fid
2	Title	cl-6-165-2-Me-1
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	87
14	Receiver Gain	78
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-04-17T09:21:58
19	Modification Date	2019-04-17T09:24:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-10320.1
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

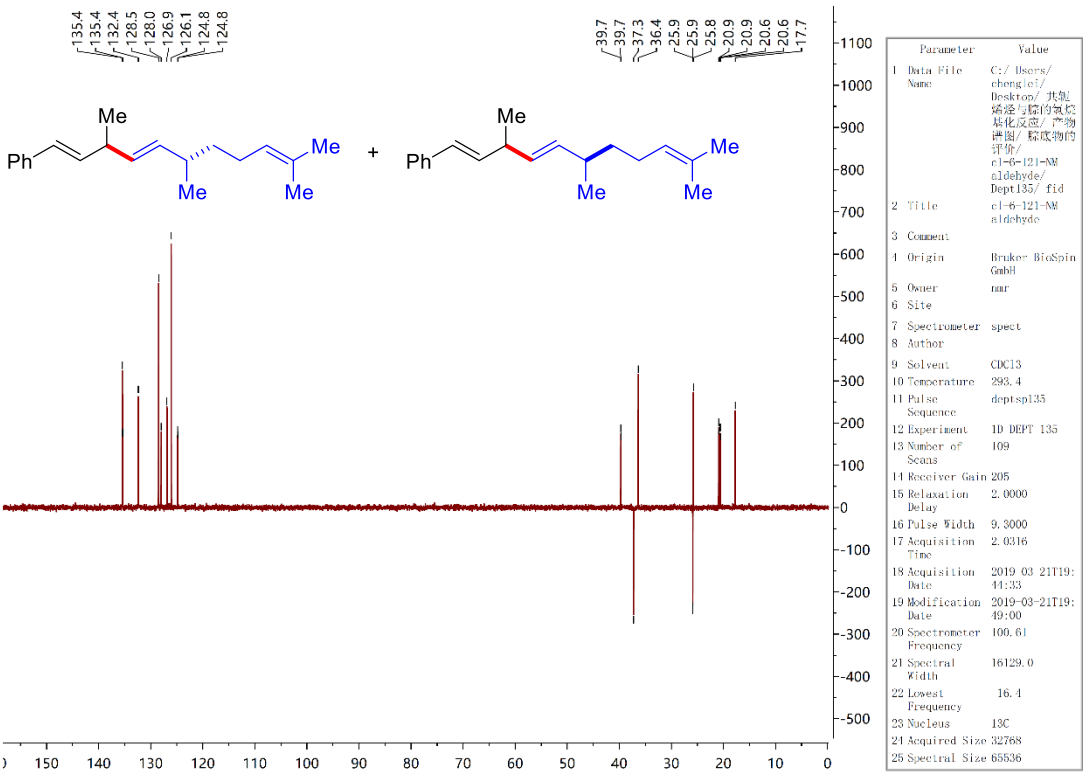
((1*E*,4*E*)-3,6,10-trimethylundeca-1,4,9-trien-1-yl)benzene (6g)



	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氢硅基化反应/ 产物谱图/ 醛底物的评价/ c1 6 121 NM aldehyde/ H/ fid
2	Title	c1-6-112-NM
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	515.0
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	101
15	Relaxation Delay	1.0000
16	Pulse Width	13.7000
17	Acquisition Time	1.9999
18	Acquisition Date	2019 03 21T16: 41:00
19	Modification Date	2019-03-21T16: 41:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	-1640.9
23	Nucleus	1H
24	Acquired Size	16446
25	Spectral Size	65536

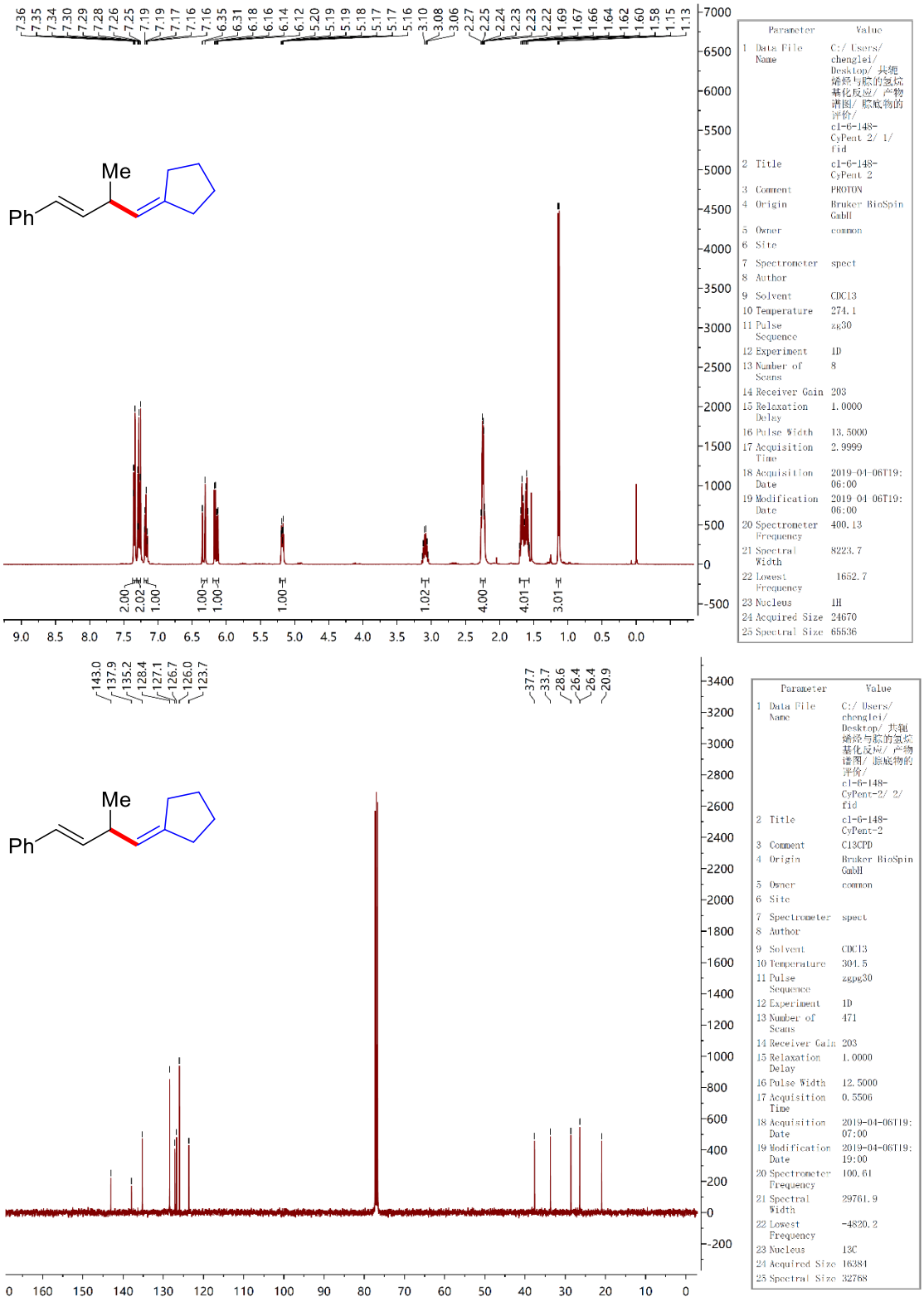


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氢硅基化反应/ 产物谱图/ 醛底物的评价/ c1 6 121 NM aldehyde/ C/ fid
2	Title	c1-6-121-NM aldehyde
3	Comment	13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.6
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	263
14	Receiver Gain	205
15	Relaxation Delay	1.0000
16	Pulse Width	9.3000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-03-21T19: 40:46
19	Modification Date	2019-03-21T19: 40:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	15349.8
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536



