Electronic Supplementary Material (ESI) for Chemical Communications.


*Supporting Information*

# Regiospecific constructing *m*-alkenyl benzaldehyde from *β*-bromoenal and yinyl borate

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## 1. General Information

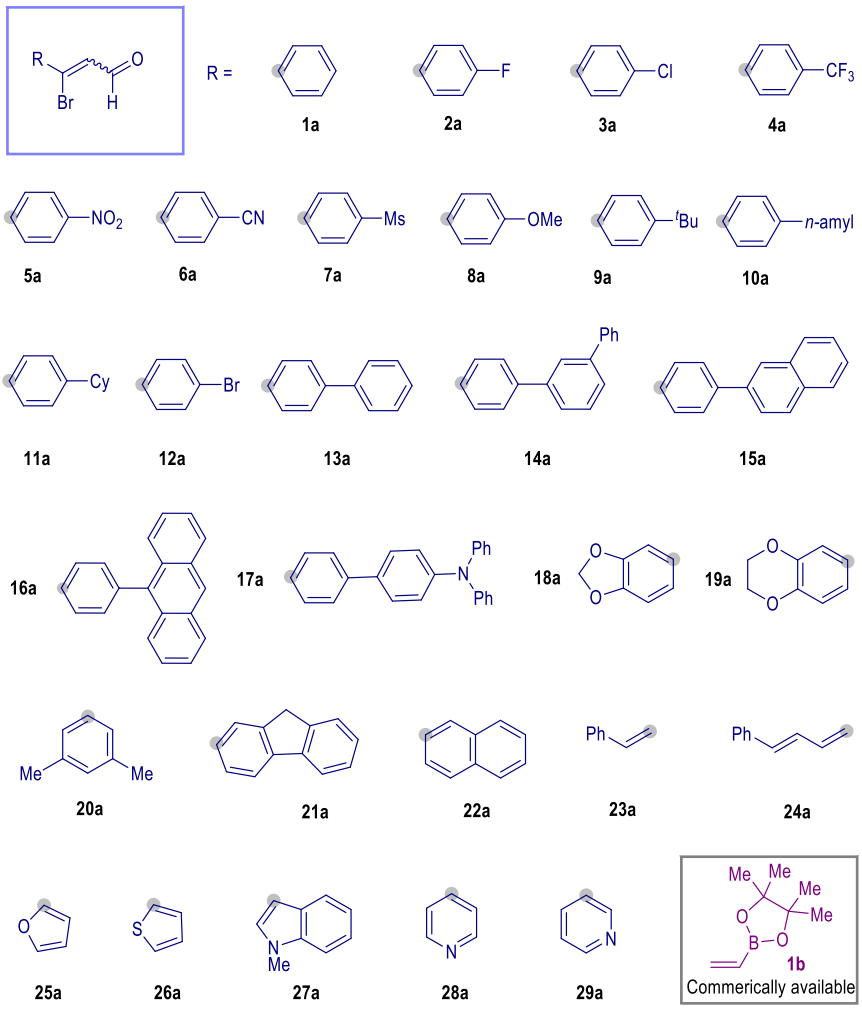
Unless stated otherwise, all glassware were flame-dried before use and all solvents were distilled from appropriate drying agents prior to use. All reagents were used as received from commercial suppliers unless otherwise stated. Non-commercially available substrates were synthesized following reported protocols. Thin-layer chromatography (TLC) was performed by UV absorbance (254 nm) and staining with phosphomolybdic acid. 200–300 mesh silica gel was used for column chromatography separation. NMR spectra were recorded on Bruker AV 400, 500 and 600 spectrometers at 400 MHz ($^{1}$H NMR), 100 MHz ($^{13}$C NMR), 500 MHz ($^{1}$H NMR), 125 MHz ($^{13}$C NMR) and 564 MHz ($^{19}$F NMR). Proton and carbon chemical shifts were reported relative to the solvent used as an internal reference ($CDCl_3$: $\delta_H$ = 0.000 ppm; $\delta_C$ = 77.000 ppm). All coupling constants (*J* values) were reported in Hertz (Hz). Multiplicities were reported as follows: singlet (s), doublet (d), doublet of doublets (dd), triplet (t), triplet of doublets (td), quartet (q), and multiplet (m). Infrared (IR) spectra were measured on Thermofisher Nicolet iN10 FM-IR spectrometer using KBr plates. UV-3101 PC NIR scanning spectrophotometer and the emission spectra on a RF-6000 spectrofluorimeter.

High resolution mass spectral analysis (HRMS) was recorded on a FT-ICR (Fourier transform ion cyclotron resonance) mass spectrometer by using electrospray ionization (ESI) techniques. Single crystal X-ray diffraction measurements were performed on an Agilent SuperNova-CCD X-Ray diffractometer.

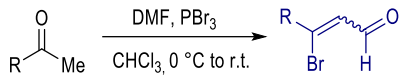
The reactions were monitored by thin layer chromatography (TLC) using silica gel GF254 plates and visualisation was by ultraviolet fluorescene ($\lambda$ = 254 nm) and staining with phosphomolybdic acid. Column chromatographic was performed on 200-300 mesh silica gel.

## 2. Preparation of Substrates

All structures of substrates **a** and **b** were presented as below. Pinacol vinyl boronate **1b** is commercially available. *β*–bromoenals **1a**–**2a**[1], **3a**–**4a**[2], **5a**[3], **6a**[4], **8a**[2], **11a**[3], **12a**[2], **18a**[3], **22a**[3], **23a**[5], **25a**–**26a**[5] were synthesized according to literatures. The substituted hypnone raw materials of **24a** were synthesized according to literature[6]. The preparations of substrates **7a**, **9a**–**10a**, **13a**–**17a**, **19a**–**21a**, **24a**, **27a**–**29a** were provided as follows procedures.

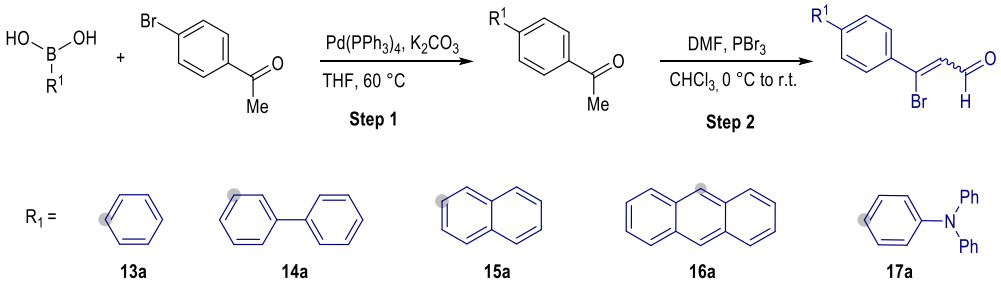


## 2.1 Synthesis of *β*-Bromoenals 7a, 9a–10a, 19a–21a, 24a, 27a–29a




**Procedure A:** Under Ar atmosphere, $PBr_3$ (3.5 equiv., 3.5 mmol) was added to stirred solution of DMF (3.0 equiv., 3.0 mmol) in 40.0 ml of dry chloroform at 0 °C. The acetophenone substrates (1.0 equiv., 1.0 mmol) were added into the solution and stirred at room temperature for 8.0 h. After the reaction was completed (detected by TLC), ice-water was added slowly to quench reaction, and then the saturated $NaHCO_3$ aqueous were added dropwise to mixture at 0 °C until the solution is neutral (detected by PH test paper). The mixture was extracted with DCM (3 × 60 ml). The organic layers were combined and washed with brine, then dried over anhydrous $Na_2SO_4$. The resulting crude product was concentrated under reduced pressure and flashed by column chromatography on silica gel to obtain product of *β*-bromoenal.

## 2.2 Synthesis of *β*-Bromoenals 13a–17a

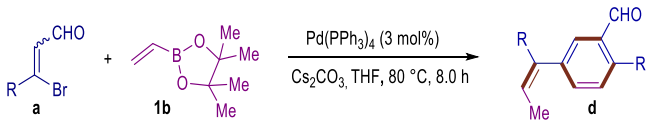



**Procedure B:**

**Step 1**: Under Ar atmosphere, 4-bromoacetophenone (398.1 mg, 2.0 mmol), boronic acid (1.2 equiv., 2.4 mmol), $Pd(PPh_3)_4$ (23.5 mg, 0.01 mmol) and potassium carbonate (331.7 mg, 2.4 mmol) were added in THF (20.0 ml). The mixture was stirred at 60 °C for 12.0 h. After the reaction was completed (detected by TLC), it was diluted with water and extracted with EA. The combined organic layers were washed with brine and dried over anhydrous saturated $Na_2SO_4$ and concentrated in *vacuo*. The resulting crude product was flashed by column chromatography on silica gel to afford the obtain *p*-substituted acetophenone products.

**Step 2**: Operation is the same with procedure A.

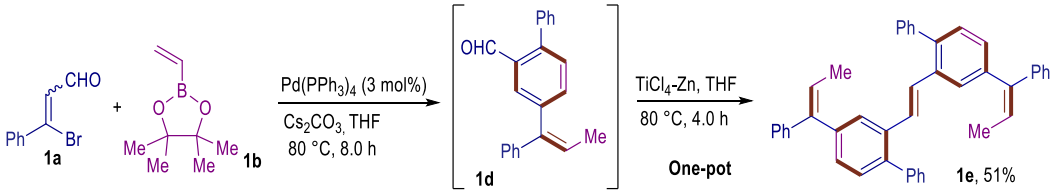
### 2.3 Syntheses of Substituted *m*-Alkenyl Benzaldehydes




**Procedure C:** *β*-Bromoenal **a** (0.1 equiv., 0.1 mmol), borate **1b** (25.4 ul, 0.15 mmol), $Pd(PPh_3)_4$ (3.5 mg, 0.03 mmol), $Cs_2CO_3$ (65.2 mg, 0.2 mmol) were added in turn into THF (1.0 ml) under argon atmosphere. Then the mixture was stirred at 80 °C for 8.0 h. After the reaction system was cooled to room temperature, the solvent was remoced in *vacuo*. The crude product was directly purified by flash chromatography to obtain the target product **d**.

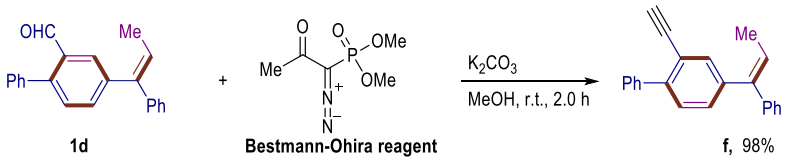
## 3. Synthetic Applications

### 3.1 Synthesis of 1e in One-pot Operation




After the reaction of **1a** (211.0 mg, 1.0 mmol) and **1b** (0.25 ml, 1.5 mmol) was fully transformed into **1d** by the monitoring of TLC, the reaction system was cooled to 0 °C to add titanium(IV) chloride (0.16 ml, 1.5 mmol) and activated zinc dust (98.0 mg, 1.5 mmol), and then the mixture was additionally stirred at 80 °C for 2.0 h. Finally, the reaction was cooled to room temperature and directly concentrated under *vacuo*. The crude product was directly purified by flash chromatography to obtain the target product **1e** in the yield of 51%.

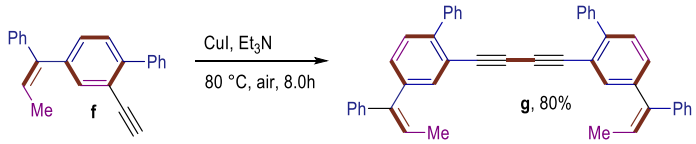
### 3.2 Synthesis of f




The target product **1d** (298.4 mg, 1.0 mmol) was dissolved in MeOH (15.0 ml) under argon, and then the reaction solution was stirred at room temperature. The anhydrous $K_2CO_3$ (276.4 mg, 2.0 mmol) and Bestmann-Ohira reagent (0.18 ml, 1.2 mmol) were

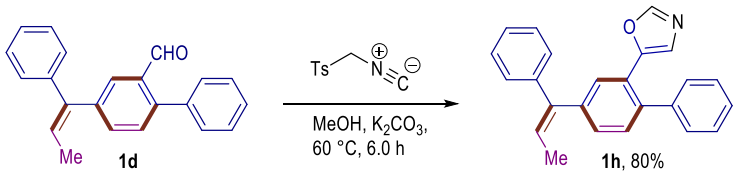
added to the reaction system. The mixture was stirred for 3.0 h at room temperature. Then methanol was removed under reduce pressure. The saturated $NH_4Cl$ was added into the resulting mixture and extracted with $CH_2Cl_2$ (3 × 20 ml). The combined organic layer was dried over $Na_2SO_4$ and concentrated in *vacuo*. The crude compound was purified by flash column chromatography (PE/EA = 100:1) to obtain product **f** in the yield of 98%.

### 3.3 Synthesis of g



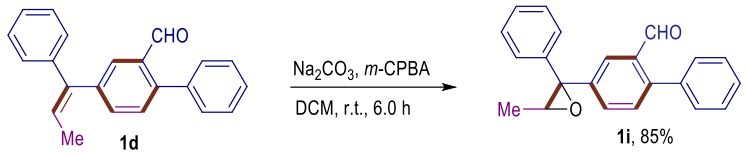

The mixture of **f** (310.4 mg, 1.0 mmol), CuI (10.2 mg, 0.5 mmol), $Et_3N$ (0.25 ml, 1.5 mmol) were added to a 100 ml dried flask under Air., and then toluene (10.0 ml) was added. After the mixture was stirred at 80 °C for 8.0 h and then the organic solvent was removed under vacuum. The crude product was purified by column chromatography (PE/EA = 150:1) to obtain the product **g** in the yield of 80%.

### 3.4 Synthesis of 1h



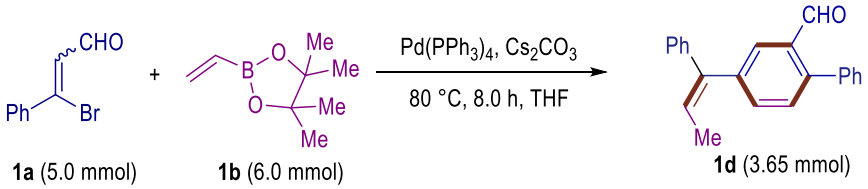

Tosylmethyl isocyanide (292.8 mg, 1.5 mmol), and potassium carbonate (207.3 mg, 1.5 mmol) were added to solution of **1d** (298.3 mg, 1.0 mmol) in anhydrous MeOH (3.0 ml) under argon, and then the reaction solution was stirred at room temperature for 6.0 h. The methanol was removed under reduce pressure, water was added in the resulting reaction system and the solution was extracted with $CH_2Cl_2$ (3 × 20 ml). The combined organic layers were dried over anhydrous $Na_2SO_4$ and removed under reduced pressure. The crude product was purified by column chromatography (PE/EA = 20:1) to obtain product **1h** in the yield of 80%.

### 3.5 Synthesis of 1i




*m*-Alkenyl benzaldehyde **1d** (298.3 mg, 1.0 mmol), $Na_2CO_3$ (212.0 mg, 2.0 mmol) and $CH_2Cl_2$ (20.0 ml) were added *in turn* in anhydrous $CH_2Cl_2$ (10.0 ml). The solution of *m*-CPBA (207.1 mg, 1.2 mmol) in DCM (20.0 ml) were added dropwise to the mixture at 0 °C. The reaction mixture was allowed to warm at room temperature and stirred for 6.0 h. After the reaction was finished by TLC monitoring, the reaction was quenched with saturated $Na_2S_2O_4$ aqueous. The aqueous phase was extracted with $CH_2Cl_2$ (3 × 20 ml) and the combined organic layers were dried over anhydrous $Na_2SO_4$. The organic solvent was removed under reduced pressure and the crude product was purified by silica gel column chromatography to obtain product **1i** (PE:PA = 30:1) in the yield of 85%.

### 3.6 Gram-scale Synthesis




To an over dried 100 ml round bottom flask was charged compound **1a** (1.05 g, 5.0 mmol), pinacol vinylboronate **1b** (1.0 ml, 6.0 mmol), $Cs_2CO_3$ (3.25 g, 10.0 mmol), $Pd(PPh_3)_4$ (173.3 mg, 0.15 mmol), and then THF (20.0 ml) was added. The reaction was stirred at 80 °C for 8.0 h. The solvent was concentrated in *vacuo*, the crude product was purified by column chromatography (PE/EA = 100:1) to obtain product **1d** (1.1 g, 3.65 mmol, 73% yield).

## 4. Optical and Photophysical Properties

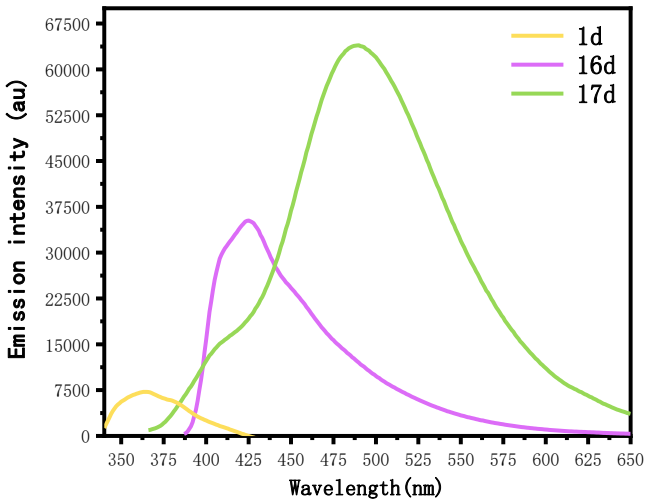



Fig. 1 The fluorescence intensity of **1d**, **16d**, **17d** in THF

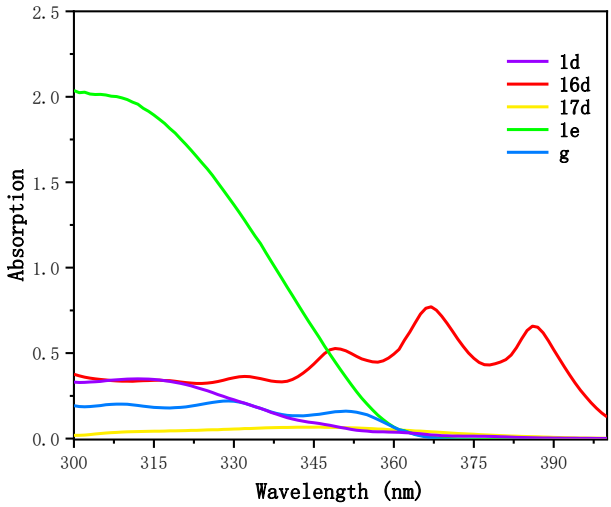
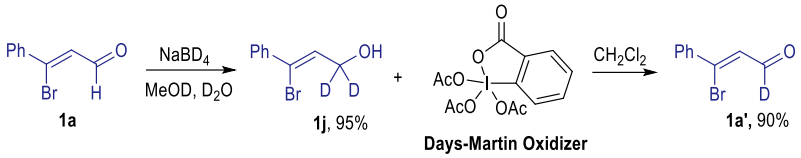



Fig. 2. The absorption spectra of **1d**, **16d**, **17d**, **1e** and **g** in THF

Fig. 3. Ptographs of **1e** (a) and **g** (b) in THF–water mixtures with 0% and 99% water fractions ($c$ = 10 μmol/L).