	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氧烷基化反应/ 产物谱图/ 标底物的评价/ c1-6-121-NM aldehyde/ Dept135/ fid
2	Title	c1-6-121-NM aldehyde
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.4
11	Pulse Sequence	deptspl135
12	Experiment	1D DEPT 135
13	Number of Scans	109
14	Receiver Gain	205
15	Relaxation Delay	2.0000
16	Pulse Width	9.3000
17	Acquisition Time	2.0316
18	Acquisition Date	2019 03 21T19: 41:33
19	Modification Date	2019-03-21T19: 49:00
20	Spectrometer Frequency	100.61
21	Spectral Width	16129.0
22	Lowest Frequency	16.4
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

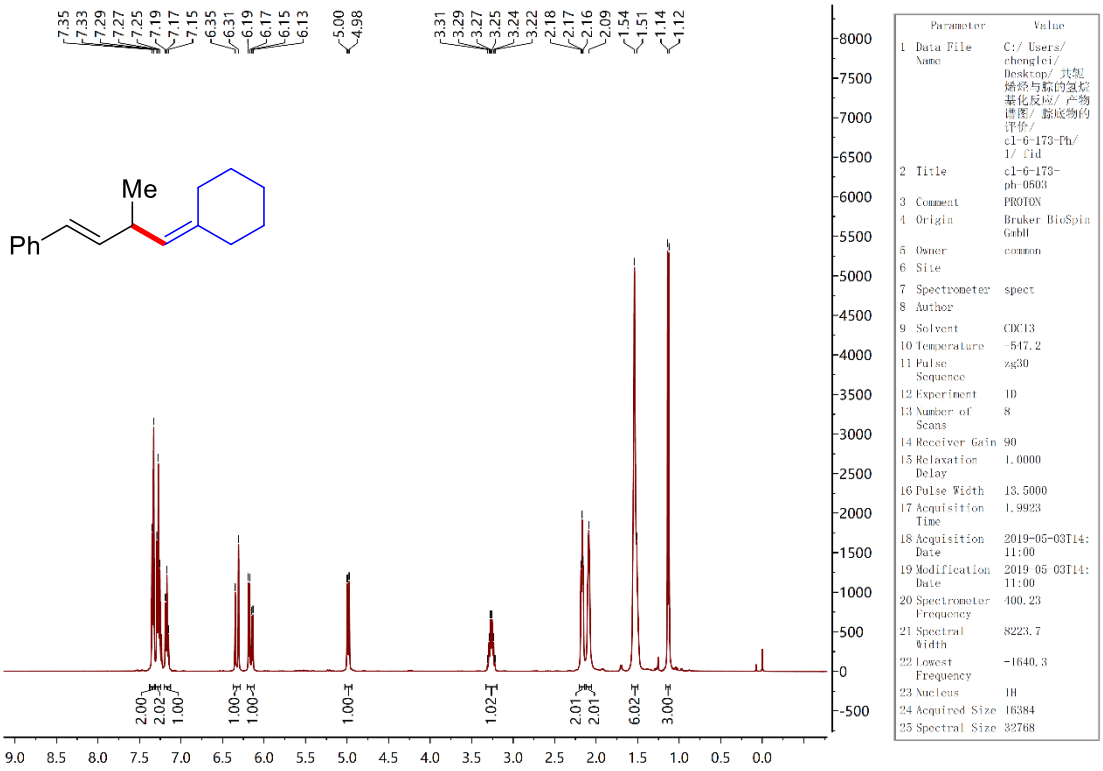
(*E*)-(4-cyclopentylidene-3-methylbut-1-en-1-yl)benzene (6h)



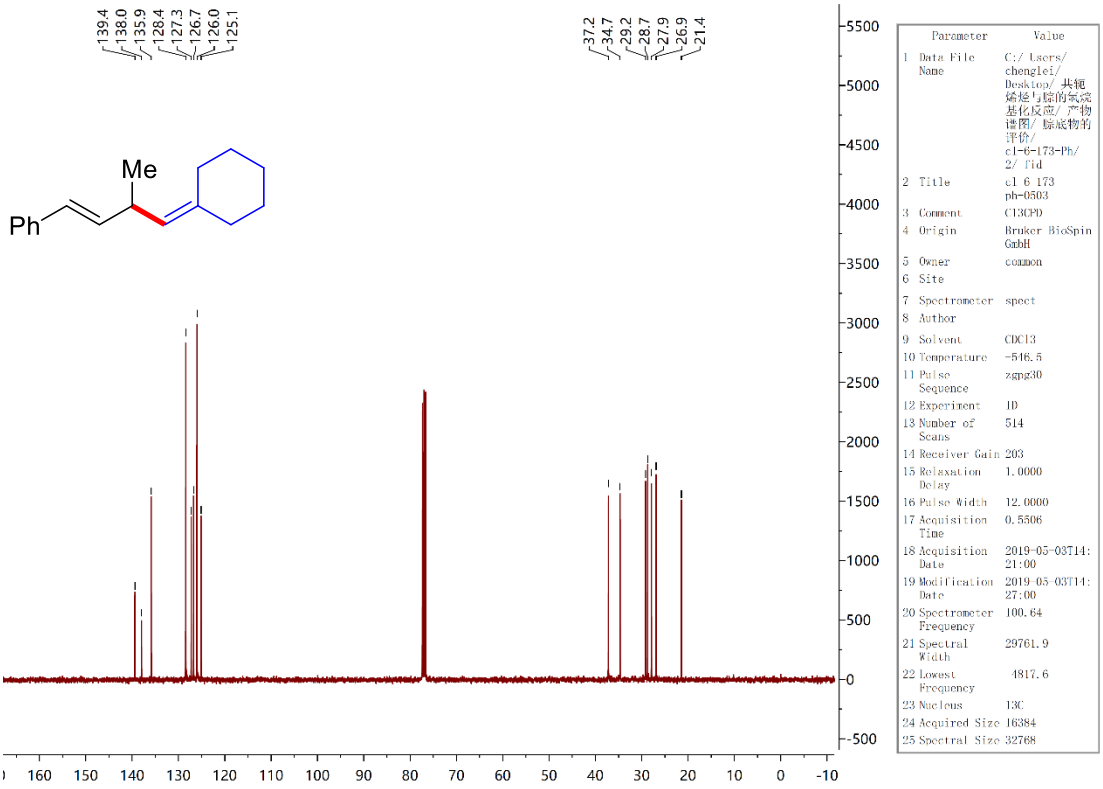
	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-148-CyPent 2/ 1/ fid
2	Title	cl-6-148-CyPent 2
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	274.1
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	2.9999
18	Acquisition Date	2019-04-06T19:06:00
19	Modification Date	2019 04 06T19:06:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8223.7
22	Lowest Frequency	1652.7
23	Nucleus	1H
24	Acquired Size	24670
25	Spectral Size	65536

	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-148-CyPent-2/ 2/ fid
2	Title	cl-6-148-CyPent-2
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	304.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	471
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.5000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-04-06T19:07:00
19	Modification Date	2019-04-06T19:19:00
20	Spectrometer Frequency	100.61
21	Spectral Width	29761.9
22	Lowest Frequency	-4820.2
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-(4-cyclohexylidene-3-methylbut-1-en-1-yl)benzene (6i)

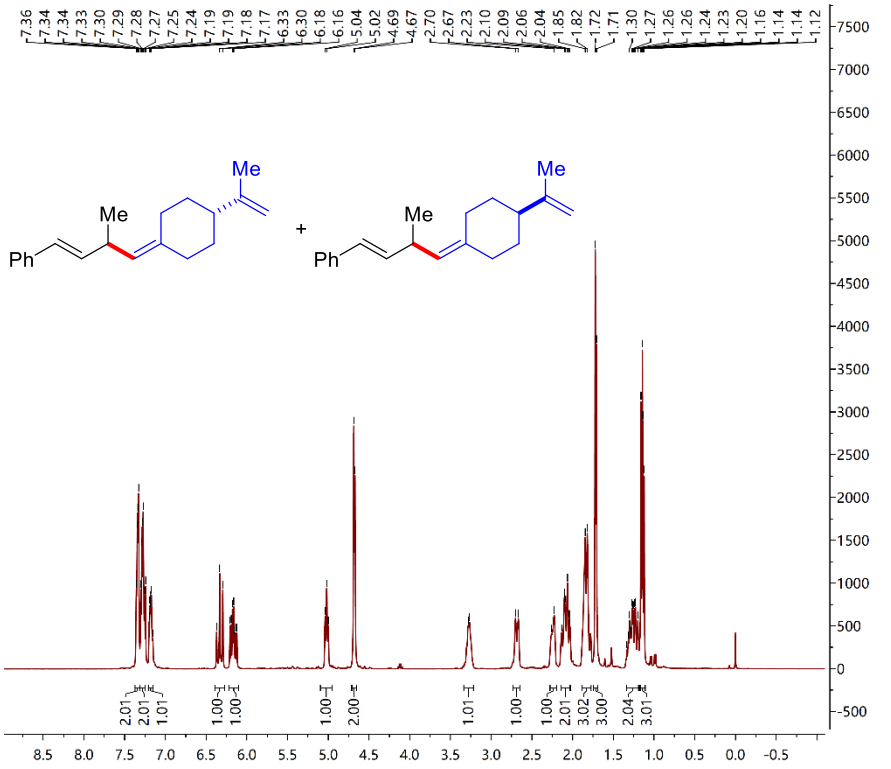


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氢烷基化反应/ 产物谱图/ 原底物的评价/ cl-6-173-Ph/ 1/ fid
2	Title	cl-6-173-ph-0503
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-547.2
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	90
15	Relaxation Delay	1.0000
16	Pulse Width	13.5000
17	Acquisition Time	1.9923
18	Acquisition Date	2019-05-03T14:11:00
19	Modification Date	2019-05-03T14:11:00
20	Spectrometer Frequency	400.23
21	Spectral Width	8223.7
22	Lowest Frequency	-1640.3
23	Nucleus	1H
24	Acquired Size	16384
25	Spectral Size	32768

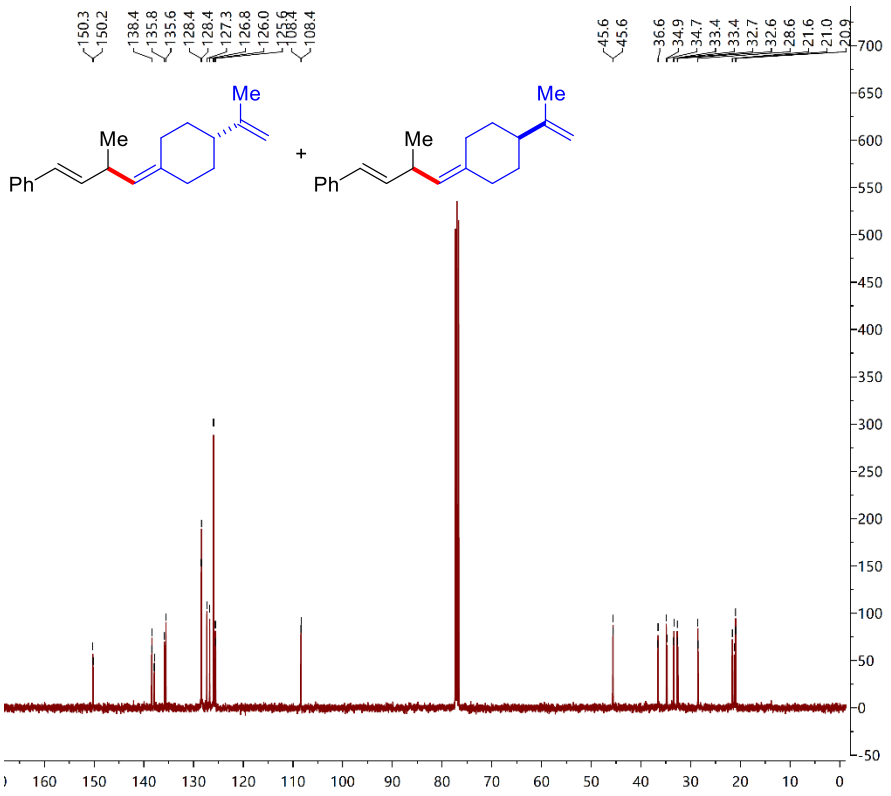


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与醛的氢烷基化反应/ 产物谱图/ 原底物的评价/ cl-6-173-Ph/ 2/ fid
2	Title	cl 6 173 ph-0503
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	common
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	-546.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	514
14	Receiver Gain	203
15	Relaxation Delay	1.0000
16	Pulse Width	12.0000
17	Acquisition Time	0.5506
18	Acquisition Date	2019-05-03T14:21:00
19	Modification Date	2019-05-03T14:27:00
20	Spectrometer Frequency	100.64
21	Spectral Width	29761.9
22	Lowest Frequency	-4817.6
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-(3-methyl-4-(4-(prop-1-en-2-yl)cyclohexylidene)but-1-en-1-yl)benzene (6j)

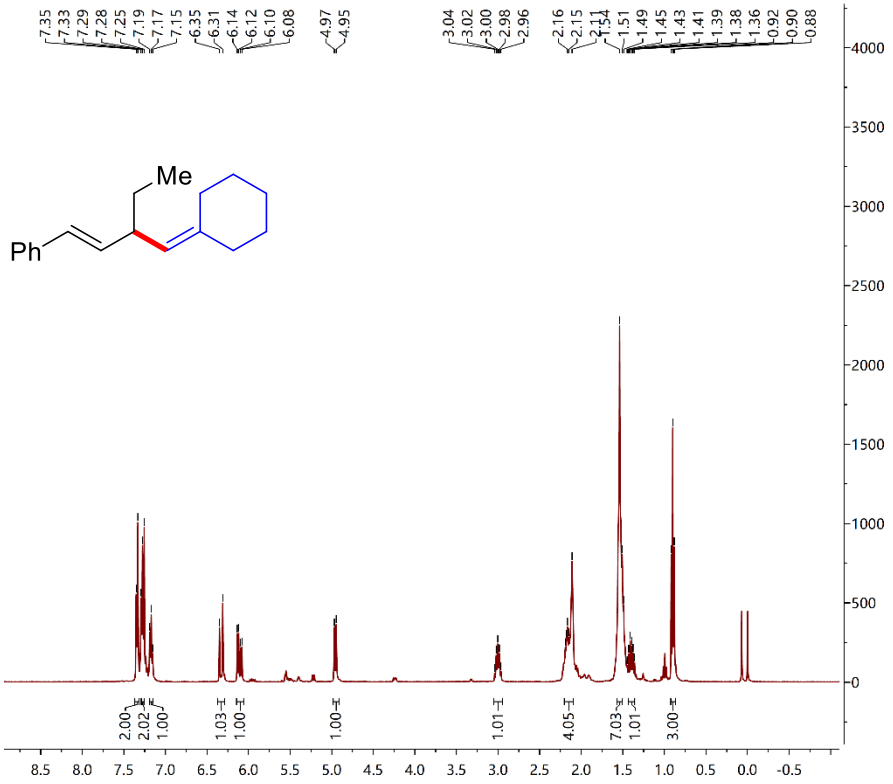


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ c1 6 144 ZSQ 1/ 1/ fid
2	Title	c1-6-144-ZSQ-1
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.2
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	63
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	1.9999
18	Acquisition Date	2019-04-05T01: 10:44
19	Modification Date	2019-04-05T01: 10:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	16025
25	Spectral Size	32768