# 5. Mechanistic Studies

## 5.1 Deuterium-labeling Experiment



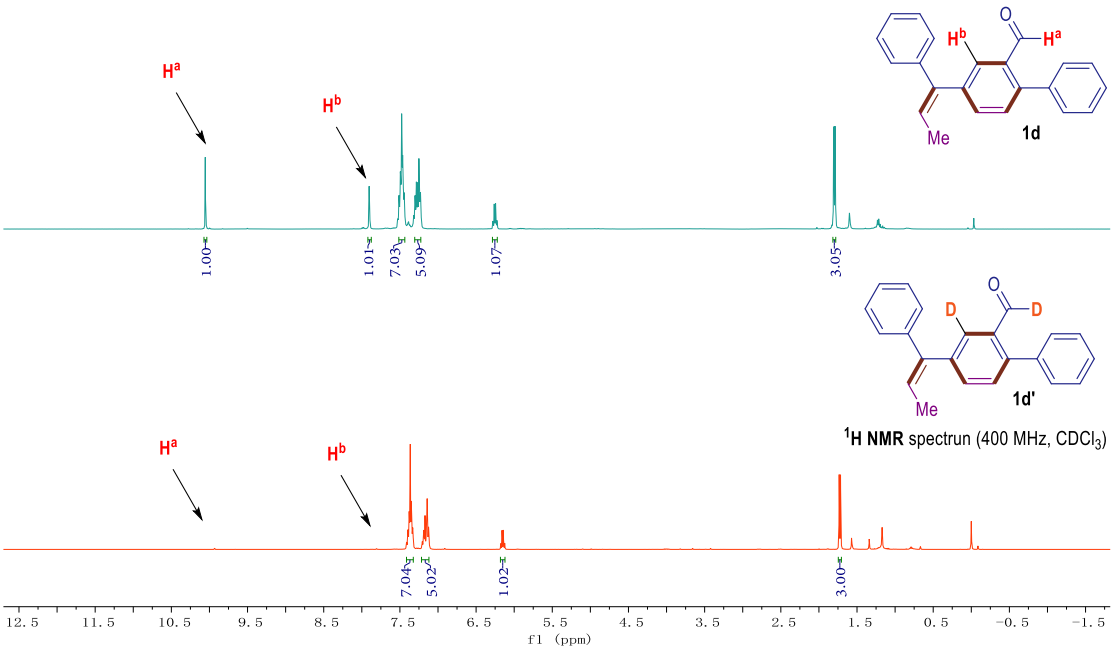

The $NaBD_4$ (22.7 mg, 0.6 mmol) was added to a solution of the $\beta$-bromoenal (105.5 mg, 0.5 mmol) at 0 °C in MeOD (10.0 ml) under Ar. The mixture was allowed to warm to room temperature and stirred. After the reaction was completed (detected by TLC), the reaction was quenched with $D_2O$ slowly and it was stirred for another 10.0 min. The crude mixture was concentrated in *vacuo* to remove MeOD. Then the aqueous mixture was extracted with DCM (3 × 10 ml) and the combined organic layer was dried over $Na_2SO_4$, crude product was concentrated under reduced pressure and flashed by column chromatography on silica gel to obtain product **1j** in the yield of 95%.

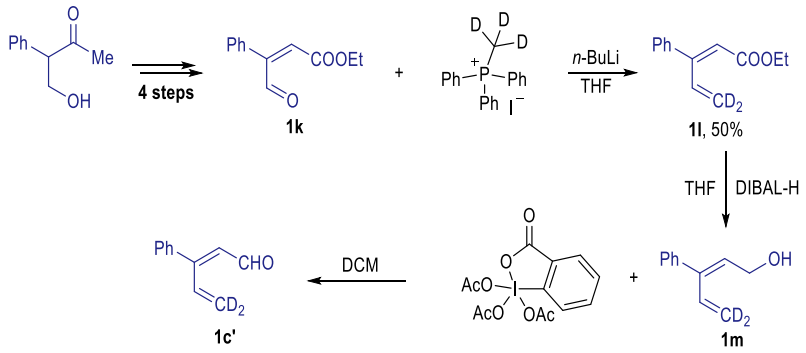
The mixture of **1j** (96.8 mg, 0.45 mmol), Days-Martin Oxidizer (381.7 mg, 0.9 mmol), were added to a 100 ml dried flask under Ar., and then DCM (10.0 ml) was added. After the reaction was completed (detected by TLC), and then crude product was concentrated under reduced pressure and flashed by column chromatography on silica gel to obtain product **1a'** in the yield of 90%.

**NOTE: To obtain high deuterated ratio (99% D), the process need be repeated three times.**

According to procedure C, the product **1d'** (25.5 mg, 85%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 100:1).

$^1$H NMR spectrun (400 MHz, $CDCl_3$)



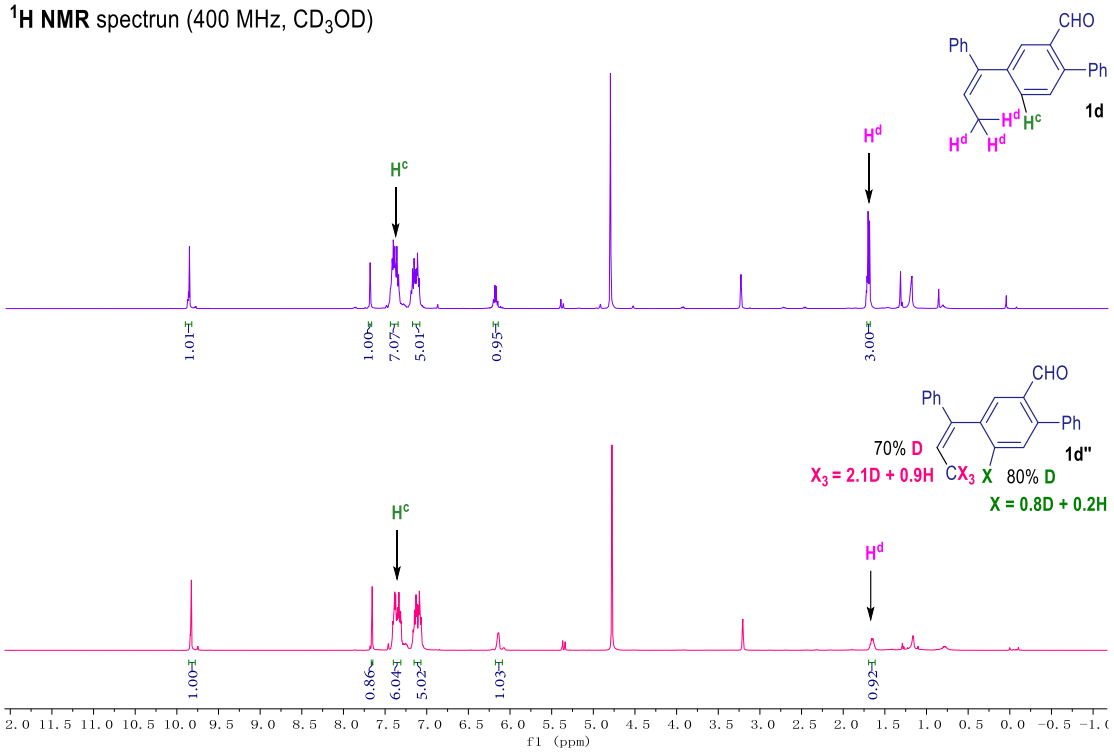




**1k** was synthesized according to the literature[7].

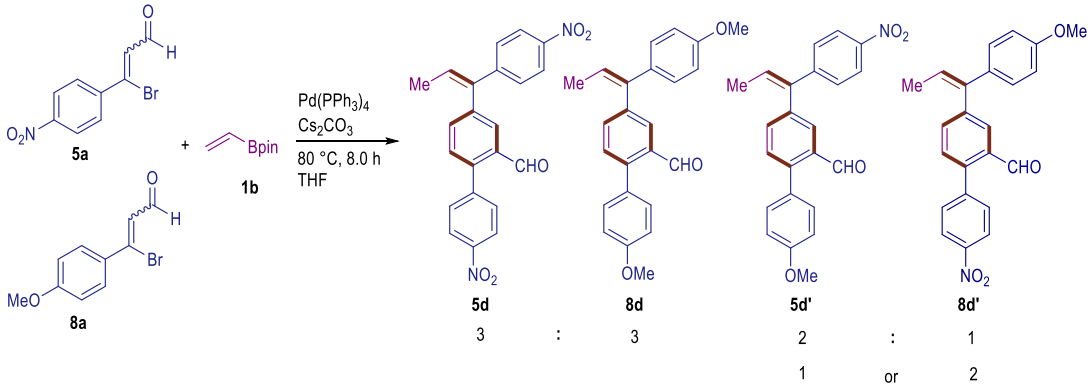
To the solution of $PPh_3{\cdot}CD_3I$ (5.3 g, 10.0 mmol) in 30.0 mL of dry THF under Ar, *n*-BuLi (12.0 mL of 1.0 M in THF, 12.0 mmol,) was added dropwise at 0°C. After stirring for 30 minutes, **1k** (1.9 g, 10.0 mmol) was added into the reaction mixture. Then the reaction mixture was stirred for another 6.0 hours at the room temperature. After the reaction was completed (detected by TLC), the mixture was quenched with $H_2O$ at the 0 °C and extracted with DCM (3 × 60 ml). The organic layers were combined and washed with brine, then dried over anhydrous $Na_2SO_4$. The resulting crude product was concentrated under reduced pressure and flashed by column chromatography on silica gel to obtain product **1l** in the yield of 50%.

The DIBAL-H (4.0 ml of 1.0 M in toluene, 4.0 mmol) was added to a solution of the **1l** (408.5 mg, 2.0 mmol) at 0 ºC in dry toluene under Ar. The mixture allowed to warm to room temperature and stirred. After the reaction was completed (detected by TLC), the reaction was quenched with 10% HCl slowly and it was stirred for another 10 min. The crude mixture was concentrated in *vacuo* to remove toluene. Then the aqueous mixture was extracted with DCM (3 × 60 ml) and the combined organic layer was dried over $Na_2SO_4$, the crude product **1m** was concentrated under reduced pressure. The crude product of **1m**, Days-Martin Oxidizer (1.2 g, 3.0 mmol) were added to a 100 ml dried flask under Ar., and then DCM (10.0 ml) was added. After the reaction was completed (detected by TLC), the crude product was concentrated under reduced pressure and flashed by column chromatography on silica gel to obtain product **1c'**.

**1c'** (0.1 equiv., 0.1 mmol), $Pd(PPh_3)_4$ (3.5 mg, 0.03 mmol), $Cs_2CO_3$ (65.2 mg, 0.2 mmol) were added in turn into THF (1.5 ml) under argon atmosphere. Then the mixture was stirred at 80 °C for 1.0 h. After the reaction was cooled to room temperature, the solvent was removed in *vacuo*. The crude product was directly purified by flash chromatography to obtain the target product **1d''**.



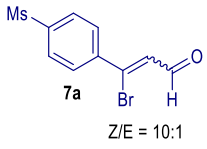
## 5.2 Crossover Experiment




*β*-Bromoenal **5a** (25.6 mg, 0.1 mmol), *β*-Bromoenal **8a** (24.1 mg, 0.1 mmol), borate **b** (50.0 ul, 0.3 mmol), $Pd(PPh_3)_4$ (7.0 mg, 0.006 mmol), $Cs_2CO_3$ (130.3mg, 0.4 mmol) were added *in turn* into THF (2.0 ml) under argon atmosphere. Then the mixture was stirred at 80 °C for 8.0 h and cooled to room temperature, and then concentrated in *vacuo*. The crude product was directly purified by flash chromatography to obtain the target products **5d**, **8d**, **5d'** and **8d'**.

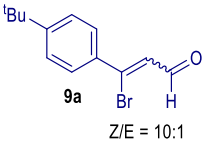
## 6. Characterization Data for Compounds

3–bromo–3–(4–(methylsulfonyl)phenyl)acrylaldehyde (**7a**)



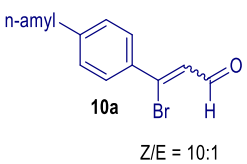

According to procedure A, the product **7a** (206.7 mg, 72%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 5:1), the mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. Major isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.00 (d, *J* = 6.4 Hz, 1H), 7.95 (d, *J* = 8.0 Hz, 2H), 7.82 (d, *J* = 8.0 Hz, 2H), 6.78 (d, *J* = 6.4 Hz, 1H), 3.03 (s, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.7, 142.8, 142.5, 141.5, 129.5, 128.8, 127.8, 44.3; minor isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.31 (d, *J* = 6.4 Hz, 1H), 7.98 (d, *J* = 8.0 Hz, 2H), 7.63 (d, *J* = 8.0 Hz, 2H), 6.79 (d, *J* = 6.4 Hz, 1H), 3.05 (s, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 188.2, 141.6, 135.7 135.4, 132.7, 130.3, 127.7, 44.3.

(*Z*)–3–bromo–3–(4–(tert–butyl)phenyl)acrylaldehyde (**9a**)




According to procedure A, the product **9a** (192.3 mg, 72%) as a yellow amorphous oil could be obtained by column chromatography on silica gel (PE/EA = 40:1). Major isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.93 (d, *J* = 6.4 Hz, 1H), 7.52 (d, *J* = 8.0 Hz, 2H), 7.31 (d, *J* = 8.0 Hz, 2H), 6.67 (d, *J* = 6.4 Hz, 1H), 1.20 (s, 9H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 193.1, 155.2, 144.7, 134.1, 127.7, 126.4, 125.5, 30.8; minor isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.30 (d, *J* = 6.4 Hz, 1H), 7.39 (d, *J* = 8.0 Hz, 2H), 7.22 (d, *J* = 8.0 Hz, 2H), 6.62 (d, *J* = 6.4 Hz, 1H), 1.18 (s, 9H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 189.2, 154.5, 149.4, 133.6, 133.5, 129.4, 125.2, 34.7.

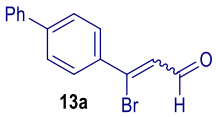
(*Z*)–3–bromo–3–(4–pentylphenyl)acrylaldehyde (**10a**)




According to procedure A, the product **10a** (185.6 mg, 69%) as a yellow amorphous oil could be obtained by column chromatography on silica gel (PE/EA = 100:1), the mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. the mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. Major isomer: **$^1$H**

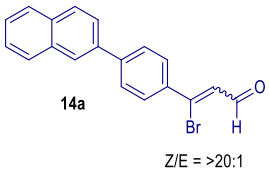
**NMR (400 MHz, $CDCl_3$)** δ 9.93 (d, *J* = 6.4 Hz, 1H), 7.50 (d, *J* = 8.0 Hz, 2H), 7.11 (d, *J* = 8.0 Hz, 2H), 6.66 (d, *J* = 6.4 Hz, 1H), 2.52 (t, *J* = 7.6 Hz, 2H), 1.55 – 1.47 (m, 2H), 1.22 – 1.21 (m, 4H), 0.80 – 0.76 (m, 3H); **$^{13}$C NMR (100 MHz, $CDCl_3$)** δ 193.3, 147.2, 145.0, 134.4, 128.6, 128.3, 126.3, 35.5, 31.2, 30.6, 23.3, 13.8; minor isomer: **$^{1}$H NMR (400 MHz, $CDCl_3$)** δ 9.30 (d, *J* = 6.4 Hz, 1H), 7.27 (d, *J* = 8.0 Hz, 2H), 7.11 (d, *J* = 8.0 Hz, 2H), 6.61 (d, *J* = 6.4 Hz, 1H), 2.52 (t, *J* = 7.6 Hz, 2H), 1.55 – 1.47 (m, 2H), 1.22 – 1.21 (m, 4H), 0.80 – 0.76 (m, 3H); **$^{13}$C NMR (100 MHz, $CDCl_3$)** δ 189.3, 149.6, 146.5, 133.7, 133.6, 129.6, 128.3, 35.5, 31.2, 30.6, 23.3, 13.8.

3–([1,1'–biphenyl]–4–yl)–3–bromoacrylaldehyde (**13a**)



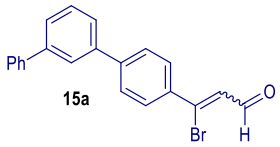

According to procedure A, the product **13a** (209.6 mg, 73%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 50:1), the mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. **$^{1}$H NMR (400 MHz, $CDCl_3$)** δ 10.00 (d, *J* = 6.4 Hz, 1H), 7.72 – 7.69 (m, 2H), 7.59 – 7.53 (m, 4H), 7.40 – 7.37 (m, 2H), 7.34 – 7.32 (m, 1H), 6.77 (d, *J* = 6.4 Hz, 1H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 193.6, 144.6, 144.5, 139.4, 136.0, 129.0 128.6, 128.2, 127.3, 127.1, 127.0.

3–bromo–3–(4–(naphthalen–2–yl)phenyl)acrylaldehyde (**14a**)



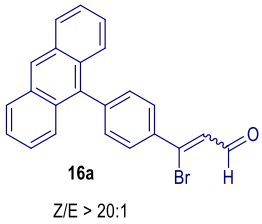

According to procedure A, the product **14a** (219.2 mg, 65%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 80:1). The mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. Major isomer: **$^{1}$H NMR (400 MHz, $CDCl_3$)** δ 10.04 (d, *J* = 6.4 Hz, 1H), 7.85 – 7.75 (m, 5H), 7.51 – 7.33 (m, 6H), 6.82 (d, *J* = 6.4 Hz, 1H); **$^{13}$C NMR (100 MHz, $CDCl_3$)** δ 193.6, 144.7, 144.5, 138.6, 136.2, 133.8, 131.2, 130.5, 128.4, 128.4, 128.1, 127.3, 127.0, 126.4, 126.0, 125.5, 125.3; minor isomer: **$^{1}$H NMR (400 MHz, $CDCl_3$)** δ 9.48 (d, *J* = 6.4 Hz, 1H), 7.85 – 7.75 (m, 5H), 7.51 – 7.33 (m, 6H), 6.77 (d, *J* = 6.4 Hz, 1H); **$^{3}$C NMR (100 MHz, $CDCl_3$)** δ 189.5 143.8, 143.0, 138.5, 135.5, 134.3, 132.0, 130.2, 129.7, 129.4, 127.3, 128.0, 127.0, 126.4, 126.0, 125.5, 125.3.

3–([1,1':3',1"-terphenyl]–4–yl)–3–bromoacrylaldehyde (**15a**)



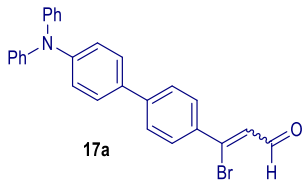

According to procedure A, the product **15a** (203.4 mg, 68%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 20:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.02 (d, *J* = 6.4 Hz, 1H), 7.74 (d, *J* = 8.0 Hz, 3H), 7.64 (d, *J* = 8.0 Hz, 2H), 7.58 – 7.52 (m, 4H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.42 – 7.38 (m, 2H), 7.32 (d, *J* = 8.0 Hz, 1H) ,6.89 (d, *J* = 6.4 Hz, 1H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 193.6, 144.6, 144.5, 142.1, 140.8, 140.0, 136.2 129.4, 128.9, 128.6, 127.6 127.5, 127.2, 127.1, 126.1.

3–(4–(anthracen–9–yl)phenyl)–3–bromoacrylaldehyde (**16a**)




According to procedure A, the product **16a** (240.1.6 mg, 62%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 100:1). The mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. Major isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.08 (d, *J* = 6.4 Hz, 1H), 8.45 (s, 1H), 7.98 (d, *J* = 8.0 Hz, 2H), 7.86 (d, *J* = 8.0 Hz, 2H), 7.53 (d, *J* = 8.0 Hz, 2H), 7.45 (d, *J* = 8.0 Hz, 2H), 7.42 – 7.38 (m, 2H), 7.31 – 7.28 (m, 2H) 6.89 (d, *J* = 6.4 Hz, 1H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 193.6, 144.7, 142.9, 139.5, 136.4, 135.1, 131.8, 131.7, 131.2, 129.9, 128.5, 128.1, 127.5, 127.3, 126.2, 125.8, 125.2.

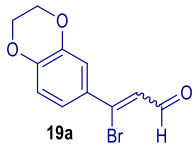
3–bromo–3–(4'–(diphenylaminuteo)–[1,1'–biphenyl]–4–yl)acrylaldehyde (**17a**)




According to procedure A, the product **17a** (354.4 mg, 78%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 25:1).The mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. Major isomer: **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.98 (d, *J* = 6.5 Hz, 1H), 7.67 (d, *J* = 7.5 Hz, 2H), 7.54 (d, *J* = 7.5 Hz, 2H), 7.40 (d, *J* = 7.5 Hz, 2H), 7.19 (t, *J* = 7.5 Hz, 4H), 7.06 – 7.04 (m, 6H), 6.97 (t, *J* = 7.5 Hz, 2H), 6.75 (d, *J* = 6.5 Hz, 1H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 193.5, 148.2, 147.3, 144.7, 144.0, 135.2, 132.6,

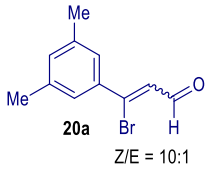
130.3, 128.6, 127.7, 126.7, 126.6, 124.8, 123.4, 123.2; minor isomer: **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.38 (d, *J* = 6.5 Hz, 1H), 7.67 (d, *J* = 7.5 Hz, 2H), 7.54 (d, *J* = 7.5 Hz, 2H), 7.44 (d, *J* = 7.5 Hz, 2H), 7.19 (t, *J* = 7.5 Hz, 4H), 7.06 – 7.04 (m, 6H), 6.97 (t, *J* = 7.5 Hz, 2H), 6.75 (d, *J* = 6.5 Hz, 1H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 189.5, 149.3, 148.2, 147.3, 144.7, 144.0, 134.7, 134.0, 132.7, 130.3, 128.6, 127.7, 126.7 126.4, 123.2.

3–bromo–3–(2,3–dihydrobenzo[b][1,4]dioxin–6–yl)acrylaldehyde (**19a**)



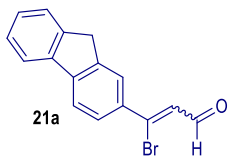

According to procedure A, the product **19a** (189.6 mg, 71%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.98 (d, *J* = 6.4 Hz, 1H), 7.22 (s, 1H), 7.20 (d, *J* = 8.0 Hz, 1H), 6.85 (d, *J* = 8.0 Hz, 1H), 6.67 (d, *J* = 6.4 Hz, 1H), 4.24 – 4.21 (m, 4H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 193.7, 146.8, 146.5, 144.6, 143.4, 130.4, 125.9, 121.7, 117.5, 64.6, 64.2.

3–bromo–3–(3,5–dimethylphenyl)acrylaldehyde (**20a**)




According to procedure A, the product **20a** (145.8 mg, 61%) as a yellow amorphous oil could be obtained by column chromatography on silica gel (PE/EA = 100:1). The mixture (*Z*/*E* isomers) could not be isolated by flash column chromatography. Major isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.96 (d, *J* = 6.4 Hz, 1H), 7.22 (s, 2H), 7.02 (s, 1H), 6.67 (d, *J* = 6.4 Hz, 1H), 2.27 (s, 6H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 193.6, 145.4, 138.4, 137.3, 133.3, 127.1, 125.8, 21.1; minor isomer: **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.31 (d, *J* = 6.4 Hz, 1H), 7.17 (s, 1H), 7.00 (s, 2H), 6.65 (d, *J* = 6.4 Hz, 1H), 2.26 (s, 6H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 189.7, 145.4, 138.2, 136.5, 133.9, 132.7, 127.4, 21.1.

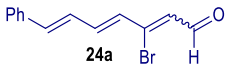
(*Z*)–3–bromo–3–(9H–fluoren–3–yl)acrylaldehyde (**21a**)




According to procedure A, the product **21a** (203.4 mg, 68%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 20:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 10.00 (d, *J* = 6.5 Hz, 1H), 7.79 (s, 1H), 7.72 (d, *J* = 8.0 Hz, 1H), 7.70 – 7.68

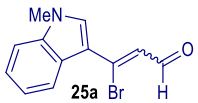
(m, 1H), 7.65 – 7.63 (m, 1H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.34 – 7.27 (m, 2\H), 6.76 (d, *J* = 6.5 Hz, 1H), 3.84 (s, 2H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 193.7, 145.6, 145.4, 144.0, 143.6, 140.2, 135.4, 128.0, 127.2, 127.1, 126.7, 125.2, 124.8, 120.7, 119.8, 36.8.

(4*E*,6*E*)–3–bromo–7–phenylhepta–2,4,6–trienal (**24a**)



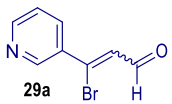

According to procedure A, the product **24a** (178.7 mg, 68%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 50:1). **$^{1}$H NMR (400 MHz, CDCl$_3$)** δ 10.00 (d, *J* = 6.4 Hz, 1H), 7.41 – 7.39 (m, 2H), 7.32 – 7.28 (m, 2H),7.26 – 7.20 (m, 2H), 6.89 – 6.87 (m, 2H), 6.42 (d, *J* = 8.0 Hz, 1H), 6.32 (d, *J* = 6.4 Hz, 1H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 193.4, 142.2, 141.7, 140.1, 136.1, 129.9, 129.1, 128.8, 128.1, 127.2, 126.7.

3–bromo–3–(1–methyl–1H–indol–3–yl)acrylaldehyde (**25a**)



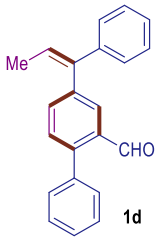

According to procedure A, the product **25a** (184.8 mg, 70%) as a yellow amorphous solid could be obtained by column chromatography on silica gel (PE/EA = 40:1). **$^{1}$H NMR (500 MHz, CDCl$_3$)** δ 10.07 (d, *J* = 6.5 Hz, 1H), 7.90 (d, *J* = 8.0 Hz, 1H),7.78 (m, 1H), 7.36 – 7.35 (m, 2H), 7.30 (d, *J* = 8.0 Hz, 1H), 6.91 (d, *J* = 6.5 Hz, 1H), 3.85(s, 3H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 194.1, 138.4, 137.7, 136.3, 124.4, 123.6, 122.3, 122.2, 120.5, 114.6, 110.5, 33.5.

3–bromo–3–(pyridin–3–yl)acrylaldehyde (**29a**)



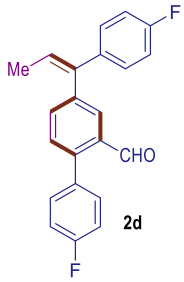

According to procedure A, the product **29a** (163.2 mg, 77%) as a yellow amorphous oil could be obtained by column chromatography on silica gel (PE/EA = 2:1). **$^{1}$H NMR (400 MHz, CDCl$_3$)** δ 10.00 (d, *J* = 6.4 Hz, 1H), 8.85 (s, 1H), 8.63 – 8.62 (m, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 7.35, 7.34 (dd, *J* = 5.6, 8.0 Hz, 1H), 6.78 – 6.76 (d, *J* = 6.4 Hz, 1H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.8, 152.1, 148.3, 140.8, 135.5, 133.5, 128.5, 123.5.

4–(1–phenylprop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**1d**)



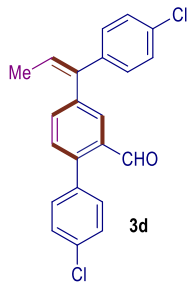

According to the procedure C, the reaction of **1a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **1d** as a light yellow solid (25.3 mg, 85%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^{1}$H NMR (500 MHz, $CDCl_3$)** δ 9.87(s, 1H), 7.77 (s, 1H), 7.30 – 7.24 (m, 7H), 7.10 – 7.04 (m, 5H), 6.07 (q, *J* = 7.0 Hz, 1H), 1.65 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 191.9, 144.2, 142.1, 141.0, 139.5, 137.3, 135.0, 133.3, 130.5, 129.9, 128.8, 128.2, 128.0, 127.9, 127.1, 126.8, 125.1, 15.5; **IR($cm^{-1}$)**: ν 3027, 2922, 2851, 1686, 1599, 1479, 1447, 1393, 764, 696; **HRMS**: m/z: $[M+Na]^+$calculated for $C_{22}H_{19}O^+$, 321.1249, found 321.1251.

(*E*)–4'–fluoro–4–(1–(4–fluorophenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**2d**)



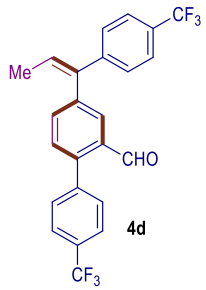

According to the procedure C, the reaction of **2a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **2d** as a light yellow amorphous oil (26.1 mg, 78%). The crude product was purified by column chromatography on silica gel (PE/EA = 80:1). **$^{1}$H NMR (500 MHz, $CDCl_3$),** δ 9.92 (s, 1H), 7.77 (s, 1H), 7.34 (s, 2H), 7.34 – 7.32 (m, 2H), 7.13 – 7.08 (m, 4H), 6.91 – 6.88 (m, 2 H), 6.11 (q, *J* = 7.0 Hz, 1H), 1.72 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 191.3, 163.4 (d, $J_{C-F}$ = 376.0 Hz ), 161.4 (d, $J_{C-F}$ = 376.0 Hz ), 161.0, 143.3, 140.1, 139.7, 138.5 (d, $J_{C-F}$ = 12.5 Hz ), 135.1, 133.6, 133.5 (d, $J_{C-F}$ = 12.5 Hz ), 131.7 (d, $J_{C-F}$ = 32.5 Hz ), 130.8, 129.1, 128.8 (d, $J_{C-F}$ = 32.5 Hz ), 125.3, 115.5 (d, $J_{C-F}$ = 86.0 Hz ), 115.0 (d, $J_{C-F}$ = 86.0 Hz ), 15.7; **$^{19}$F NMR (564 MHz, $CDCl_3$)** δ -113.7 – -113.7 (m, 1F), -115.7 – -115.7 (m, 1F); **IR($cm^{-1}$)**: ν 3449, 3052, 2904, 2857, 2755, 2032, 1897, 1814, 1685, 1600, 1390, 963, 717; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{22}H_{17}F_2O^+$, 335.1242, found 335.1236.

(*E*)–4'–chloro–4–(1–(4–chlorophenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**3d**)



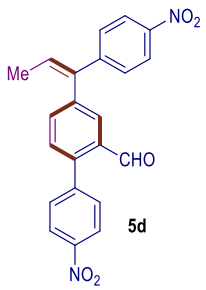

According to the procedure C, the reaction of **3a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **3d** as a light yellow amorphous oil (27.5 mg, 75%). The crude product was purified by column chromatography on silica gel (PE/EA = 80:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.92 (s, 1H), 7.77 (s, 1H), 7.40 (d, *J* = 8.0 Hz, 2H), 7.35 (s, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 8.0 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 6.16 (q, *J* = 7.2 Hz, 1H), 1.73 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 191.8, 143.2, 140.7, 140.0, 139.7, 135.9, 135.2, 134.6, 133.6, 132.9, 131.3, 130.8, 129.3, 128.7, 128.5, 128.3, 126.1, 15.8 ; **IR(cm$^{-1}$)**: ν 3474, 2850, 1689, 1601, 1392, 1245, 1195, 1091, 816, 771; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{22}H_{17}Cl_2O^+$, 367.0651, found 367.0645.

(*E*)–4'–(trifluoromethyl)–4–(1–(4–(trifluoromethyl)phenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**4d**)



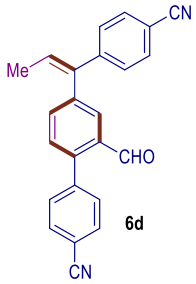

According to the procedure C, the reaction of **4a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **4d** as a light yellow amorphous oil (32.6 mg, 75%). The crude product was purified by column chromatography on silica gel (PE/EA = 20:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.91 (s, 1H), 7.80 (s, 1H), 7.68 (d, *J* = 8.0 Hz, 2H), 7.49 – 7.44 (m, 4H), 7.39 (s, 2H), 7.24 (d, *J* = 8.0 Hz, 2H), 6.28 – 6.24 (q, *J* = 7.0 Hz, 1H), 1.77 – 1.76 (d, *J* = 7.0 Hz, 3H) ; **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 191.4, 145.6, 143.0, 141.2, 140.0, 139.8, 135.3, 133.7, 130.8, 130.5 (d, $J_{C-F}$ = 129.2 Hz ), 130.4, 129.5, 129.3 (d, $J_{C-F}$ = 129.2 Hz ), 127.9, 127.5, 125.5 (d, $J_{C-F}$ = 14.0 Hz ), 125.3 (d, $J_{C-F}$ = 14.0 Hz ), 124.2 (d, $J_{C-F}$ = 1081.5 Hz ), 124.0 (d, $J_{C-F}$ = 1081.5 Hz ), 15.8; **$^{19}$F NMR (564 MHz, CDCl$_3$)** δ -62.5 (s, 3F), -62.6 (s, 3F); **IR(cm$^{-1}$)**: ν 3451, 3025, 2924, 1662, 1494, 1448, 1324, 1068, 962, 691; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{24}H_{17}F_6O^+$, 433.1032, found 433.1026.

(*E*)–4'–nitro–4–(1–(4–nitrophenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**5d**)



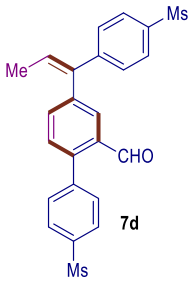

According to the procedure C, the reaction of **5a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **5d** as a light yellow amorphous solid (28.3 mg, 73%). The crude product was purified by column chromatography on silica gel (PE/EA = 10:1) **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.93 (s, 1H), 8.32 (d, *J* = 8.0 Hz, 2H), 8.09 (d, *J* = 8.0 Hz, 2H), 7.81 (s, 1H), 7.56 (d, *J* = 8.0 Hz, 2H), 7.44 (s, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 6.41 (q, *J* = 7.2 Hz, 1H), 1.81 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 199.8, 148.3, 147.8, 146.8, 144.2, 142.1 139.8, 139.4, 135.3, 133.8, 131.0, 130.8, 130.8, 130.1, 127.8, 123.9, 123.7, 16.1; **IR(cm$^{-1}$)**: ν 3470, 3056, 2849, 2748, 2226, 1930, 1687, 1602, 1483, 830, 545; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{22}H_{17}N_2O_5^+$, 389.1132, found 389.1110.

(*E*)–4'–(1–(4–cyanophenyl)prop–1–en–1–yl)–2'–formyl–[1,1'–biphenyl]–4–carbonitrile (**6d**)



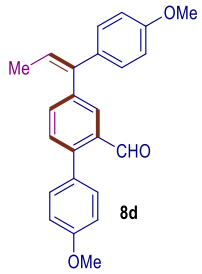

According to the procedure C, the reaction of **6a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **6d** as a light yellow amorphous solid (26.4 mg, 76%). The crude product was purified by column chromatography on silica gel (PE/EA = 30:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.99 (s, 1H), 8.37 (d, *J* = 8.0 Hz, 2H), 8.14 (d, *J* = 8.0 Hz, 2H), 7.87 (s, 1H), 7.62 (d, *J* = 8.0 Hz, 2H), 7.50 (s, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 6.47 (q, *J* = 7.2 Hz, 1H), 1.87 (d, *J* = 7.2 Hz, 3H) ; **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 190.8, 148.2, 147.7, 146.7, 144.2, 142.0, 139.7, 193.3, 135.3, 133.8, 131.0, 130.8, 130.0, 129.4, 129.0, 127.7, 124.3, 123.9, 123.7, 16.1 ; **IR(cm$^{-1}$)**: ν 3455, 2918, 2850, 1689, 1597, 1516, 1477, 1344, 1108, 854, 700; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{24}H_{17}N_2O^+$, 349.1335, found 349.1319.

(*E*)–4'–(methylsulfonyl)–4–(1–(4–(methylsulfonyl)phenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**7d**)



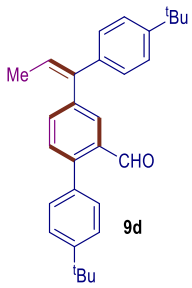

According to the procedure C, the reaction of **7a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **7d** as a light yellow amorphous solid (35.9 mg, 79%). The crude product was purified by column chromatography on silica gel (PE/EA = 5:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.91 (s, 1H), 8.02 (d, *J* = 8.0 Hz, 2H), 7.80 – 7.78 (m, 3H), 7.59 (d, *J* = 8.0 Hz, 2H), 7.43 (s, 1H), 7.33 (d, *J* = 8.0 Hz, 2H), 6.35 (q, *J* = 7.0 Hz, 1H), 3.08 (s, 3H), 3.00(s, 3H), 1.80 (d, *J* = 7.0 Hz, 3H) ; **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 191.0, 147.4, 143.2, 142.4, 140.3, 139.7, 139.5, 138.8, 135.3, 133.7, 131.0, 130.8, 129.7, 129.4, 127.9, 127.5, 127.4, 44.5, 44.5, 16.0; **IR(cm$^{-1}$)**: ν 3061, 2925, 2852, 2752, 2293, 2237, 1933, 1813, 1688, 1625, 956, 831; **HRMS**: m/z: $[M+Na]^+$ calculated for $C_{24}H_{22}O_5S_2Na^+$, 477.0800, found 477.0797.

(*E*)–4'–methoxy–4–(1–(4–methoxyphenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**8d**)



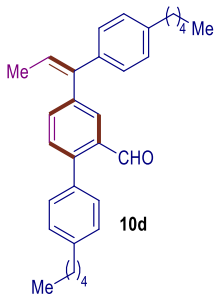

According to the procedure C, the reaction of **8a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **8d** as a light yellow amorphous solid (27.9 mg, 78%). The crude product was purified by column chromatography on silica gel (PE/EA = 50:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.95 (s, 1H), 7.77 (s, 1H), 7.35 (s, 2H), 7.28 (d, *J* = 8.0 Hz, 2H), 7.06 (d, *J* = 8.0 Hz, 2H), 6.945 (d, *J* = 8.0 Hz, 2H), 6.74 (d, *J* = 8.0 Hz, 2H), 6.17 (q, *J* = 7.2 Hz, 1H), 3.81 (s, 3H), 3.72 (s, 3H), 1.71 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.8, 144.7, 142.5, 141.4, 139.7, 138.0, 137.6, 135.2, 133.5, 130.6, 129.7, 128.8, 128.7, 128.1, 125.3, 125.0, 123.9, 21.3, 15.7; **IR(cm$^{-1}$)**: ν 3457, 2927, 2837, 1685, 1605, 1509, 1248, 1178, 1034, 830; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{24}H_{23}O_3^+$, 359.1641, found 359.1647.

(*E*)–4'–(tert–butyl)–4–(1–(4–(tert–butyl)phenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**9d**)



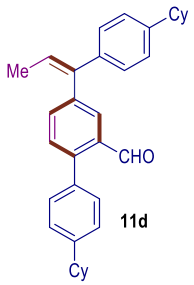

According to the procedure C, the reaction of **9a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **9d** as a light yellow amorphous solid (32.8 mg, 80%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.96 (s, 1H), 7.79 (s, 1H), 7.43 (d, *J* = 8.0 Hz, 2H), 7.37 (s, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.22 (d, *J* = 8.0 Hz, 2H), 7.08 (d, *J* = 8.0 Hz, 2H), 6.14 (q, *J* = 7.2 Hz, 1H), 1.71 (d, *J* = 7.2 Hz, 3H), 1.31 (s, 9H), 1.23 (s, 9H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.8, 151.2, 149.9, 144.4, 141.0, 139.7, 139.4, 135.3, 134.6, 133.5, 130.6, 129.9, 128.9, 126.8, 125.4, 125.1, 124.5, 34.7, 34.4, 31.3, 31.3, 15.7; **IR (cm$^{-1}$)**: ν 3462, 3084, 2961, 2927, 2865, 1689, 1602, 1264, 1110, 972, 820; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{30}H_{35}O^+$, 411.2682, found 411.2656.