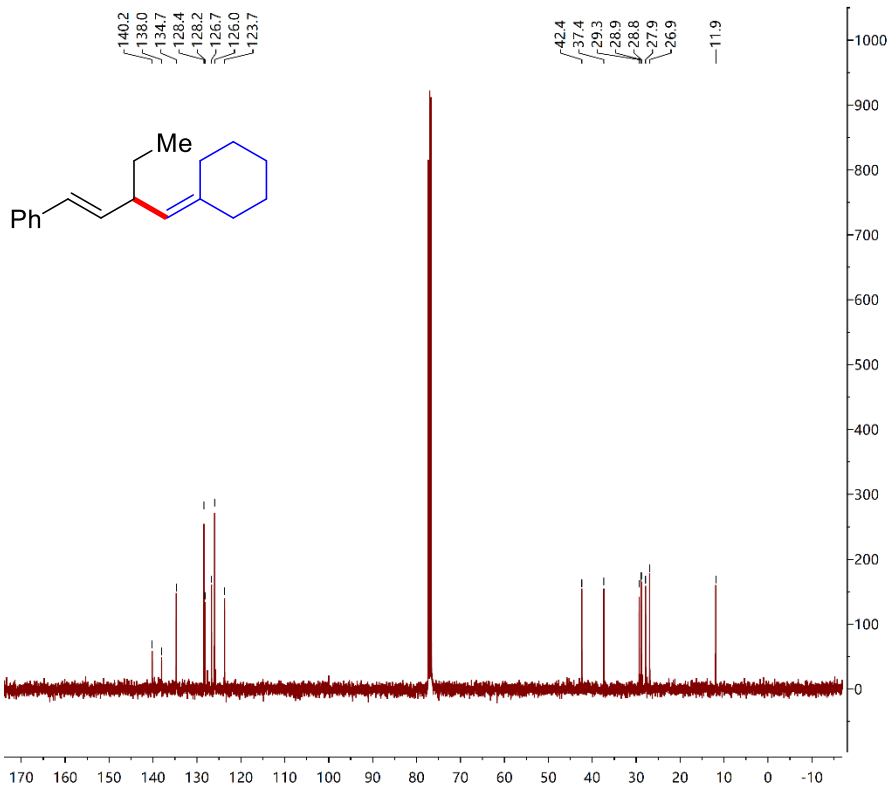


	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ c1-6-144-ZSQ 1/ 2/ fid
2	Title	c1-6-144-ZSQ-1
3	Comment	test
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	295.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	443
14	Receiver Gain	71
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-04-05T01: 12:12
19	Modification Date	2019 04 05T01: 25:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	-10320.1
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-(3-(cyclohexylidenemethyl)pent-1-en-1-yl)benzene (6k)

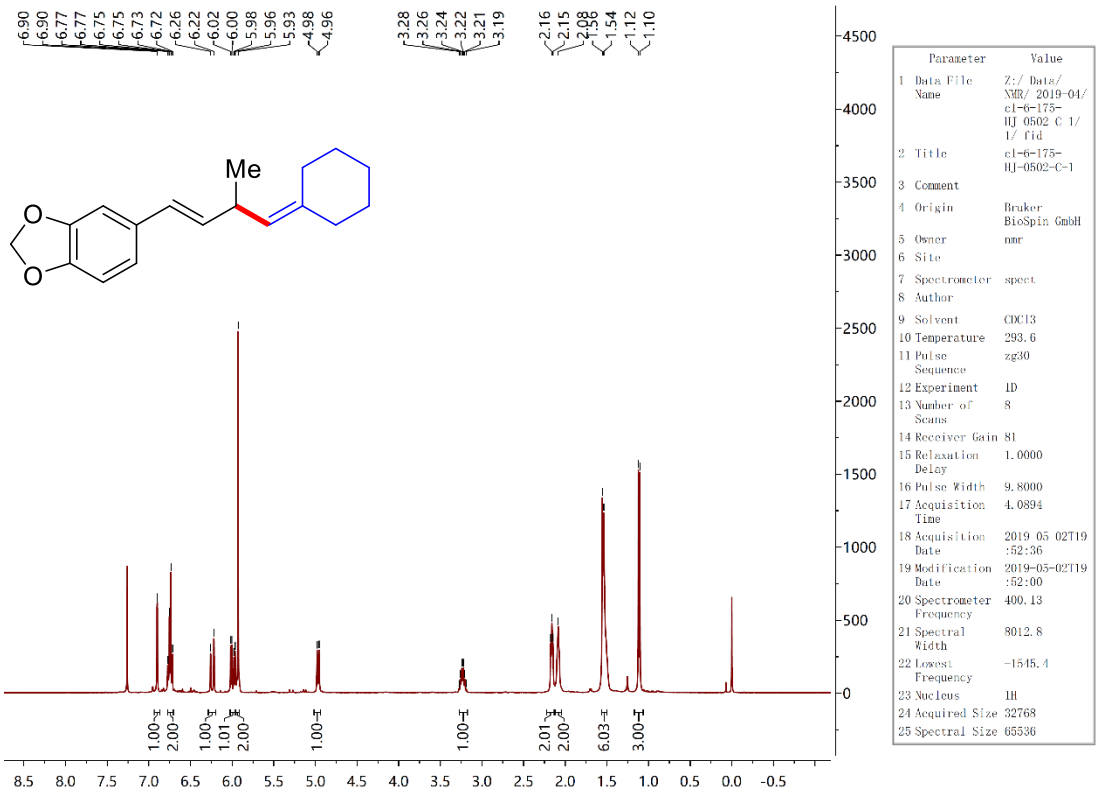


	Parameter	Value
1	Data File Name	C:/ Users/ chengfei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 原底物的评价/ CL-6-173-Me-Ph补C/ 1/ fid
2	Title	CL-6-173-Me-Ph补C
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	298.7
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	157
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019-04-22T13:55:33
19	Modification Date	2019-04-22T13:55:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1584.6
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536

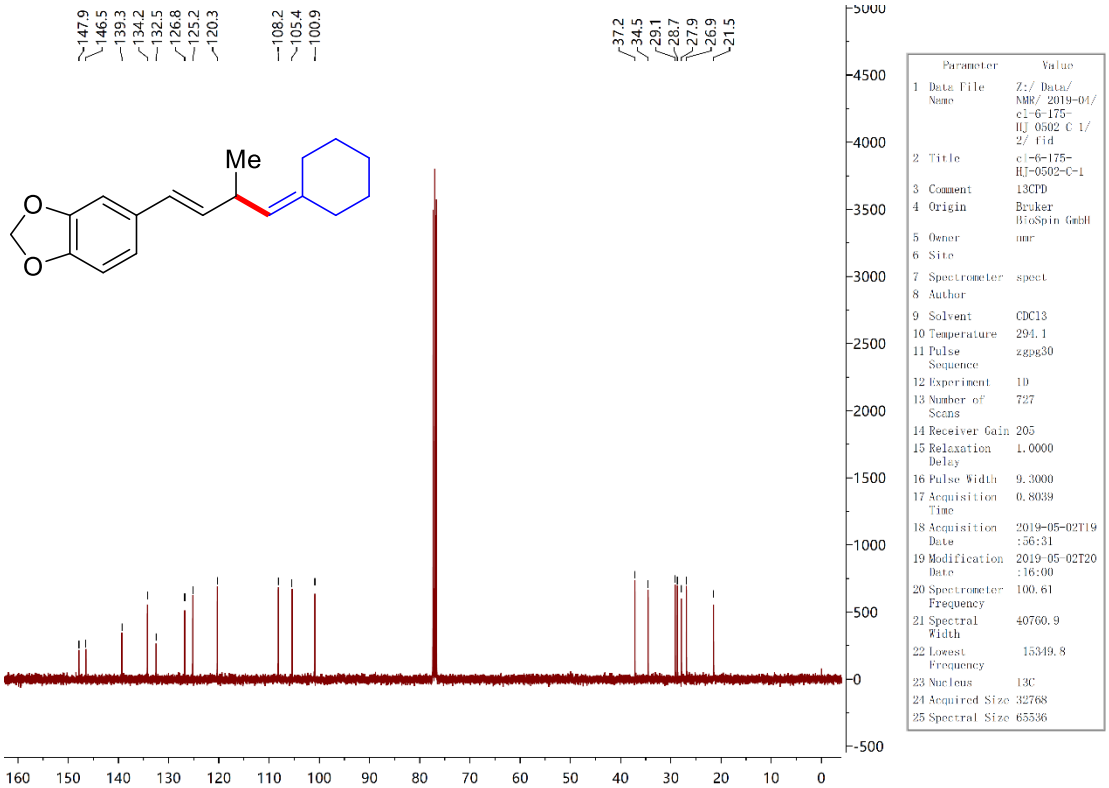


	Parameter	Value
1	Data File Name	C:/ Users/ chengfei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 原底物的评价/ CL-6-173-Me-Ph补C/ 2/ fid
2	Title	CL-6-173-Me-Ph补C
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	299.2
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	333
14	Receiver Gain	87
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-04-22T13:57:16
19	Modification Date	2019-04-22T14:04:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