(*E*)–4'–butyl–4–(1–(4–butylphenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**10d**)



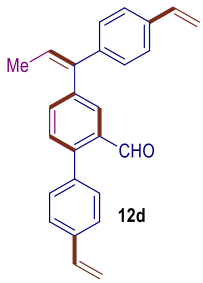

According to the procedure C, the reaction of **10a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **10d** as a light yellow amorphous solid (27.9 mg, 79%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.95 (s, 1H), 7.79 (s, 1H), 7.37 (s, 2H), 7.27 – 7.26 (m, 2H), 7.23 – 7.21 (m, 2H), 7.06 – 7.05 (m, 2H), 7.02 – 7.02 (m, 2H), 6.13 (q, *J* = 7.0 Hz, 1H), 2.61 (t, *J* = 7.5 Hz, 2H), 2.50 (t, *J* = 7.0 Hz, 2H), 1.72 (d, *J* = 7.0 Hz, 3H), 1.64 – 1.58 (m, 2H), 1.29 – 1.25 (m, 9H), 0.85 – 0.82 (m, 7H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 192.8,0 144.5, 143.0, 141.8, 141.0, 139.7, 139.6, 135.3, 134.8, 133.5, 130.6, 130.1, 128.9, 128.5, 128.2, 127.0, 124.4, 35.6, 35.5, 31.5, 31.1, 25.5, 15.7, 14.0; **IR(cm$^{-1}$)**: ν 3448, 3023, 2926, 2854, 2750, 1690, 1601, 1261, 974, 757; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{32}H_{39}O^+$, 439.2922, found 439.2983.

(*E*)–4'–cyclohexyl–4–(1–(4–cyclohexylphenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**11d**)




According to the procedure C, the reaction of **11a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **11d** as a light yellow amorphous solid (36.8 mg, 80%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.95 (s, 1H), 7.78 (s, 1H), 7.36 (s, 2H), 7.28 – 7.23 (m, 4H), 7.07 – 7.02 (m, 4H), 6.12 (q, *J* = 7.0 Hz, 1H), 2.51 (t, *J* = 10.5 Hz, 1H), 2.40 (t, *J* = 10.5 Hz, 1H), 1.88–1.74 (m, 9H), 1.71 (d, *J* = 7.0 Hz, 3H), 1.44 – 1.29 (m, 9H), 1.23 – 1.15 (m, 2H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 192.8, 148.1, 146.9, 144.5, 141.1, 139.9, 139.6, 135.3, 135.0, 133.5, 130.6, 130.1, 128.9, 127.1, 126.9, 126.6, 124.5, 44.3, 44.2, 34.4, 34.4, 26.9, 26.8, 26.1, 26.1, 15.7; **IR(cm$^{-1}$)**: ν 3463, 3023, 2849, 1908, 1688, 1601, 970, 649; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{35}H_{39}O^+$, 463.2995, found 463.2989.

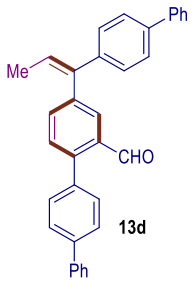
(*E*)–4'–vinyl–4–(1–(4–vinylphenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**12d**)




According to the procedure C, the reaction of **12a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **12d** as a light yellow amorphous solid (24.4 mg, 70%). The crude product was purified by column chromatography on silica gel (PE/EA = 80:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.96 (s, 1H), 7.80 (s, 1H), 7.46 (d, *J* = 8.0 Hz, 2H), 7.39 – 7.38 (m, 2H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.26 (d, *J* = 8.0 Hz, 2H), 7.11 (d, *J* = 8.0 Hz, 2H), 6.74, 6.73 (dd, *J* = 10.8, 17.6 Hz 1H), 6.64, 6.63 (dd, *J* = 10.8, 17.6 Hz 1H), 6.19 (q, *J* = 7.2 Hz, 1H), 5.78 (d, *J* = 17.6 Hz, 1H), 5.66 (d, *J* = 17.6 Hz, 1H), 5.27 (d, *J* = 10.8 Hz, 1H), 5.15 (d, *J* = 10.8 Hz, 1H), 1.74 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.4, 144.1, 141.8, 140.8, 139.7, 137.5 137.0, 136.4, 136.1, 135.3, 133.6, 130.6, 130.4, 129.2, 128.5, 127.4, 126.3, 126.1, 125.4, 114.9 113.7, 15.8; **IR(cm$^{-1}$)**: ν 3438, 2850, 1686, 1600, 1394, 1355, 1117, 989,

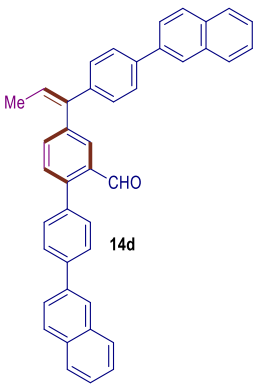
910, 830, 799; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{26}H_{23}O^+$, 351.1743, found 351.1751.

(*E*)–4–(1–([1,1'–biphenyl]–4–yl)prop–1–en–1–yl)–[1,1':4',1''–terphenyl]–2–carbaldehyde (**13d**)




According to the procedure C, the reaction of **13a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **13d** as a light yellow amorphous solid (40.5 mg, 90%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 10.0 (s, 1H), 7.85 (s, 1H), 7.64 (d, *J* = 8.0 Hz, 2H), 7.58 (d, *J* = 8.0 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 2H), 7.44 – 7.43 (m, 6H), 7.39 – 7.38 (m, 2H), 7.39 – 7.30 (m, 3H), 7.22 (d, *J* = 8.0 Hz, 3H), 6.23 (q, *J* = 6.5 Hz, 1H), 1.76 (d, *J* = 6.5 Hz, 3H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 192.4, 144.1, 141.3, 141.0, 140.8, 140.7, 140.3, 139.8, 139.7, 136.5, 135.3, 133.6, 130.8, 130.6, 129.2, 128.9, 128.7, 127.7, 127.6, 127.2, 127.2, 127.1, 126.9, 125.5, 15.8; **IR (cm$^{-1}$)**: ν 3447, 1655, 1597, 1492, 1355, 1166, 1090, 682, 570; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{34}H_{27}O^+$, 451.2056, found 451.2057.

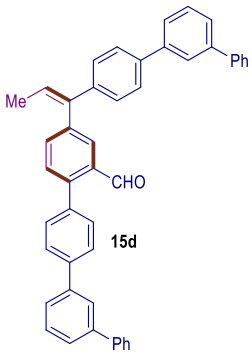
(*E*)–4'–(naphthalen–1–yl)–4–(1–(4–(naphthalen–1–yl)phenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**14d**)




According to the procedure C, the reaction of **14a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **14d** as a light yellow amorphous solid (37.4 mg, 75%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.1 (s, 1H), 7.84 – 7.87 (m, 4H), 7.84 (d, *J* = 8.0 Hz, 2H), 7.79 (d, *J* = 8.0 Hz, 1H), 7.59 – 7.51 (m, 7H), 7.48 – 7.40 (m, 6H), 7.38 – 7.37 (m, 3H), 7.32 – 7.30 (m, 2H), 6.33 (q, *J* = 7.2 Hz, 1H), 1.82 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.6, 144.3, 141.2, 140.9, 140.7, 139.9, 139.8, 139.5, 139.4, 136.5, 135.5, 134.3, 133.8, 133.8, 133.7, 131.5, 131.5, 130.9, 130.2, 130.1, 130.0, 129.2, 128.4, 129.3, 128.0, 127.6, 127.1, 126.9, 126.2, 126.1, 126.0, 125.9, 125.8, 125.8, 125.7, 125.4, 125.4 15.9; **IR(cm$^{-1}$)**: ν 3461, 2926, 2850, 1813,

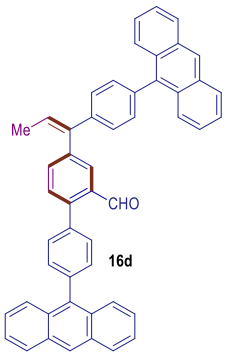
1686, 1671, 1636, 1602, 1393, 909, 777; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{42}H_{31}O^+$, 551.2369, found 551.2368.

(*E*)–4'''–(1–([1,1':3',1''–terphenyl]–4–yl)prop–1–en–1–yl)–[1,1':3',1'':4'',1'''–quaterphenyl]–2'''–carbaldehyde (**15d**)




According to the procedure C, the reaction of **15a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **15d** as a light yellow amorphous solid (45.2 mg, 75%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 10.04 (s, 1H), 7.87 (s, 1H), 7.80 (s, 1H), 7.72 – 7.69 (m, 3H), 7.60 – 7.59 (d, *J* = 8.0 Hz, 2H), 7.57 – 7.55 (m, 6H), 7.50 – 7.45 (m, 8H), 7.42 – 7.36 (m, 6H), 7.32 – 7.28 (m, 2H), 7.25 (d, *J* = 8.0 Hz, 2H), 6.25 (q, *J* = 7.0 Hz, 1H), 1.78 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 192.5, 144.1, 141.9, 141.7, 141.5, 141.3, 141.1, 141.0, 141.0, 140.8, 140.7, 139.8, 139.7, 136.6, 135.4, 133.6, 130.8, 130.6, 129.3, 129.2, 129.2, 128.8, 128.8, 127.7, 127.5, 127.4, 127.3, 127.2, 127.1, 126.5, 126.1, 126.1, 126.0, 125.9, 125.6, 15.9; **IR(cm$^{-1}$)**: ν 3488, 3029, 2919, 2850, 2248, 1945, 1806, 1686, 1598, 1474, 1389, 758, 699; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{46}H_{35}O^+$, 603.2689, found 603.2682.

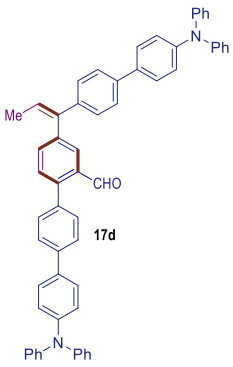
(*E*)–4'–(anthracen–9–yl)–4–(1–(4–(anthracen–9–yl)phenyl)prop–1–en–1–yl)–[1,1'–biphenyl]–2–carbaldehyde (**16d**)




According to the procedure C, the reaction of **16a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **16d** as a light yellow amorphous solid (52.1 mg, 80%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 10.23 (s, 1H), 8.42 (s, 1H), 8.38 (s, 1H), 8.02 (s, 1H), 7.97 – 7.92 (m, 5H), 7.67 – 7.57 (m, 9H), 7.48 – 7.46 (m, 2H), 7.39 – 7.36 (m, 6H), 7.29 – 7.27 (m, 4H), 6.37 (q, *J* = 7.0 Hz, 1H), 1.82 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 191.6, 143.4, 140.2, 139.9, 138.9, 137.8, 136.5, 135.7, 134.9, 134.6, 132.7,

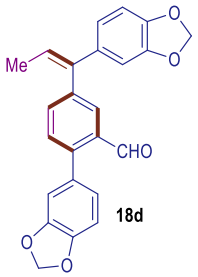
130.4, 130.3, 130.2, 129.9, 129.2, 129.1, 128.2, 127.4, 127.3, 126.0, 125.9, 125.8, 125.5, 124.7, 124.6, 124.3, 124.1, 124.1, 15.0; **IR(cm$^{-1}$)**: ν 3458, 3049, 2958, 2923, 2850, 1688, 1638, 1602, 1104, 733; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{50}H_{35}O^+$, 651.2682, found 651.2641.

(*E*)–4''–(diphenylaminuteo)–4–(1–(4'–(diphenylaminuteo)–[1,1'–biphenyl]–4–yl)prop–1–en–1–yl)–[1,1':4',1''–terphenyl]–2–carbaldehyde (**17d**)




According to the procedure C, the reaction of **17a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **17d** as a light yellow amorphous solid (39.3 mg, 50%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 10.02 (s, 1H), 7.85 (s, 1H), 7.62 (d, *J* = 8.0 Hz, 2H), 7.48 – 7.38 (m, 13H), 7.21 – 7.19 (m, 4H), 7.09 – 7.06 (m, 14H), 7.00 – 6.94 (m, 5H), 6.23 (q, *J* = 7.0 Hz, 1H), 1.77 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 192.6, 147.6, 147.6, 147.5, 147.1, 144.2, 140.8, 140.5, 139.7, 139.3, 135.9, 135.4, 134.6, 133.9, 133.6, 130.7, 130.6, 129.3, 129.2, 129.2, 127.7, 127.7, 127.6, 127.6, 126.6, 126.4, 125.2, 124.6, 124.4, 123.8, 123.7, 123.1, 122.9, 15.9; **IR(cm$^{-1}$)**: ν 3453, 3059, 2921, 2849, 1793, 1686, 1589, 1489, 1276, 966, 816, 695; **HRMS**: m/z: $[M+Na]^+$ calculated for $C_{58}H_{44}N_2ONa^+$, 807.3345, found 807.3341.

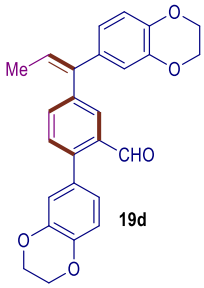
(*Z*)–2–(benzo[d][1,3]dioxol–5–yl)–5–(1–(benzo[d][1,3]dioxol–5–yl)prop–1–en–1–yl)benzaldehyde (**18d**)




According to the procedure C, the reaction of **18a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **18d** as a light yellow amorphous solid (32.1 mg, 83%). The crude product was purified by column chromatography on silica gel (PE/EA = 80:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.0 (s, 1H), 7.74(s, 2H), 7.34 (s, 1H), 6.85 (d, *J* = 8.0 Hz, 2H), 6.77 (d, *J* = 8.0 Hz, 1H), 6.64 (d, *J* = 8.0 Hz, 2H), 6.57 (d, *J* = 8.0 Hz, 1H), 6.04 (q, *J* = 7.2 Hz, 1H), 5.98 (s, 2H), 5.86 (s,

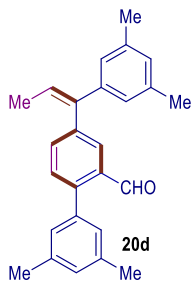
2H), 1.67 (d, $J$ = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.5, 147.9, 147.8, 147.6, 146.7, 144.0, 140.7, 139.6, 136.9, 135.2, 133.6, 131.4, 130.6, 129.0, 124.2, 124.2, 121.1, 110.3, 108.2, 107.9, 107.7, 101.4, 101.0, 15.7; **IR(cm$^{-1}$)**: ν 3458, 3011, 2957, 2920, 2853, 1860,1685, 1602, 1547, 1193, 1038, 935, 808, 752; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{24}H_{18}O_5^+$, 387.12270, found 387.12165.

(*Z*)–2–(2,3–dihydrobenzo[b][1,4]dioxin–6–yl)–5–(1–(2,3dihydrobenzo[b][1,4]dioxin–6–yl)prop–1–en–1–yl)benzaldehyde (**19d**)




According to the procedure C, the reaction of **19a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **19d** as a light yellow amorphous solid (33.9 mg, 82%). The crude product was purified by column chromatography on silica gel (PE/EA = 80:1) **$^1$H NMR (500 MHz, CDCl$_3$)** δ 9.96 (s, 1H), 7.73 (s, 1H), 7.33 (s, 2H), 7.18 (s, 1H), 6.88 (s, 2H), 6.80 (d, $J$ = 8.0 Hz, 1H), 6.70 – 6.69 (m, 1H), 6.65 – 6.62 (m, 2H), 6.05 (q, $J$ = 7.0 Hz, 1H), 4.24 (s, 4H), 4.16 (s, 4H), 1.68 (d, $J$ = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 192.6, 143.9 143.8, 143.5, 142.8, 140.5, 139.5, 136.2, 135.2, 133.5, 130.9, 130.5, 128.9, 123.9, 123.5, 120.3, 118.9, 117.2, 116.9, 116.2, 64.4, 64.4, 64.4, 64.3, 15.7; **IR(cm$^{-1}$)**: ν 3454, 2924, 2853, 1685, 1637, 1602, 1580, 1504, 1484, 1308, 1067, 893, 747; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{26}H_{23}O_5^+$, 415.1540, found 415.1541.

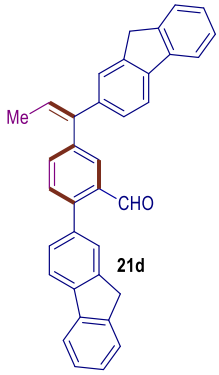
(*Z*)–4–(1–(3,5–dimethylphenyl)prop–1–en–1–yl)–3',5'–dimethyl–[1,1'–biphenyl]–2–carbaldehyde (**20d**)




According to the procedure C, the reaction of **20a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **20d** as a light yellow amorphous solid (27.9 mg, 80%). The crude product was purified by column chromatography on silica gel (PE/EA = 80:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.95 (s, 1H), 7.78 (s, 1H), 7.37 – 7.34 (m, 2H), 7.01 – 6.99 (m, 3H), 6.81 (s, 1H), 6.75 (s, 2H), 6.11 (q, $J$ = 7.2 Hz, 1H), 2.32 (s, 6H), 2.19 (s, 6H), 1.70 (d, $J$ = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ192.7, 159.7, 158.8, 144.1, 140.6, 139.6, 139.3, 135.2, 133.5, 131.3, 130.6,

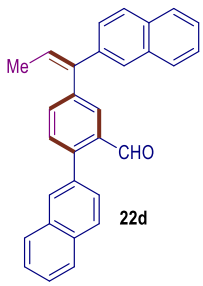
129.9, 129.1, 128.4, 123.6, 113.9, 113.6, 55.4, 55.3, 15.7; **IR(cm$^{-1}$)**: ν 3448, 3024, 2916, 2851, 2750, 1689, 1600, 1548, 1182, 843, 708; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{26}H_{27}O^+$, 355.2056, found 355.2044.

(*E*)–5–(1–(9H-fluoren–2–yl)prop–1–en–1–yl)–2–(9H–fluoren–2–yl)benzaldehyde (**21d**)




According to the procedure C, the reaction of **21a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **21d** as a light yellow amorphous solid (33.9 mg, 72%). The crude product was purified by column chromatography on silica gel (PE/EA = 60:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.04 (s, 1H), 7.87 (d, *J* = 1.6 Hz, 1H), 7.84 (d, *J* = 8.0 Hz, 1H), 7.79 (d, *J* = 8.0 Hz, 1H), 7.70 (d, *J* = 8.0 Hz, 1H), 7.63 (d, *J* = 8.0 Hz, 1H), 7.57 (s, 1H), 7.54 – 7.50 (m, 1H), 7.48 – 7.47 (m, 1H), 7.45 – 7.44 (m, 1H), 7.43 – 7.41 (m, 1H), 7.40 – 7.38 (m, 1H), 7.36 – 7.34 (m, 2H), 7.31 – 7.27 (m, 2H), 7.24 – 7.20 (m, 2H), 6.24 (q, *J* = 7.2 Hz, 1H), 3.93 (s, 2H), 3.80 (s, 2H), 1.79 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.7, 144.8, 143.5, 143.5, 143.3, 141.8, 141.5, 141.4, 141.2, 141.1, 140.7, 139.9, 136.0, 135.3, 133.7, 130.9, 129.2, 129.1, 127.2, 127.0, 126.9, 126.7, 126.6, 126.2, 125.1, 125.1, 125.0, 124.0, 120.2, 119.8, 119.8, 119.8, 119.5, 37.0, 36.9, 15.9; **IR(cm$^{-1}$)**: ν 3019, 2746, 1944, 1730, 1685, 1602, 1599, 1545, 1454, 1250, 908, 824, 733; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{36}H_{27}O^+$, 475.2056, found 475.2020.