(*E*)-5-(4-cyclohexylidene-3-methylbut-1-en-1-yl)benzo[d][1,3]dioxole (6l)

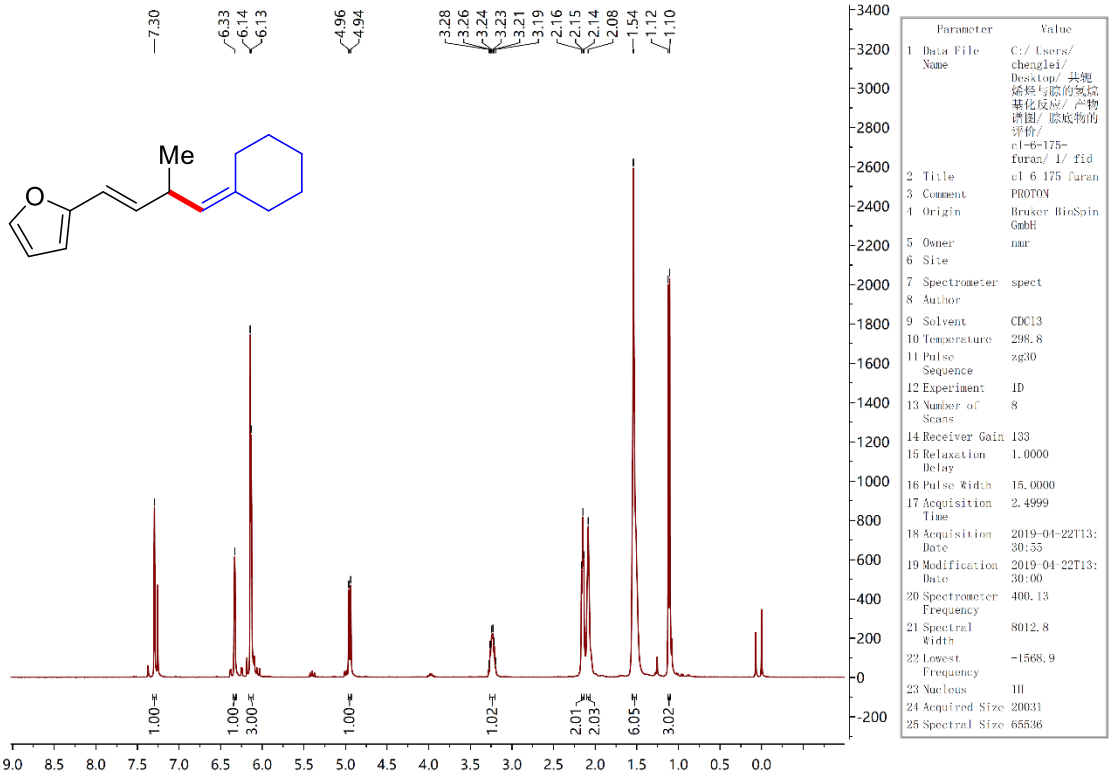


	Parameter	Value
1	Data File Name	Z:/ Data/ NMR/ 2019-04/ cl-6-175- HJ 0502 C 1/ 1/ fid
2	Title	cl-6-175-HJ-0502-C-1
3	Comment	
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	293.6
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	81
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	4.0894
18	Acquisition Date	2019 05 02T19 :52:36
19	Modification Date	2019-05-02T19 :52:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1545.4
23	Nucleus	1H
24	Acquired Size	32768
25	Spectral Size	65536



	Parameter	Value
1	Data File Name	Z:/ Data/ NMR/ 2019-04/ cl-6-175- HJ 0502 C 1/ 2/ fid
2	Title	cl-6-175-HJ-0502-C-1
3	Comment	13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	294.1
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	727
14	Receiver Gain	205
15	Relaxation Delay	1.0000
16	Pulse Width	9.3000
17	Acquisition Time	0.8039
18	Acquisition Date	2019-05-02T19 :56:31
19	Modification Date	2019-05-02T20 :16:00
20	Spectrometer Frequency	100.61
21	Spectral Width	40760.9
22	Lowest Frequency	15349.8
23	Nucleus	13C
24	Acquired Size	32768
25	Spectral Size	65536

(*E*)-2-(4-cyclohexylidene-3-methylbut-1-en-1-yl)furan (6m)



	Parameter	Value
1	Data File Name	C:/ Users/ chenglei/ Desktop/ 共轭烯烃与胺的氢烷基化反应/ 产物谱图/ 胺底物的评价/ cl-6-175-furan/ 1/ fid
2	Title	cl-6-175-furan
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	298.8
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	133
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019-04-22T13:30:55
19	Modification Date	2019-04-22T13:30:00
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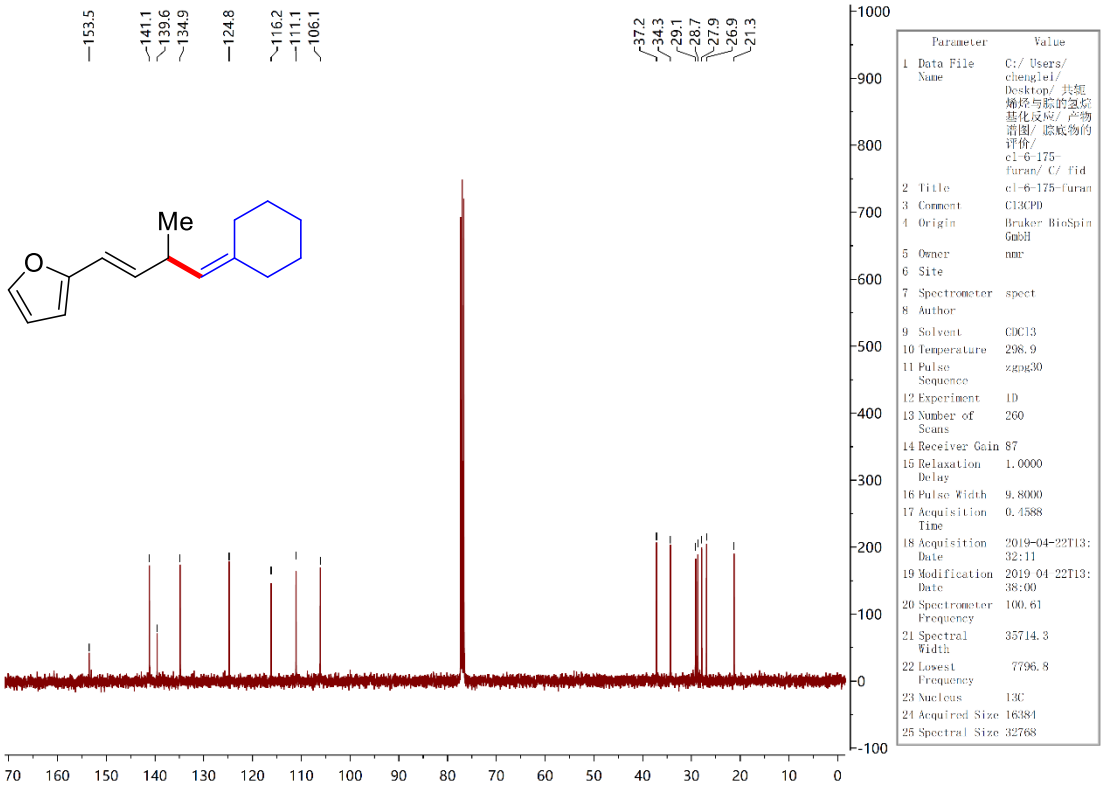
21	Spectral Width	8012.8
22	Lowest Frequency	-1568.9
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536