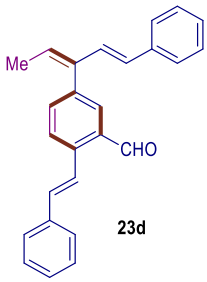
(*E*)–2–(naphthalen–2–yl)–5–(1–(naphthalen–2–yl)prop–1–en–1–yl)benzaldehyde (**22d**)




According to the procedure C, the reaction of **22a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **22d** as a light yellow amorphous solid (36.6 mg, 92%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 10.0 (s, 1H), 7.89 (s, 1H), 7.86 (d, *J* = 8.0 Hz, 1H), 7.82 – 7.80 (m, 3H), 7.70 – 7.64 (m, 3H), 7.50

(s, 2H), 7.47 – 7.41 (m, 4H), 7.36 (d, *J* = 8.0 Hz, 1H), 7.34 – 7.33 (m, 2H), 6.30 (q, *J* = 7.0 Hz, 1H), 1.79 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ192.4, 144.4, 141.2, 139.8, 139.7, 135.3, 135.0, 133.8, 133.4, 133.0, 132.8, 132.6, 131.0, 129.5, 129.2, 128.2, 128.1, 128.1, 127.8, 127.8, 127.7, 127.5, 126.8, 126.6, 126.3, 126.1, 126.0, 125.8, 125.4, 15.9; **IR(cm$^{-1}$)**: ν 3448, 3053, 2851, 1686, 1394, 1194, 815, 673, 589; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{30}H_{28}O^+$, 399.1743, found 399.1738.

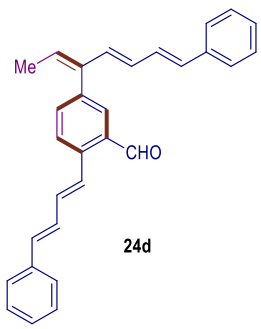
5–((1*E*,3*E*)–1–phenylpenta–1,3–dien–3–yl)–2–((*E*)–styryl)benzaldehyde (**23d**)



23d

According to the procedure C, the reaction of **23a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **23d** as a light yellow amorphous solid (23.8 mg, 68%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 10.26 (s, 1H), 8.05 (d, *J* = 16.0 Hz, 1H), 7.73 (d, *J* = 8.0 Hz, 1H), 7.59 (s, 1H), 7.53 (d, *J* = 8.0 Hz, 2H), 7.36 – 7.31 (m, 4H), 7.26 (s, 1H), 7.22 – 7.17 (m, 3H), 7.12–7.09 (m, 2H), 7.05 (s, 1H), 6.94 (d, *J* = 8.0 Hz, 1H), 5.97 – 5.89 (m, 2H), 1.59 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 192.8, 140.7, 138.5, 137.6, 137.3, 137.0, 135.2, 133.9, 133.8, 132.9, 132.6, 129.6, 129.2, 128.8, 128.5, 128.3, 127.3, 127.2, 127.2, 127.0, 126.2, 124.7, 15.2; **IR(cm$^{-1}$)**: ν 2980, 1692, 1616, 1486, 1411, 1325, 1167, 1017, 825; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{26}H_{23}O^+$, 351.1743, found 351.1721.

2–((1*E*,3*E*)–4–phenylbuta–1,3–dien–1–yl)–5–((2*E*,4*E*,6*E*)–7–phenylhepta–2,4,6–trien–3–yl)benzaldehyde (**24d**)

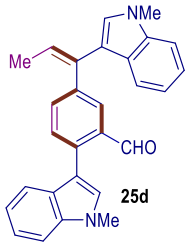


24d

According to the procedure C, the reaction of **24a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **24d** as a light yellow amorphous solid (27.3 mg, 68%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 10.22 (s, 1H), 7.68 (d, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 8.0 Hz, 1H), 7.53 (s, 1H), 7.41 – 7.40 (m, 2H), 7.29 – 7.26 (m, 4H), 7.26 – 7.17 (m,

4H), 7.12 – 7.11 (m, 1H), 7.04 – 6.92 (m, 2H), 6.78, 6.77 (dd, *J* = 11.5, 15.0 Hz, 1H), 6.68 (d, *J* = 15.0 Hz, 1H), 6.50 (d, *J* = 15.0 Hz, 1H), 6.31 (d, *J* = 15.0 Hz, 1H), 5.86 (q, *J* = 7.0 Hz, 1H), 5.79 – 5.73 (m, 1H), 1.57 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 192.8, 140.9, 138.3, 137.5, 137.4, 137.0, 136.7, 135.0, 134.7, 134.2, 133.9, 132.5, 132.3, 129.9, 129.5, 129.1, 129.0, 128.7, 128.6, 128.1, 128.0, 127.3, 126.7, 126.6, 126.2, 15.2; **IR(cm$^{-1}$)**: ν 3456, 3058, 2851, 2321, 1686, 1600, 1488, 986, 746, 690; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{30}H_{27}O^+$, 403.2056, found 403.2059.

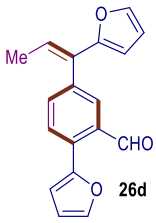
(*Z*)–2–(1–methyl–1H–indol–3–yl)–5–(1–(1–methyl–1H–indol–3–yl)prop–1–en–1–yl)benzaldehyde (**25d**)



**25d**

According to the procedure C, the reaction of **25a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **25d** as a light yellow amorphous solid (29.1 mg, 72%). The crude product was purified by column chromatography on silica gel (PE/EA = 30:1) **$^1$H NMR (500 MHz, $CDCl_3$)** δ 10.07 (s, 1H), 7.93(s, 1H), 7.63 (d, *J* = 8.0 Hz, 1H), 7.57 – 7.54 (m, 2H), 7.50 (d, *J* = 8.0 Hz, 1H), 7.33 (d, *J* = 8.0 Hz, 1H), 7.25 – 7.20 (m, 3H), 7.16 – 7.13 (m, 1H), 7.05 (s, 1H), 7.03–7.00 (m, 1H), 6.64 (s, 1H), 6.23 (q, *J* = 7.0 Hz, 1H), 3.79 (s, 3H), 3.62 (s, 3H), 1.79 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 193.4, 139.7, 137.4, 137.3, 137.1, 135.5 135.3, 133.9, 131.0, 129.9, 128.9, 128.4, 127.7, 126.3, 122.6, 121.9, 121.8, 120.7, 120.6, 119.6, 118.3, 112.1, 109.8, 109.5, 33.1, 32.8, 15.4; **IR (cm$^{-1}$)**: ν 3449, 3110, 2926, 2743, 2245, 1926, 1681, 1602, 1547, 907, 739, 649; **HRMS**: m/z: $[M+Na]^+$ calculated for $C_{28}H_{24}N_2ONa^+$, 427.1780, found 427.1783.

(*Z*)–2–(furan–2–yl)–5–(1–(furan–2–yl)prop–1–en–1–yl)benzaldehyde (**26d**)

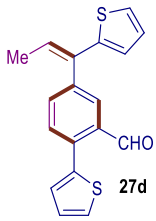


**26d**

According to the procedure C, the reaction of **26a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **26d** as a light yellow amorphous solid (24.4 mg, 88%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (400 MHz, $CDCl_3$)** δ 10.36 (s, 1H), 7.82 (d, *J* = 2.0 Hz, 1H), 7.67 – 7.65 (m, 1H), 7.57 – 7.56 (m, 1H), 7.46, 7.45 (dd, *J* = 2.0, 8.0 Hz, 1H), 7.30

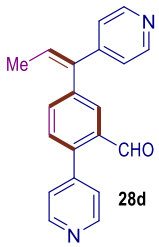
– 7.30 (m, 1H), 6.62 – 6.61 (m, 1H), 6.52 – 6.51 (m, 1H), 1H), 6.36 (q, *J* = 7.2 Hz, 1H), 6.25 – 6.24 (m, 1H), 5.72 – 5.71 (m, 1H), 1.65 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, $CDCl_3$)** δ 192.2, 154.8, 151.0, 144.4, 141.8, 137.4, 135.1, 133.0, 132.3, 131.3, 129.4, 128.3, 122.7, 112.0, 111.3,111.1, 107.1, 14.7; **IR(cm$^{-1}$)**: ν 3456, 2918, 1794, 1685, 1605, 1561, 1503, 1260, 1013, 804, 741, 593; **HRMS**: m/z: $[M+Na]^+$ calculated for $C_{18}H_{14}O_3Na^+$, 301.0835, found 301.0837.

(Z)–2–(thiophen–2–yl)–5–(1–(thiophen–2–yl)prop–1–en–1–yl)benzaldehyde (**27d**)




According to the procedure C, the reaction of **27a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **27d** as a light yellow amorphous solid (PE/EA = 50:1) to provide **4a** as a yellow amorphous solid (27.0 mg, 87%). The crude product was purified by column chromatography on silica gel (PE/EA = 100:1). **$^1$H NMR (400 MHz, $CDCl_3$)** δ 10.15 (s, 1H), 7.84 – 7.83 (m, 1H), 7.53 – 7.51 (m, 1H), 7.46 – 7.43 (m, 1H), 7.42 – 7.41 (m, 1H), 7.11 – 7.10 (m 1H), 7.08 – 7.05 (m, 2H), 6.83, 6.82 (dd, *J* =2.0, 3.6 Hz, 1H), 6.50 (d, *J* = 3.6 Hz, 1H), 6.24 (q, *J* = 7.2 Hz, 1H), 1.66 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, $CDCl_3$)** δ 191.9, 146.4, 139.3, 138.6, 137.0, 135.1, 134.9, 134.1, 131.3, 129.6, 129.0, 127.8, 127.4, 127.2, 124.8, 124.3, 123.8, 15.3; **IR (cm$^{-1}$)**: ν 3462, 2924, 2852, 1686, 1600, 915, 848, 700, 647; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{18}H_{15}OS_2^+$, 311.0558, found 311.0553.

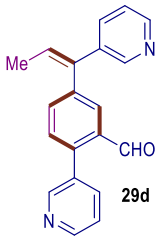
(*Z*)–2–(pyridin–4–yl)–5–(1–(pyridin–4–yl)prop–1–en–1–yl)benzaldehyde (**28d**)




According to the procedure C, the reaction of **28a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **28d** as a light yellow amorphous solid (21.2 mg, 70%). The crude product was purified by column chromatography on silica gel (PE/EA = 1:1). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 9.95 (s, 1H), 8.69 – 8.68 (m, 2H), 8.44 (s, 2H), 7.81 (s, 1H), 7.42 (s, 2H), 7.32 – 7.31 (m, 2H), 7.04 – 7.03 (m, 2H), 6.45 (q, *J* = 7.0 Hz, 1H), 1.78 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 190. 9, 149.7, 149.6, 149.0, 145.5, 141.6, 139.3, 138.7, 135.3, 133.5, 132.1, 132.0,

130.7, 129.7, 129.6, 128.5, 128.4, 124.7, 121.5, 15.9; **IR(cm$^{-1}$)**: ν 3454, 2925, 2852, 1689, 1637, 1597, 1542, 1070, 998, 914, 822; **HRMS**: m/z: $[M+Na]^+$ calculated for $C_{20}H_{17}N_2ONa^+$, 323.1154, found 323.1154.

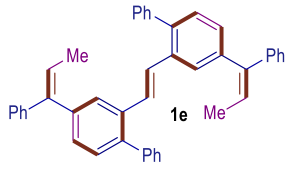
(*Z*)–2–(pyridin–3–yl)–5–(1–(pyridin–3–yl)prop–1–en–1–yl)benzaldehyde (**29d**)



**29d**

According to the procedure C, the reaction of **29a** and pinacol vinylboronate **1b** was carried out under standard condition to give the title product **29d** as a light yellow amorphous solid (21.1 mg, 70%). The crude product was purified by column chromatography on silica gel (PE/EA = 1:1). **$^1$H NMR (400 MHz, CDCl$_3$)** δ 9.94 (s, 1H), 8.65 (s, 1H), 8.44 – 8.41 (m, 2H), 7.83 (s, 1H), 7.70 (d, *J* = 8.0 Hz, 2H), 7.45 – 7.37 (m, 4H), 7.17 – 7.13 (m, 1H), 6.25 (q, *J* = 7.2 Hz, 1H), 1.79 (d, *J* = 7.2 Hz, 3H); **$^{13}$C NMR (100 MHz, CDCl$_3$)** δ 191.1, 150.1, 149.4, 148.3, 148.2, 140.7, 139.6, 137.9, 137.7, 137.2, 135.3, 134.4, 133.8, 133.3, 131.2, 129.8, 127.7, 123.2, 123.1, 15.8; **IR (cm$^{-1}$)**: ν 3470, 3028, 2923, 2852, 1689, 1603, 1470, 1414, 1106, 807, 714; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{20}H_{17}N_2O^+$, 301.1335, found 301.1338.

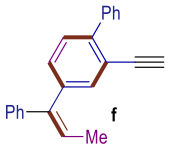
(*E*)–1,2–bis(4–((E)–1–phenylprop–1–en–1–yl)–[1,1'–biphenyl]–2–yl)ethene (**1e**)



**1e**

The crude product was purified by column chromatography on silica gel to provide **1e** as a yellow amorphous solid (141.2 mg, 50%). **$^1$H NMR (500 MHz, CDCl$_3$)** δ 7.34 – 7.33 (m, 2H), 7.30 – 7.28 (m, 3H), 7.24 – 7.20 (m, 4H), 7.17 – 7.14 (m, 3H), 7.02 (d, *J* = 7.0 Hz, 1H), 6.94 (s, 1H), 6.07 (q, *J* = 7.0 Hz, 1H), 1.72 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, CDCl$_3$)** δ 143.0, 142.0, 140.6, 139.4, 139.0, 135.3, 129.9 129.8, 129.2, 128.7, 128.0, 128.0, 127.7, 127.4, 127.0, 126.8, 124.6, 15.9; **IR(cm$^{-1}$)**: ν 3482, 2923, 1637, 1384, 1262, 1107, 799, 700, 672, 611; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{44}H_{36}^+$, 565.2889, found 565.2860.

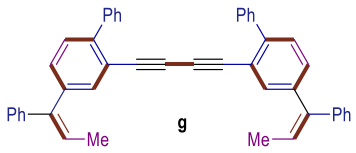
(*E*)–2–ethynyl–4–(1–phenylprop–1–en–1–yl)–1,1'–biphenyl (**f**)




The crude product was purified by column chromatography on silica gel to provide **f** as a yellow amorphous solid (288.5 mg, 98%). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 7.64 (d, *J* = 7.0 Hz, 2H), 7.47 (s, 1H), 7.42 (t, *J* = 7.0 Hz, 2H), 7.37 – 7.34 (m, 2H), 7.28 – 7.21 (m, 6H), 6.19 (q, *J* = 7.0 Hz, 1H), 3.00 (s, 1H), 1.80 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 143.3, 142.4, 141.1, 139.7, 138.9, 135.7, 131.3, 129.5, 129.1, 128.2, 128.1, 127.6, 127.2, 126.9, 125.1, 120.0, 81.6, 76.7, 15.8; **IR($cm^{-1}$)**: ν 3463, 3276, 3024, 2925, 2850, 1685, 1477, 1383, 1260, 902, 846; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{23}H_{19}^+$, 295.1481, found 295.1468.

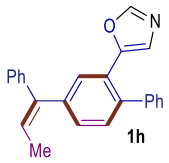
(*E*)–2–(phenylethynyl)–4–(1–phenylprop–1–en–1–yl)–1,1'–biphenyl (**g**)

1,4–bis(4–((*E*)–1–phenylprop–1–en–1–yl)–[1,1'–biphenyl]–2–yl)buta–1,3–diyne




The crude product was purified by column chromatography on silica gel to provide **g** as a yellow amorphous solid (25.4mg, 68%). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 7.51 (d, *J* = 7.0 Hz, 2H), 7.35 – 7.27 (m, 5H), 7.18 – 7.16 (m, 2H), 7.13 – 7.09 (m, 4H), 6.09 (q, *J* = 7.0 Hz, 1H), 1.70 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 143.3, 142.4, 141.1, 139.7, 138.9, 135.7, 131.1, 129.5, 129.1, 128.2, 128.1, 127.6, 127.2, 126.9, 125.1, 120.0, 81.6, 76.8, 15.8; **IR($cm^{-1}$)**: ν 3458, 3027, 2927, 2852, 1943, 1440, 1071, 769, 695, 662; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{46}H_{35}^+$, 587.2733, found 587.2736.

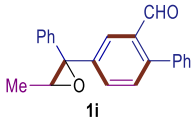
(*E*)–5–(4–(1–phenylprop–1–en–1–yl)–[1,1'–biphenyl]–2–yl)oxazole (**1h**)




The crude product was purified by column chromatography on silica gel to provide **1h** as a yellow amorphous solid (404.9 mg, 80%). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 7.55 (s, 1H), 7.49 (s, 1H), 7.25 – 7.24 (m, 3H), 7.18 – 7.12 (m, 7H), 7.09 – 7.07 (m, 2H), 6.14 (s, 1H), 6.10 (q, *J* = 7.0 Hz, 1H), 1.96 (d, *J* = 7.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 150.2, 149.7, 142.4, 141.5, 140.9, 139.5, 138.5, 130.5, 130.0, 128.7, 128.4, 128.0, 127.5, 127.1, 126.8, 124.8, 124.5, 15.7; **IR($cm^{-1}$)**: ν 3436, 3131, 3027, 2910, 2854, 2608, 2337, 1950, 1881, 1808, 1107, 954,

698; **HRMS**: m/z: $[M+H]^+$ calculated for $C_{24}H_{20}NO^+$, 338.1539, found 338.1534.

4–(3–methyl–2–phenyloxiran–2–yl)–[1,1'–biphenyl]–2–carbaldehyde (**1i**)



1i

The crude product was purified by column chromatography on silica gel to provide **1i** as a yellow amorphous solid (157.2 mg, 85%). **$^1$H NMR (500 MHz, $CDCl_3$)** δ 10.00 (s, 1H), 8.07 (s, 1H), 7.72 (d, *J* = 8.0 Hz, 1H), 7.48 – 7.42 (m, 4H), 7.40 – 7.36 (m, 4H), 7.34 – 7.28 (m, 3H), 3.56 (q, *J* = 5.0 Hz, 1H), 1.23 (d, *J* = 5.0 Hz, 3H); **$^{13}$C NMR (125 MHz, $CDCl_3$)** δ 192.1, 145.1, 140.3, 137.6, 137.3, 133.3, 133.1, 130.8, 130.0, 128.4, 128.4, 128.2, 127.9, 127.0, 126.8, 65.7, 62.2, 15.4; **IR($cm^{-1}$)**: ν 2851, 1740, 1685, 1607, 1553, 1393, 1333, 1127, 949, 836; **HRMS**: m/z: $[M+Na]^+$ calculated for $C_{22}H_{18}O_2Na^+$, 337.1199, found 337.1194.

## 6. X-Ray Structure of 1d.

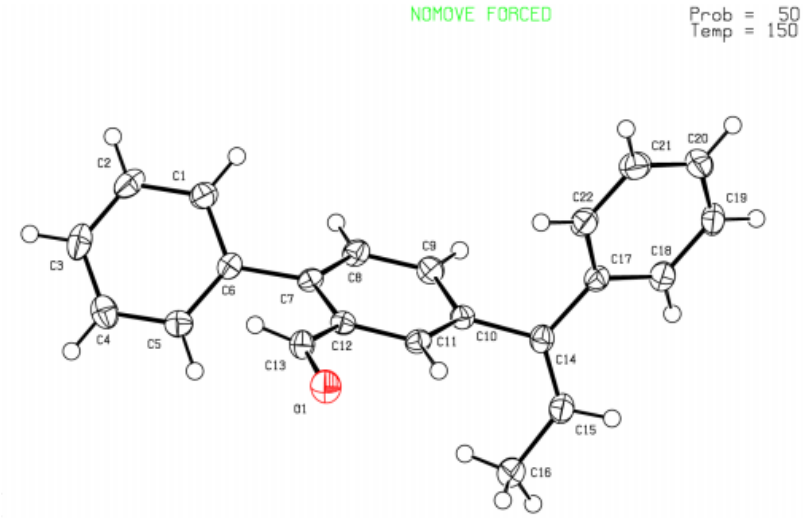



Fig. 3. X-ray crystallographic structure of 1d (CCDC 2113583) shows thermal ellipsoid probability at 50%.

The crystal **1d** was prepared by slow evaporation using petroleum ether and ethyl acetate solvent mixture (PE:EA = 100:1) at room temperature. A single crystal of **1d** was mounted and the diffraction data was collected at 150 K on a Rigaku SuperNova diffractometer using CrysAlisPro software, which coupled with a Mo source (λ = 0.71073 Å). The structure of the crystal was solved by ShelXT[8] and refined by ShelXL[9] program based on the Olex2[10] software. The ORTEP image of compound **3a** and crystallographic refinement parameters are given below.

Crystal data for $C_{22}H_{18}O$ (M =298.36 g/mol): orthorhombic, space group Pbca (no. 61), $a$ = 7.9796(2) Å, $b$ = 18.2987(4) Å, $c$ = 22.0157(6) Å, $V$ = 3214.64(15) Å$^3$, $Z$ = 8, $T$ = 293(2) K, μ(MoKα) = 0.074 mm$^{-1}$, *Dcalc* = 1.233 g/cm$^3$, 12901 reflections measured (7.024° ≤ 2Θ ≤ 57.954°), 3810 unique ($R_{int}$ = 0.0350, $R_{sigma}$ = 0.0404) which were used in all calculations. The final $R_1$ was 0.0492 (I > 2σ(I)) and $wR_2$ was 0.1241.

## 7. References

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(2) M. Mato, A. M. Echavarren, *Angew Chem. Int. Ed*. 2019, **58**, 2088–2092.
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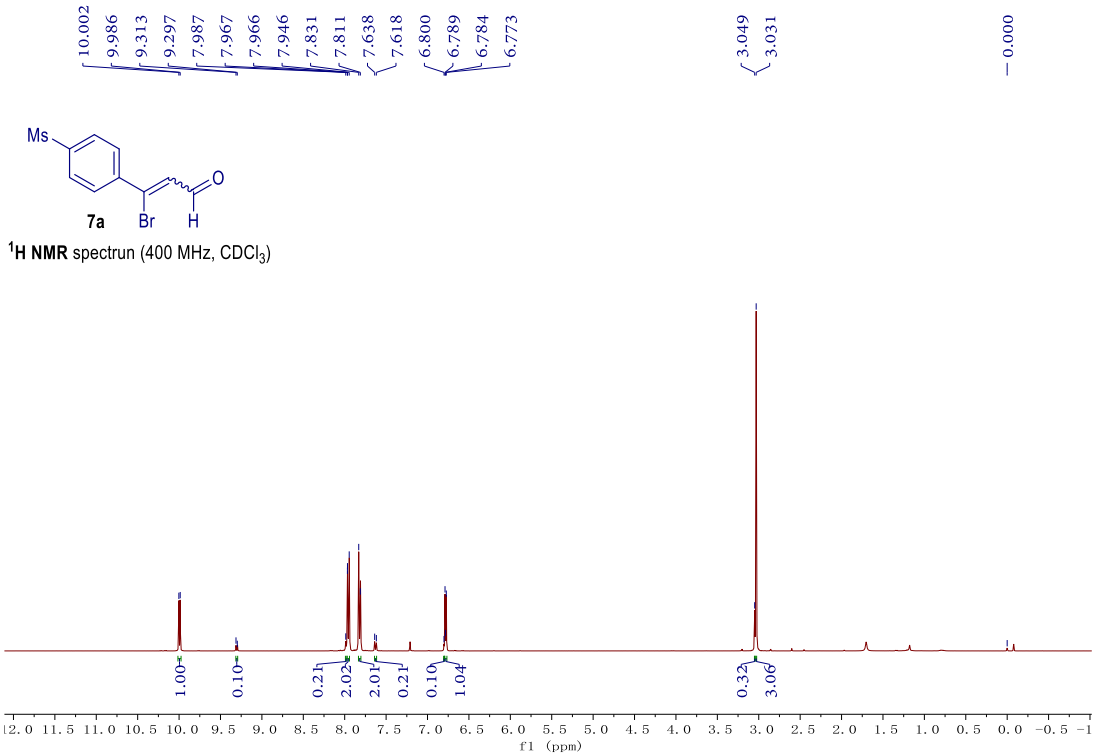
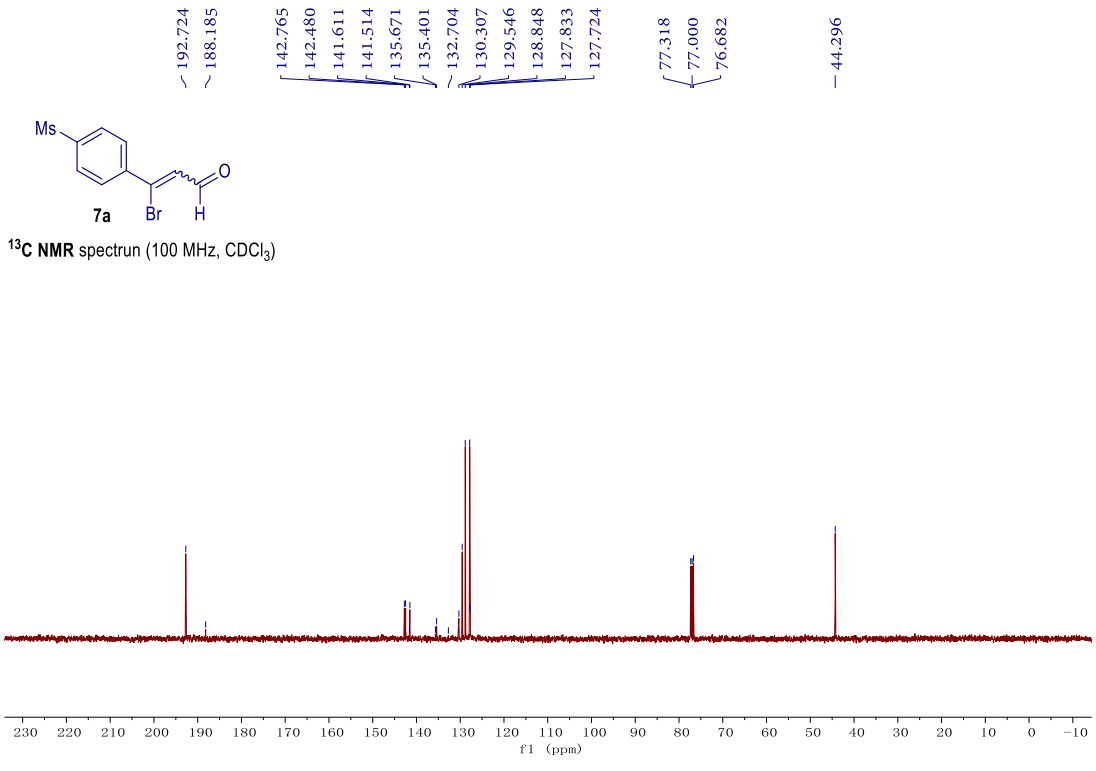
# 8. Copies of NMR Spectra

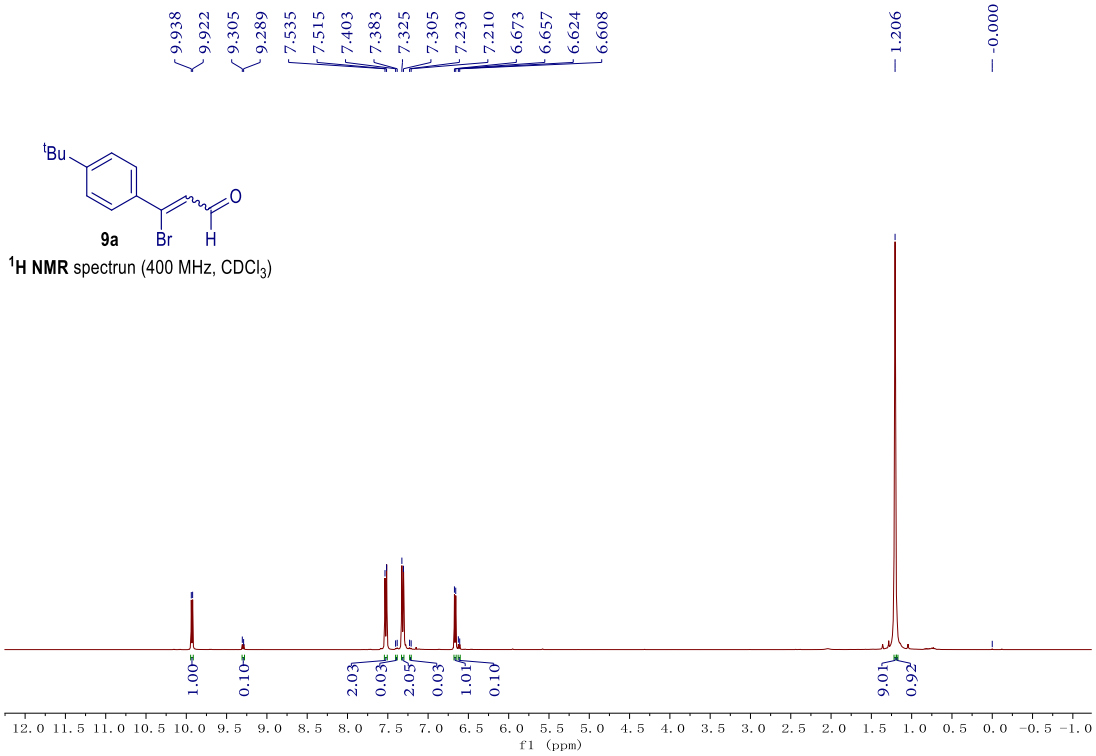



**7a**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

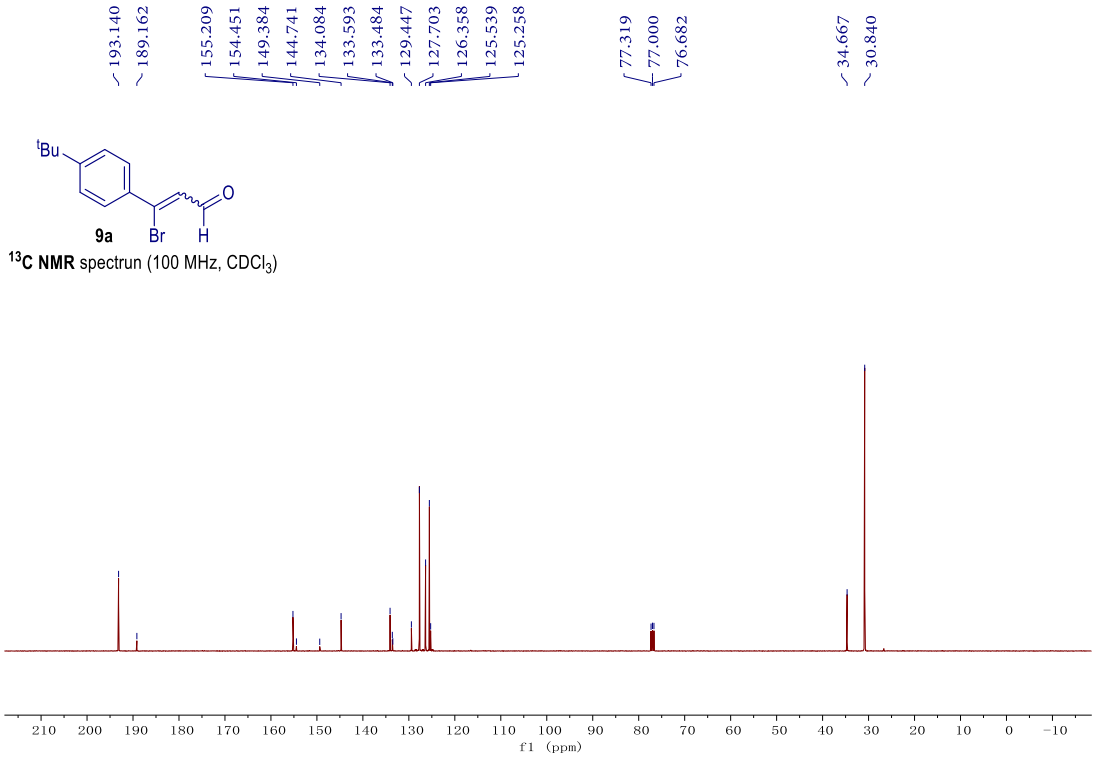



**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



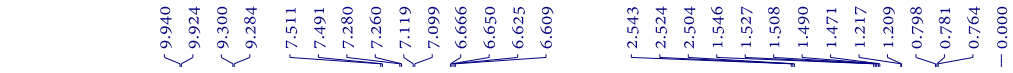

**9a**

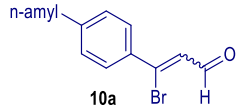
**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)



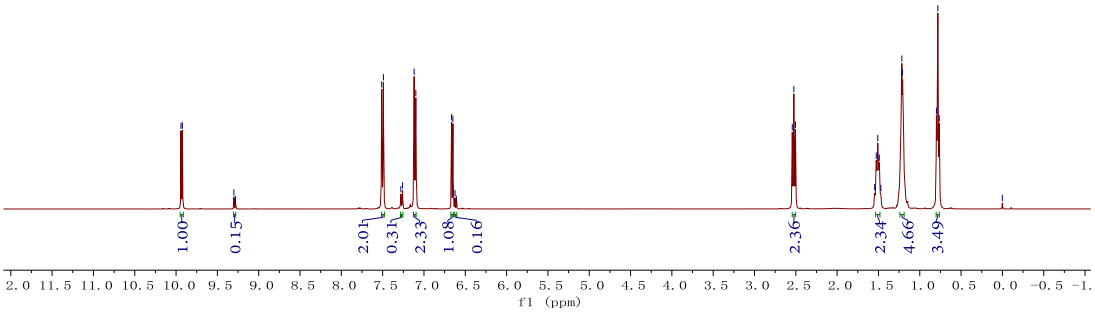

**9a**

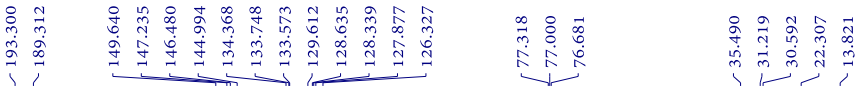
**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

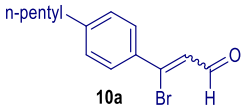


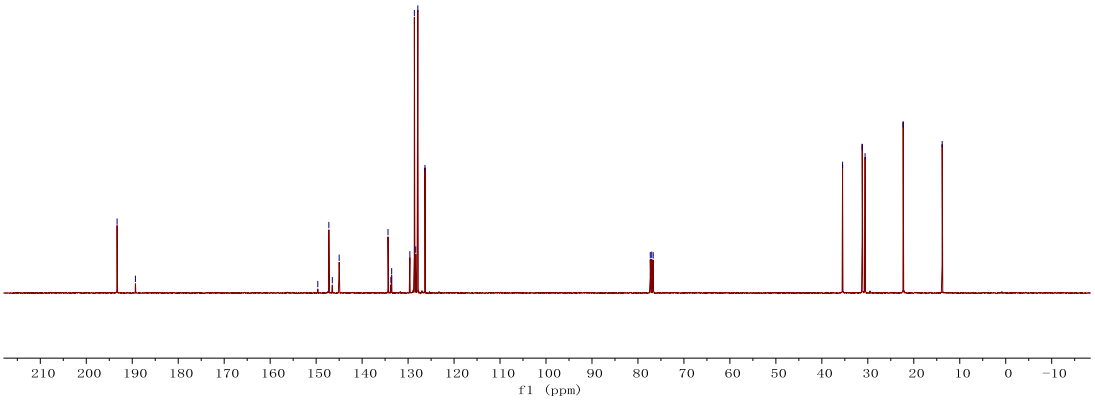

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

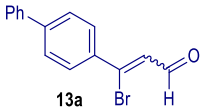


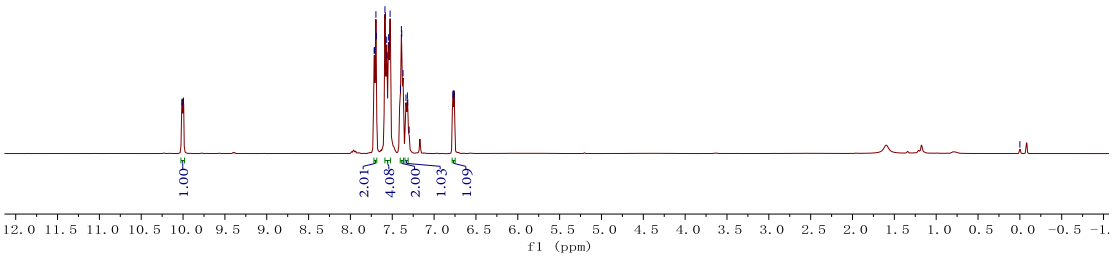

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

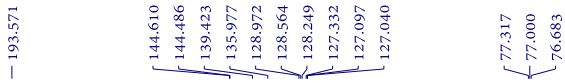


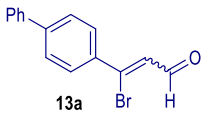




13a

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

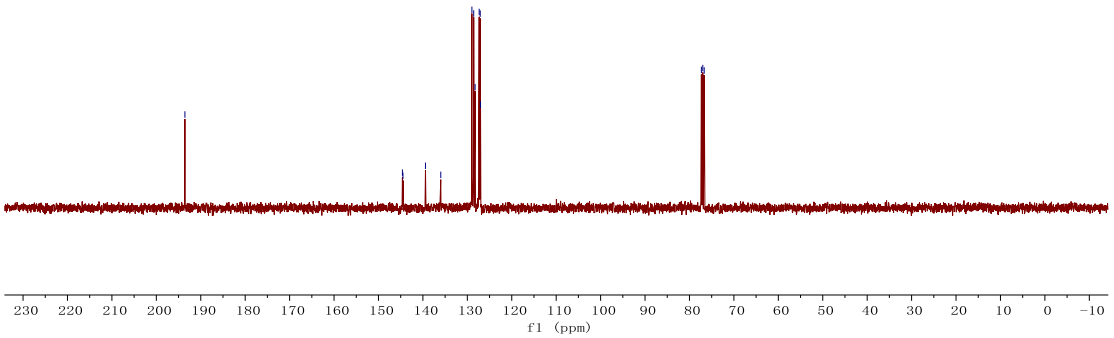


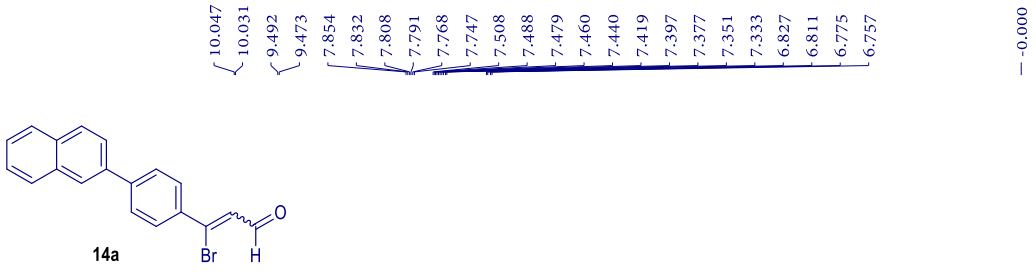




13a

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



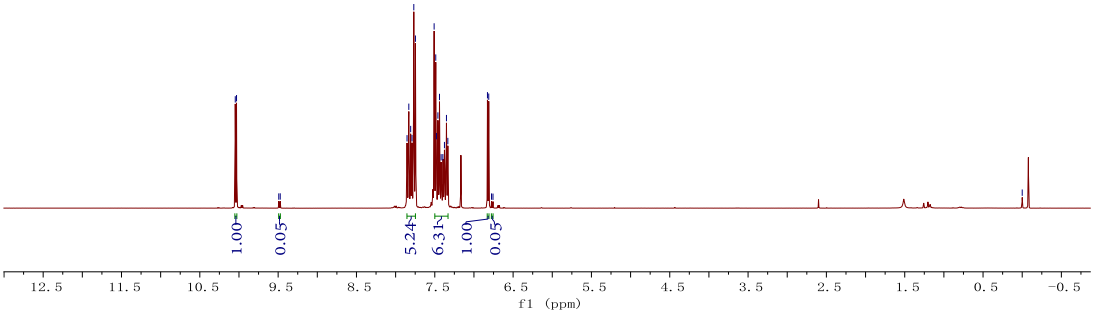




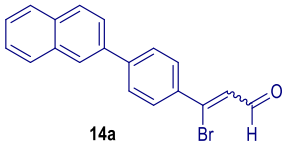


**14a**

$^{1}$**H NMR** spectrun (500 MHz, $CDCl_3$)