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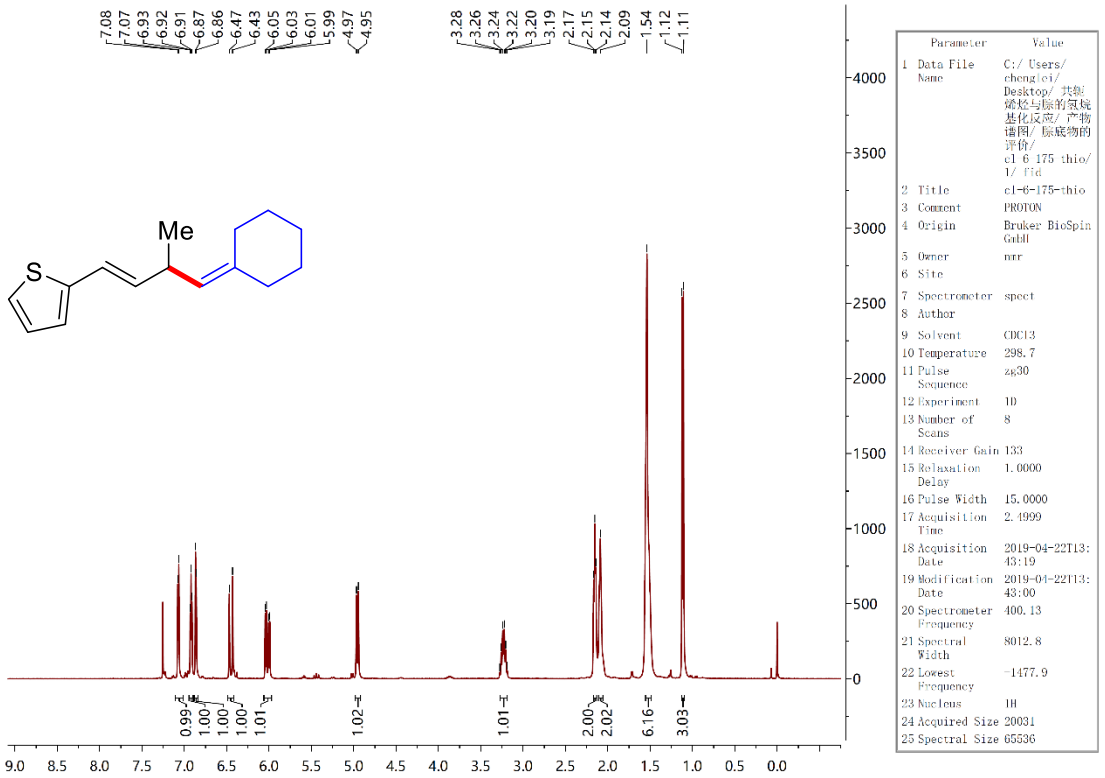
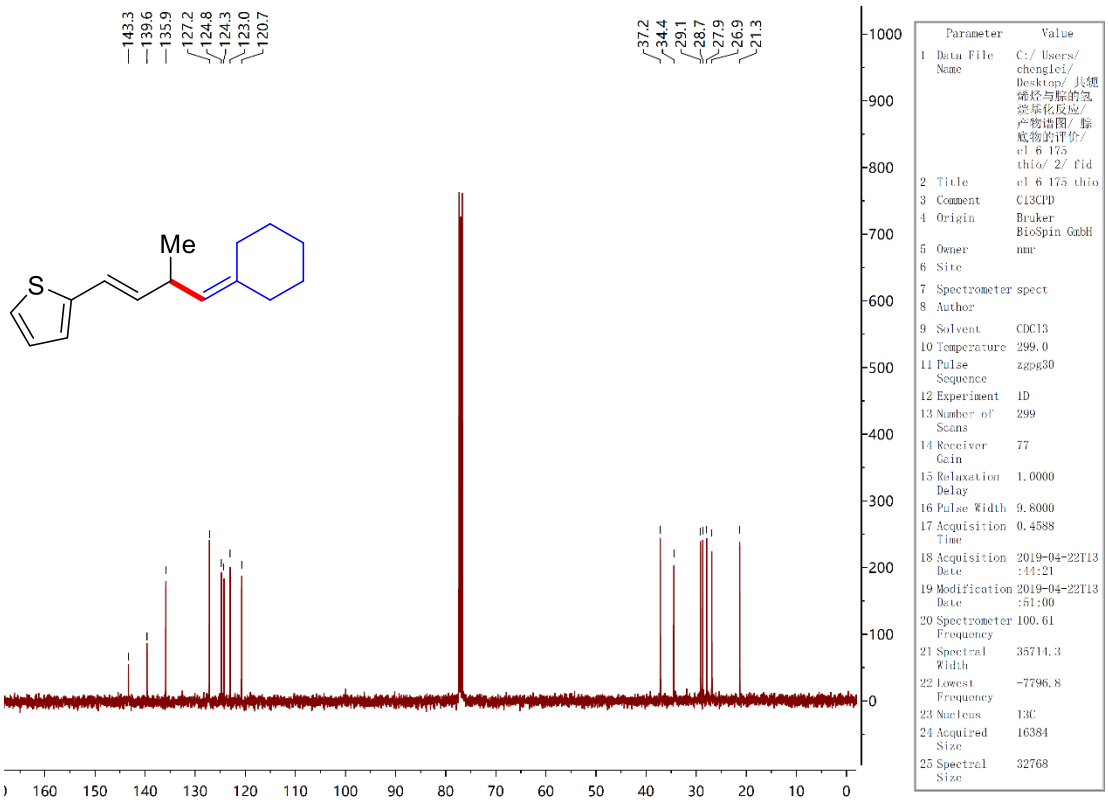
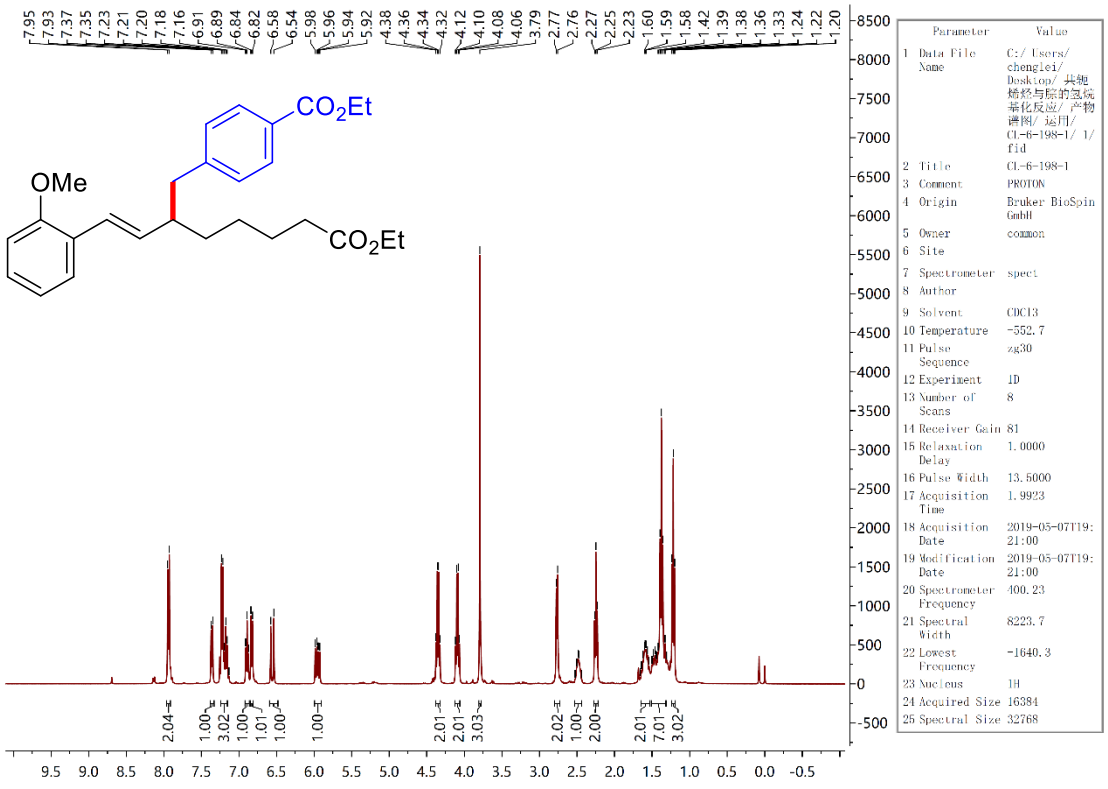
2	Title	cl-6-175-furan
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	CDCl3
10	Temperature	298.9
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	260
14	Receiver Gain	87
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-04-22T13:32:11
19	Modification Date	2019-04-22T13:38:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768