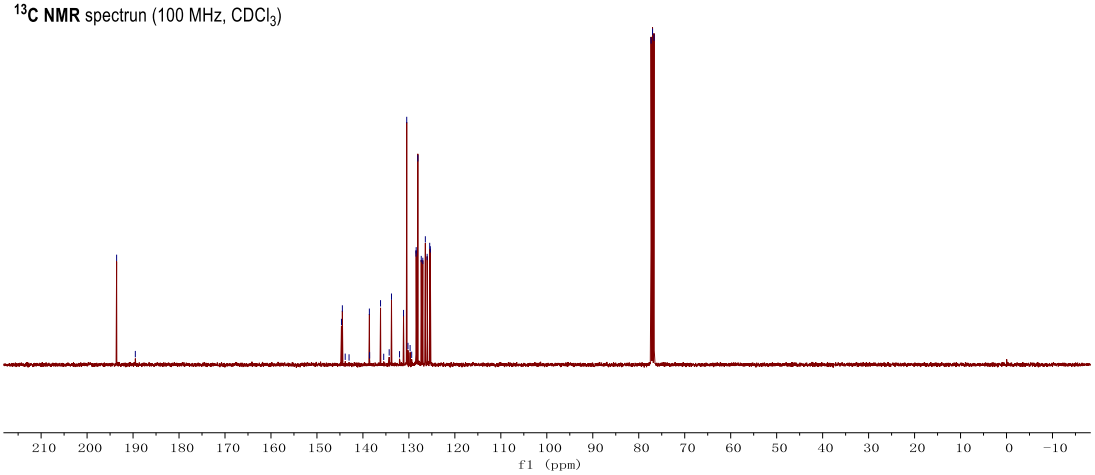


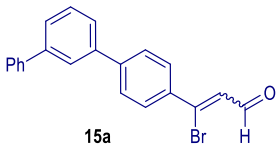





**14a**

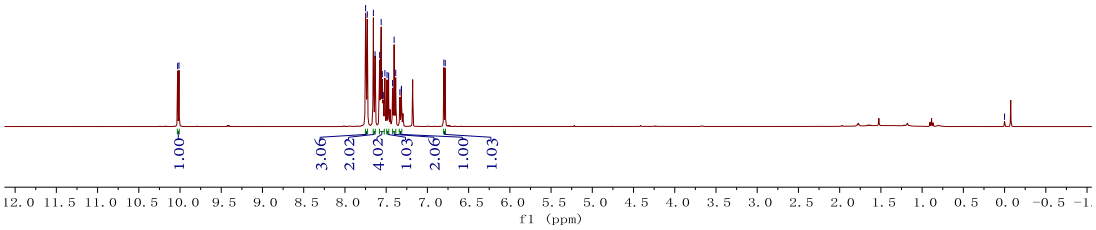
$^{13}$**C NMR** spectrun (100 MHz, $CDCl_3$)



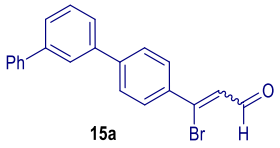




**15a**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

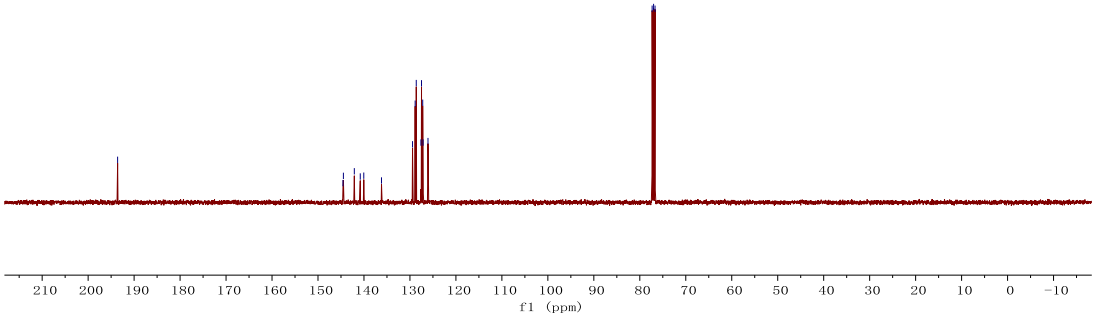


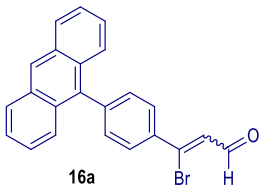





**15a**

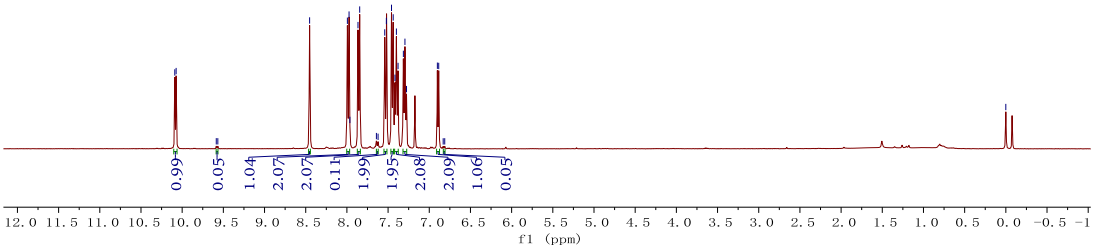
**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



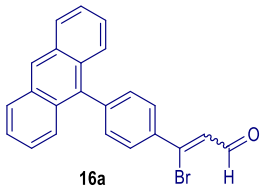




16a

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

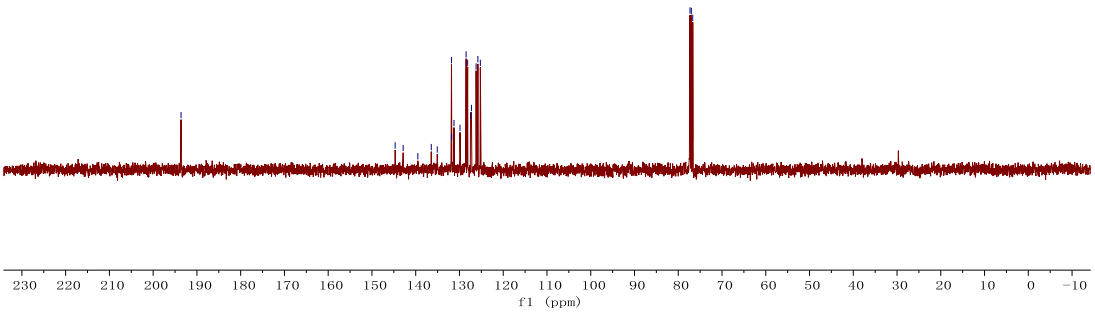


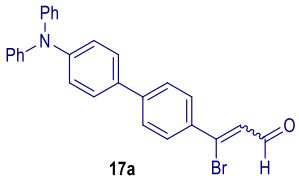





16a

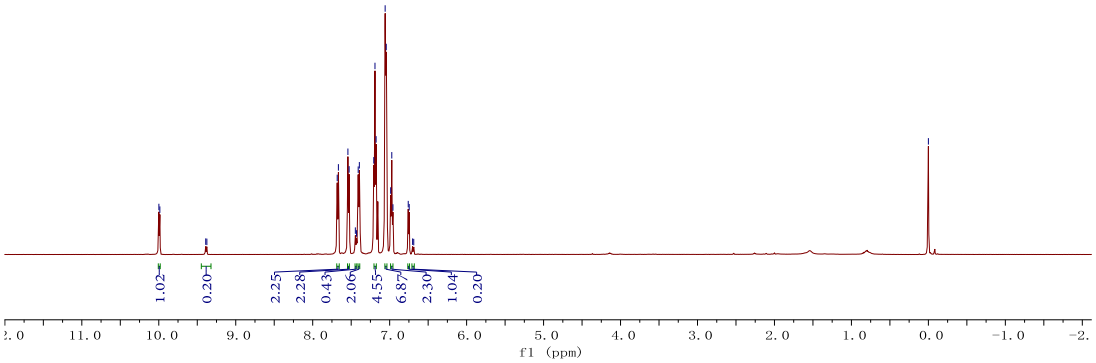
**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



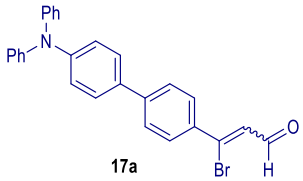




17a

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

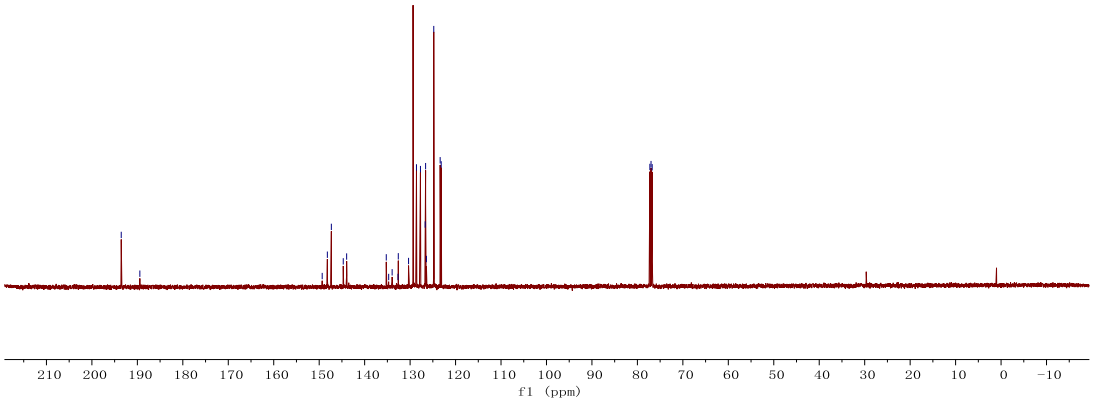


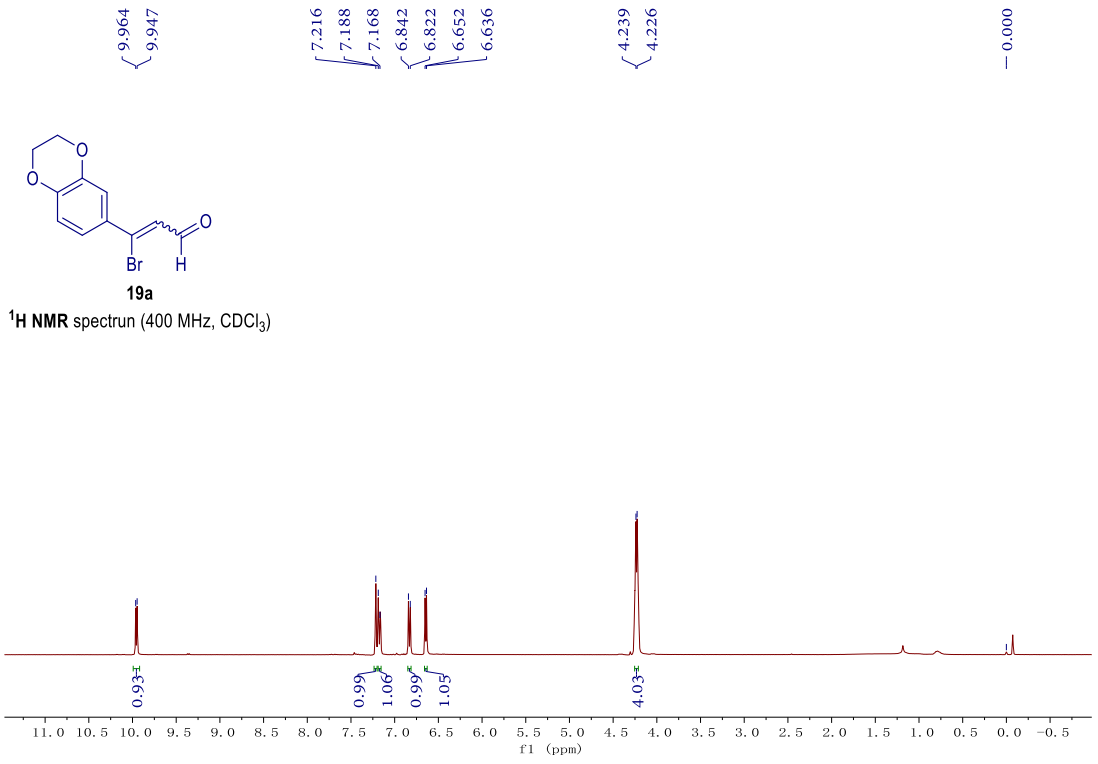





17a

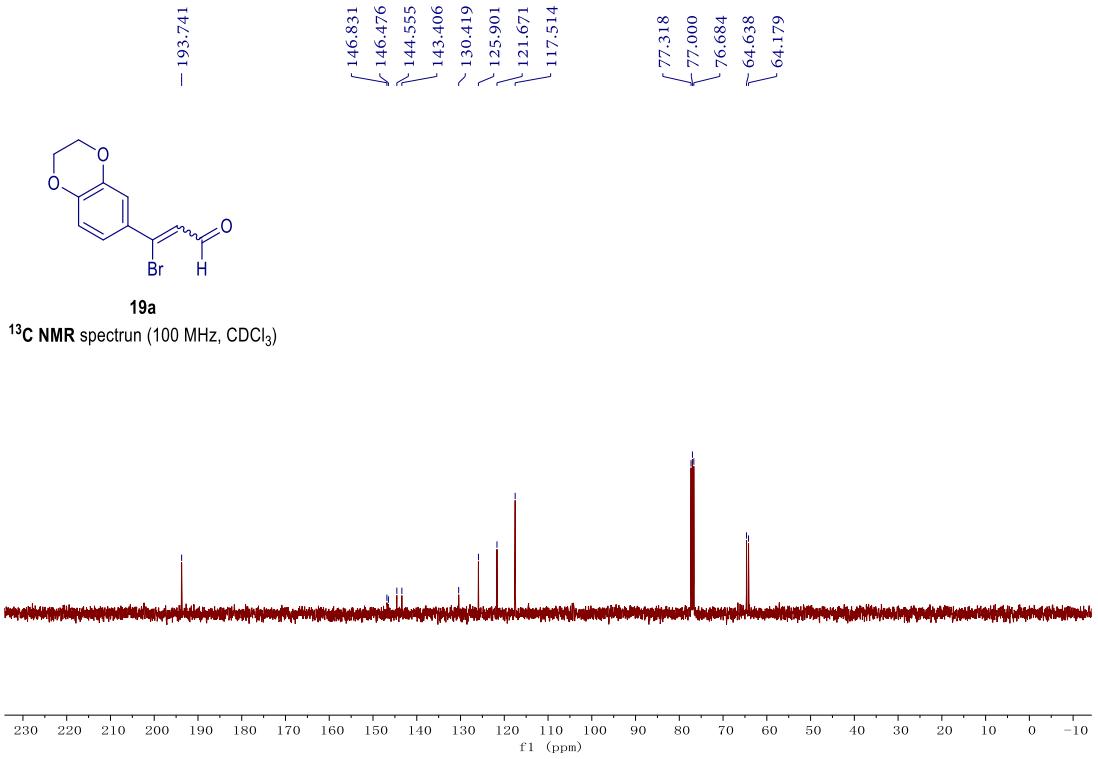
**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)