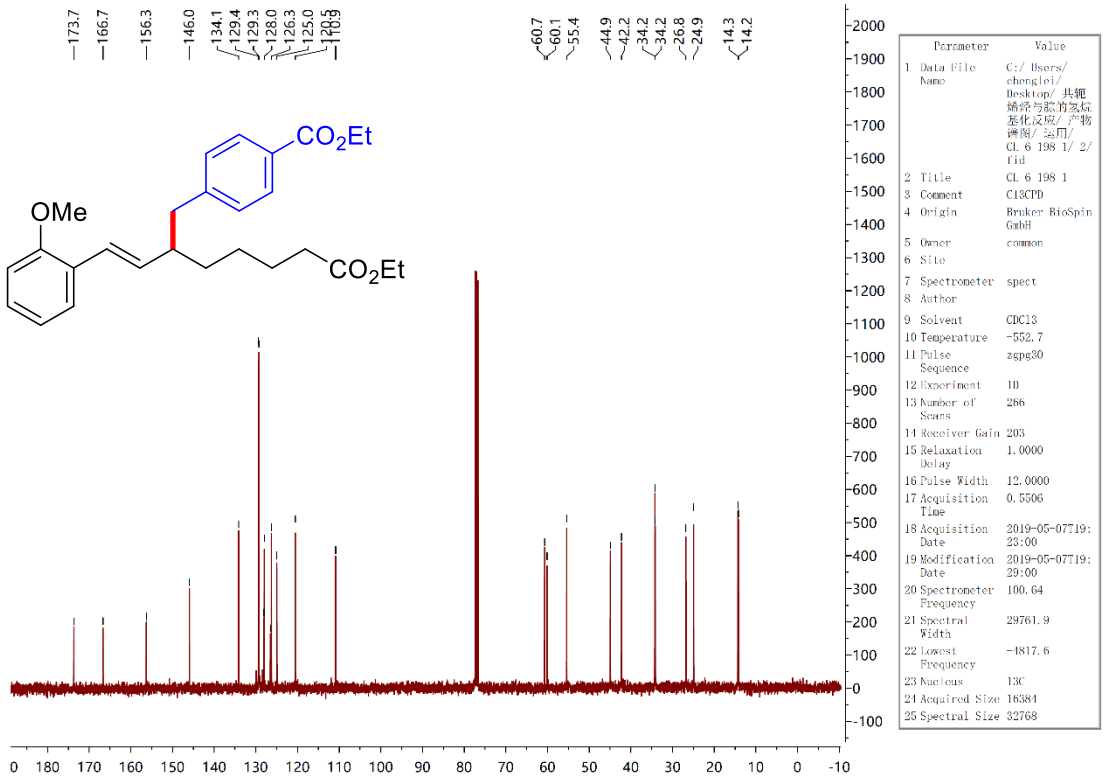
(*E*)-2-(4-cyclohexylidene-3-methylbut-1-en-1-yl)thiophene (6n)



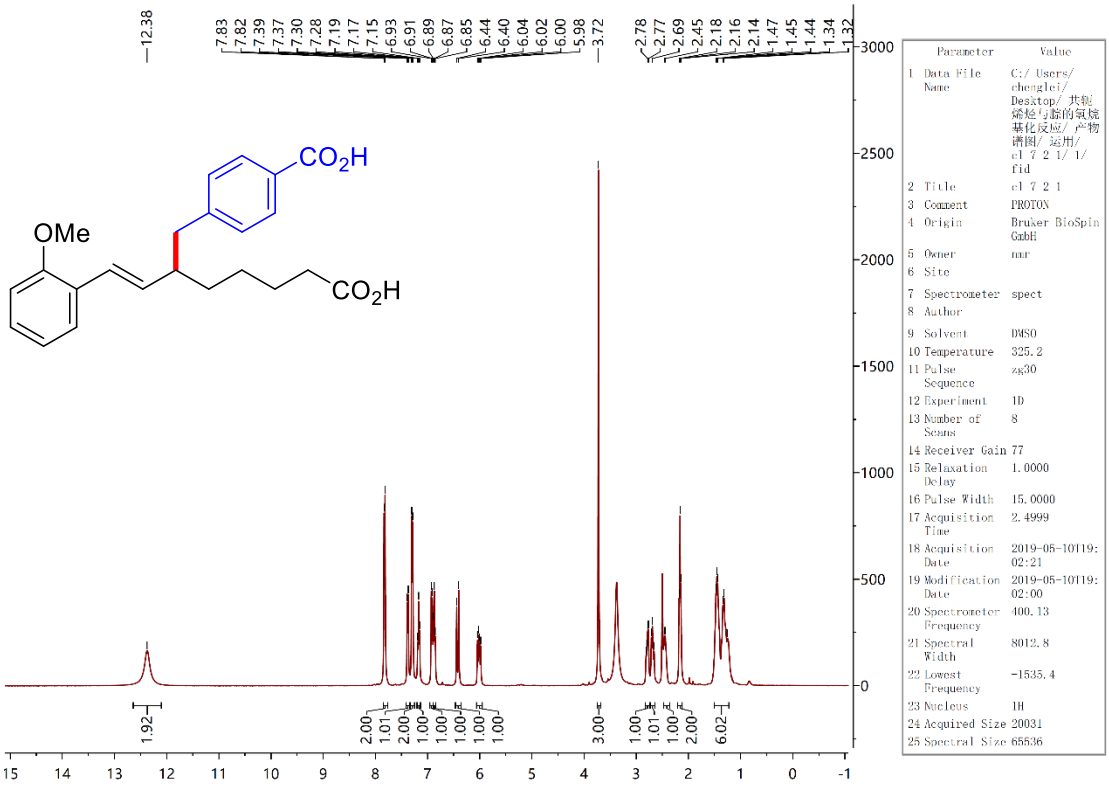


Ethyl (*E*)-4-(7-ethoxy-2-(2-methoxystyryl)-7-oxoheptyl)benzoate (7)





(*E*)-4-(6-carboxy-2-(2-methoxystyryl)hexyl)benzoic acid (8)



	Parameter	Value
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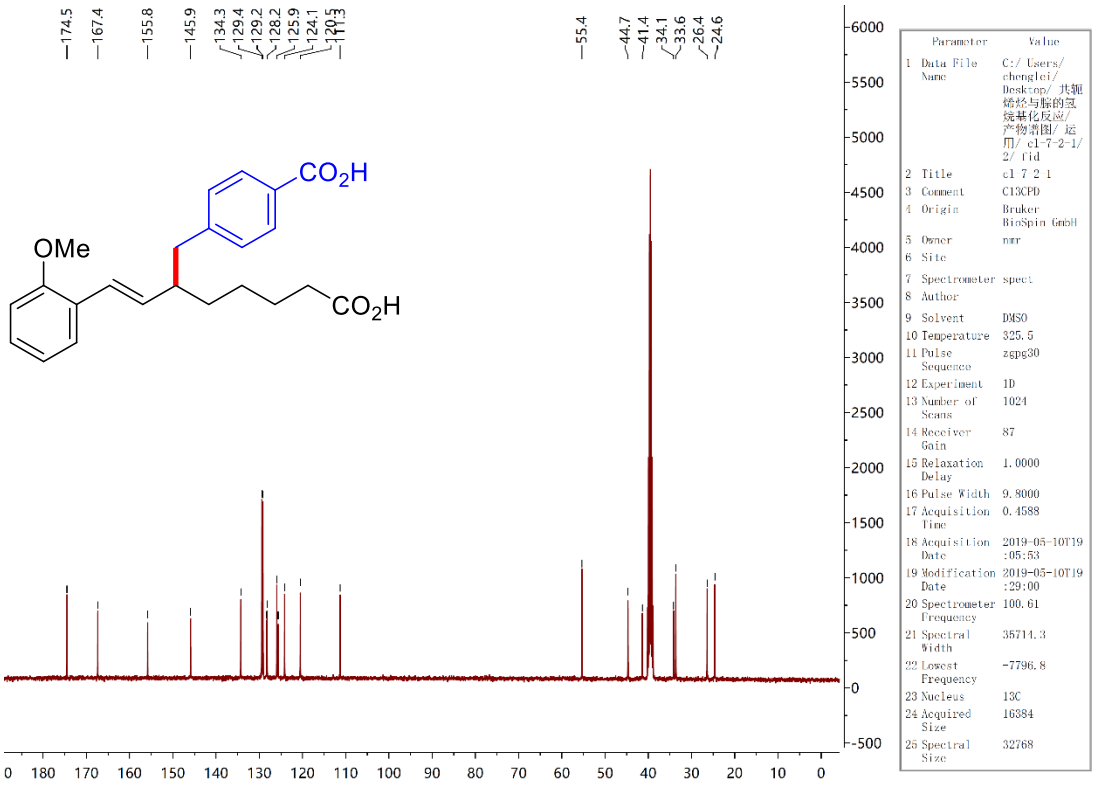
2	Title	cl 7 2 1
3	Comment	PROTON
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	DMSO
10	Temperature	325.2
11	Pulse Sequence	zg30
12	Experiment	1D
13	Number of Scans	8
14	Receiver Gain	77
15	Relaxation Delay	1.0000
16	Pulse Width	15.0000
17	Acquisition Time	2.4999
18	Acquisition Date	2019-05-10T19:02:21
19	Modification Date	2019-05-10T19:02:00
20	Spectrometer Frequency	400.13
21	Spectral Width	8012.8
22	Lowest Frequency	-1535.4
23	Nucleus	1H
24	Acquired Size	20031
25	Spectral Size	65536



	Parameter	Value
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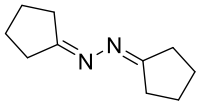
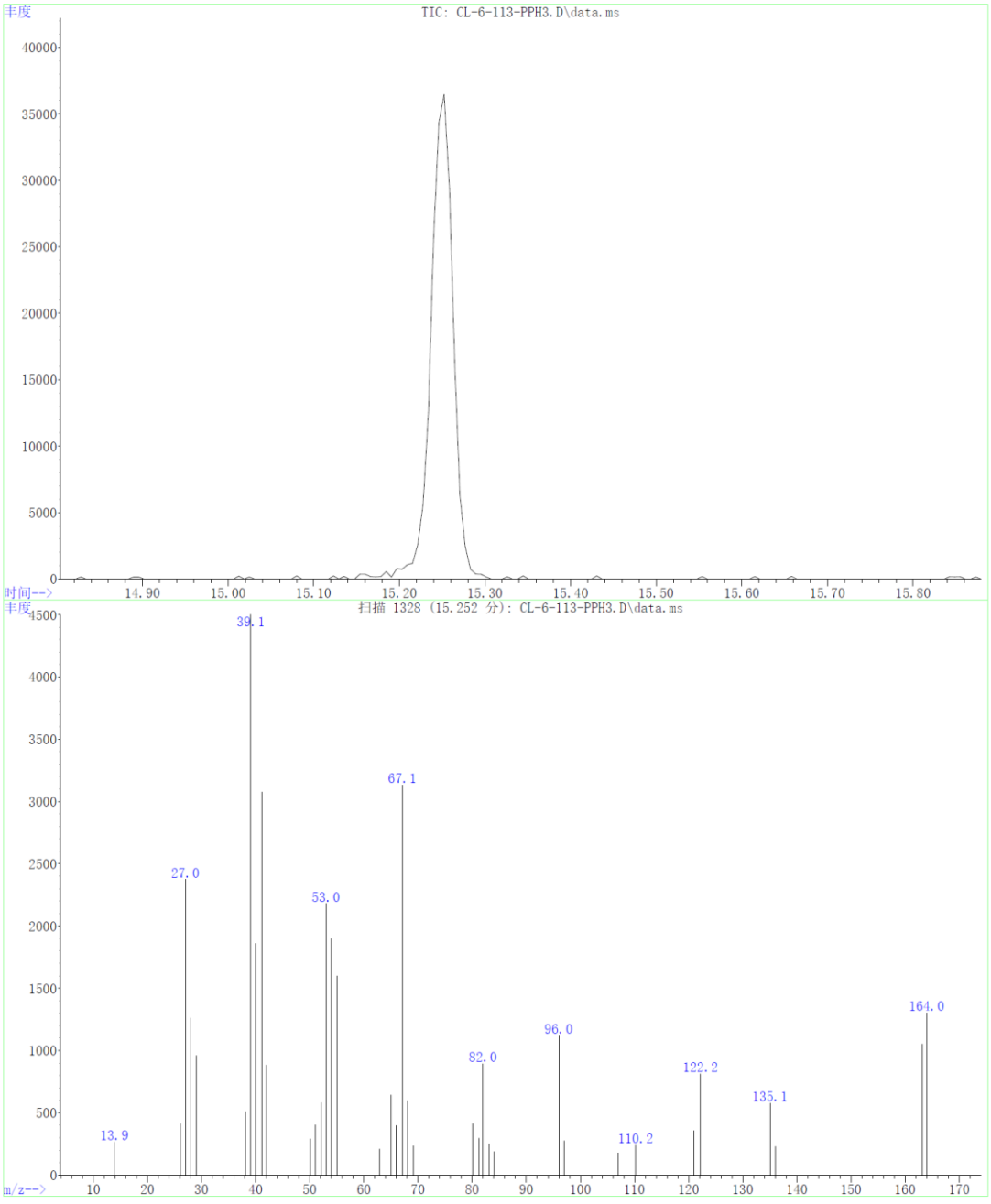
2	Title	cl 7 2 1
3	Comment	C13CPD
4	Origin	Bruker BioSpin GmbH
5	Owner	nmr
6	Site	
7	Spectrometer	spect
8	Author	
9	Solvent	DMSO
10	Temperature	325.5
11	Pulse Sequence	zgpg30
12	Experiment	1D
13	Number of Scans	1024
14	Receiver Gain	87
15	Relaxation Delay	1.0000
16	Pulse Width	9.8000
17	Acquisition Time	0.4588
18	Acquisition Date	2019-05-10T19:05:53
19	Modification Date	2019-05-10T19:29:00
20	Spectrometer Frequency	100.61
21	Spectral Width	35714.3
22	Lowest Frequency	-7796.8
23	Nucleus	13C
24	Acquired Size	16384
25	Spectral Size	32768



GC-MS chromatograph of azine **5**:
GC-MS (EI) *m/z* calcd for $C_{10}H_{16}N_2$: 164.13, Found: 164.20

文件　　：E:\DATA\CL\CL-6-113-PPH3.D
操作员　　：CL
已采集　　：14 Mar 2019 14:36 ，使用采集方法 TEST-1.M
仪器：　5975
样品名称　：
其他信息　：
样品瓶号　：0



8. References

(1) a) T. Preuß, W. Saak and S. Doye, *Chem. Eur. J.*, 2013, **19**, 3833; b) F. Pünner, A. Schmidt and G. Hilt, *Angew. Chem., Int. Ed.*, 2012, **51**, 1270.

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