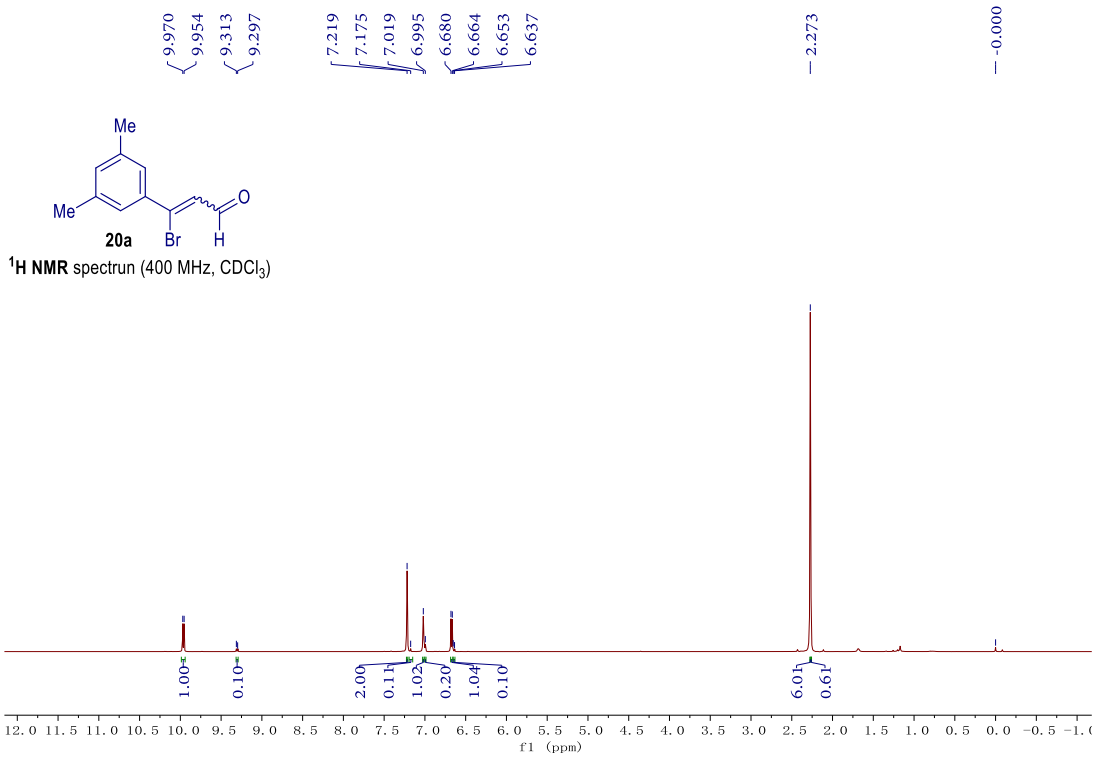

**19a**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

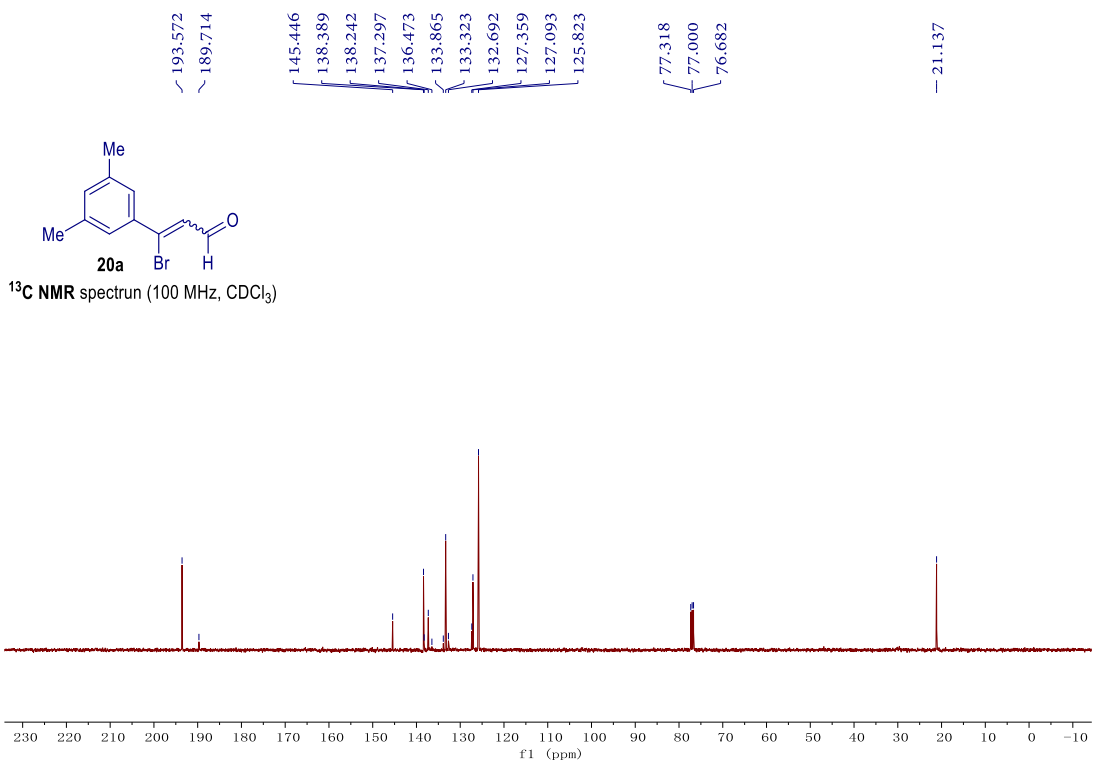



**19a**

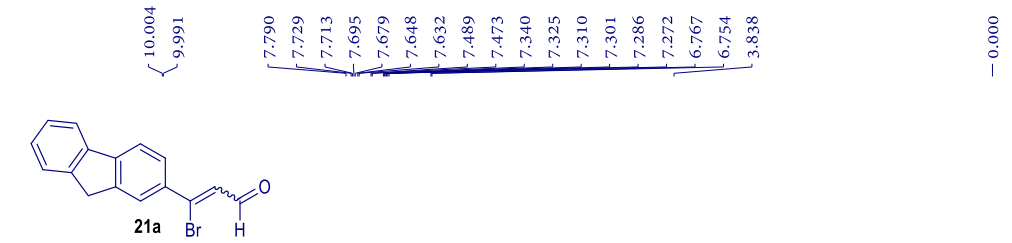
**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



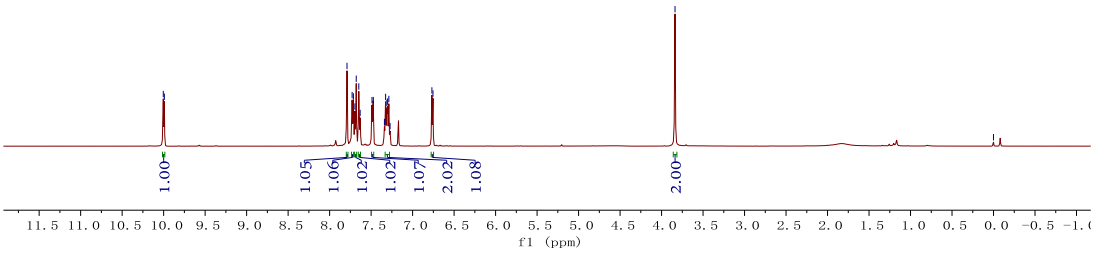

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

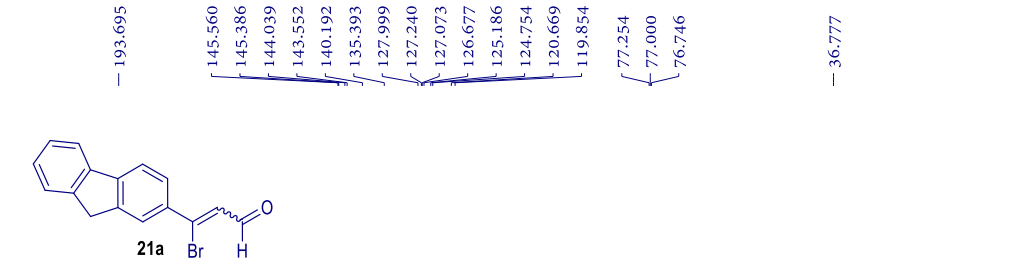



**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

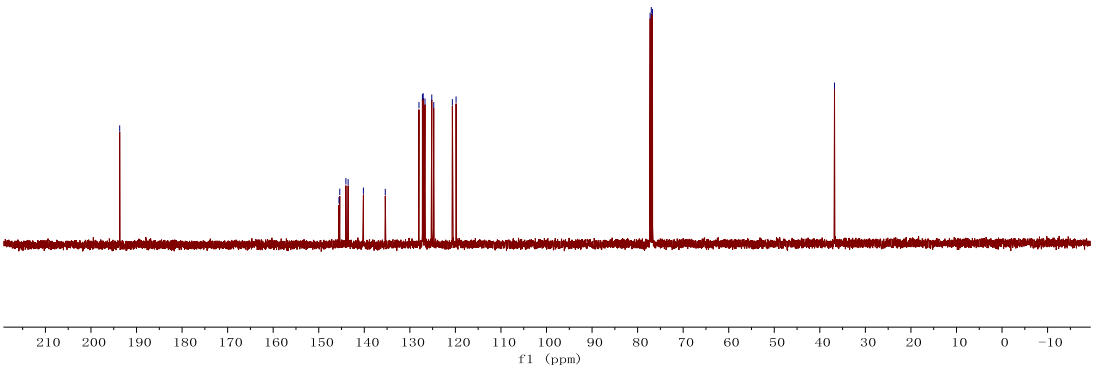


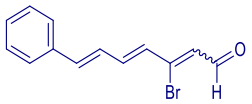

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)



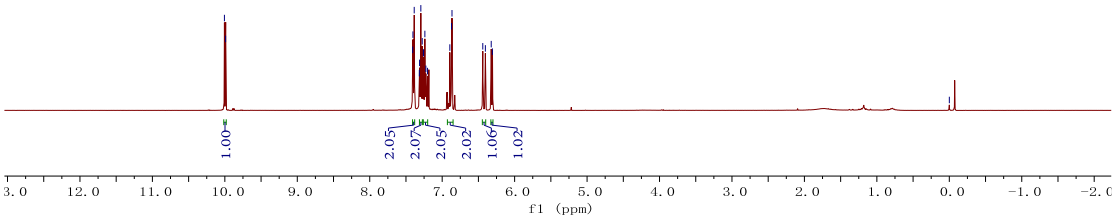

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

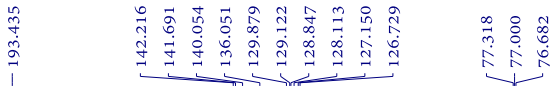


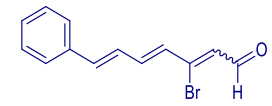




**24a**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

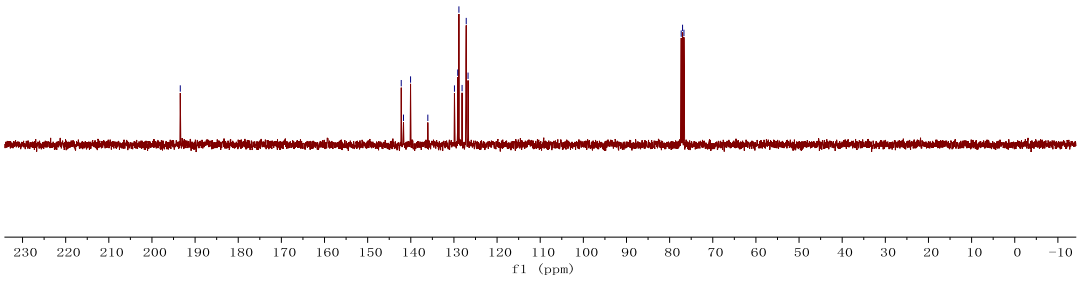


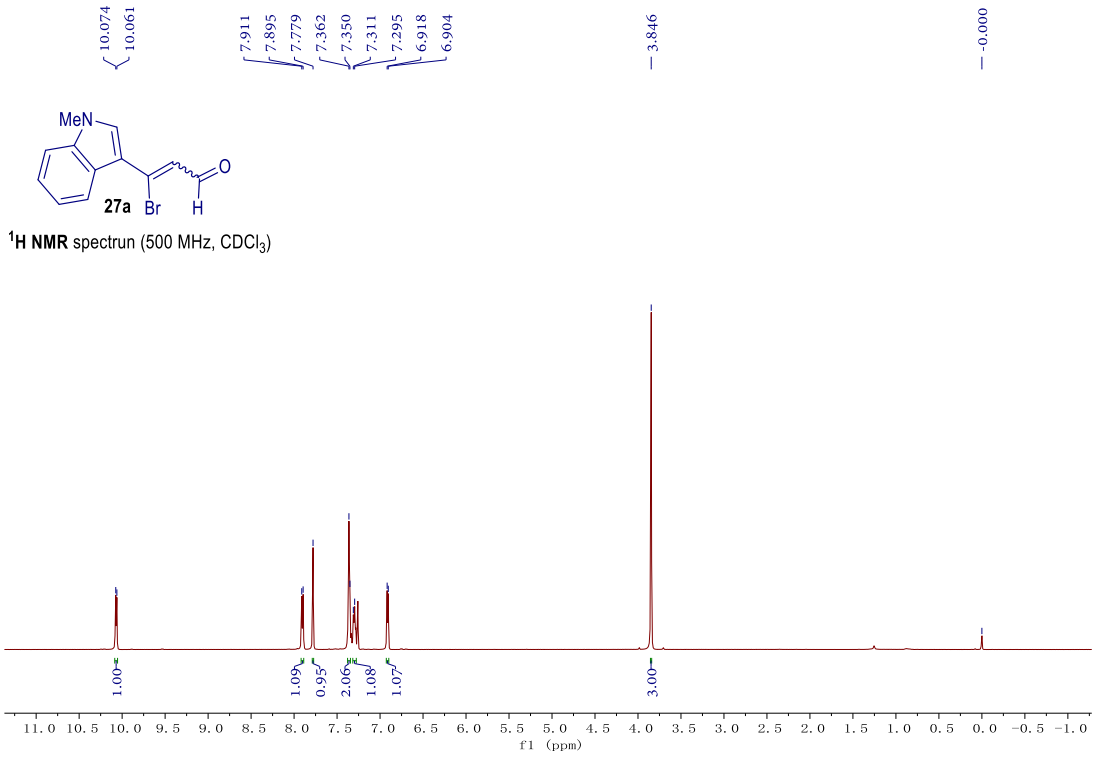



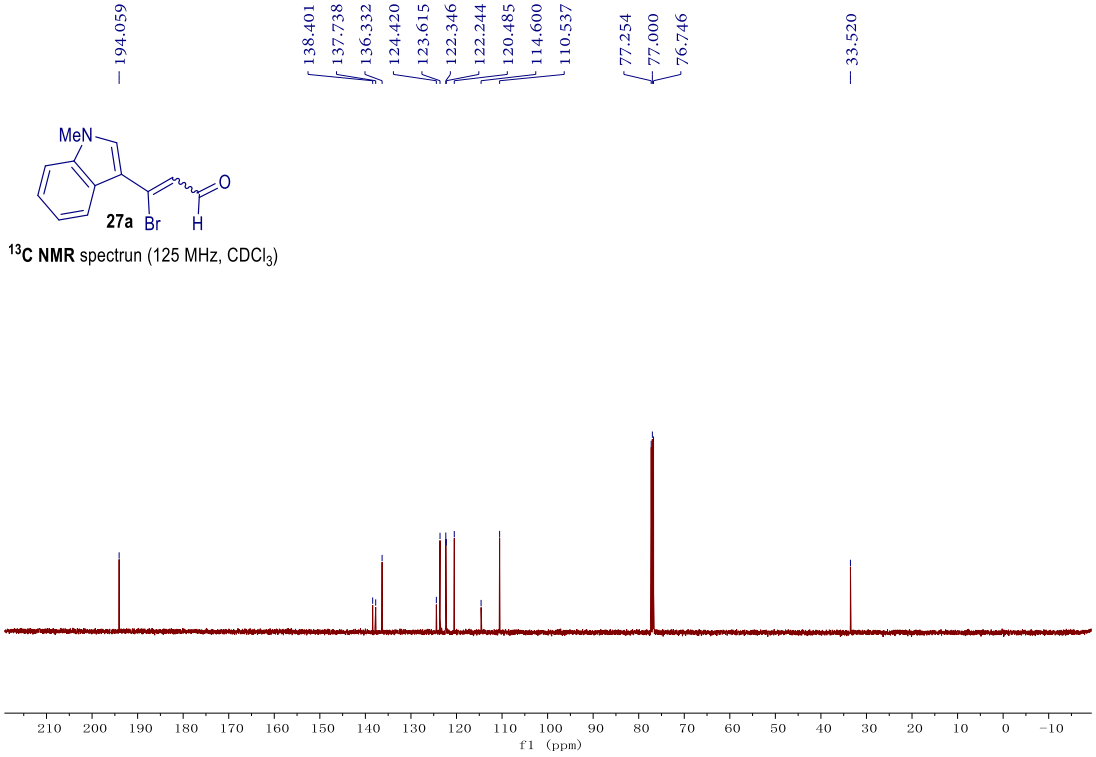

**24a**

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

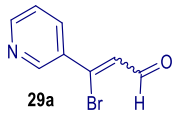





$^{1}$**H NMR** spectrun (500 MHz, $CDCl_3$)

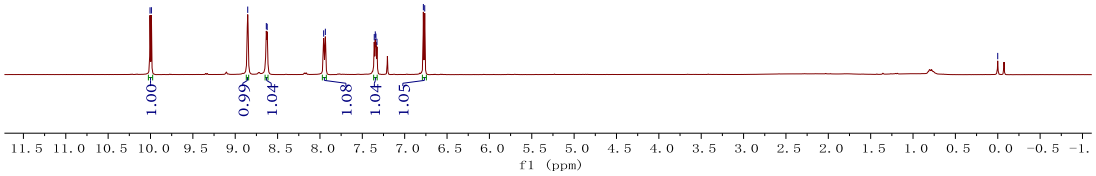



$^{13}$**C NMR** spectrun (125 MHz, $CDCl_3$)

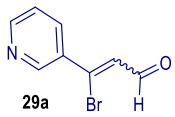




**29a**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

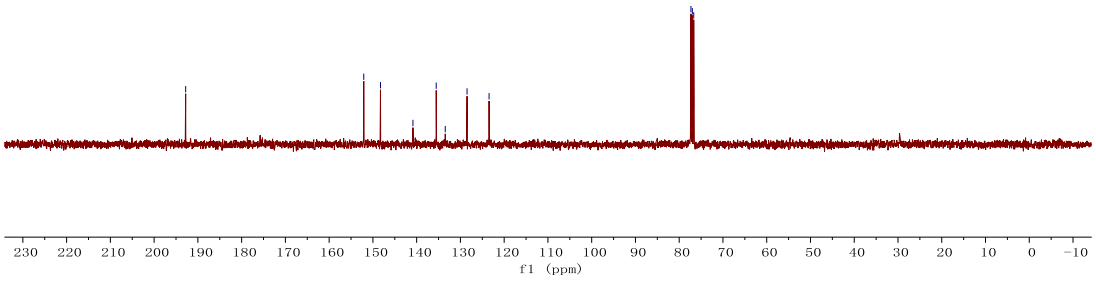


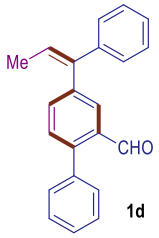





**29a**

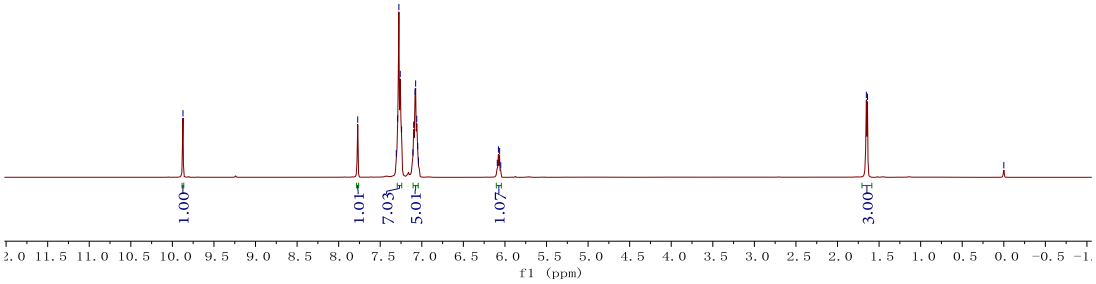
**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



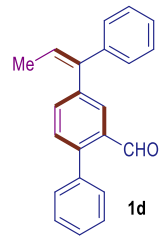




**1d**

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

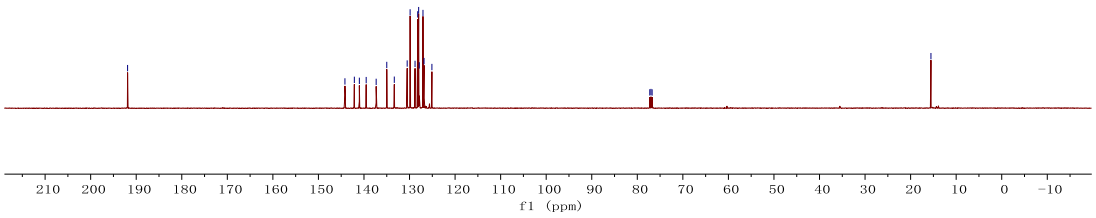


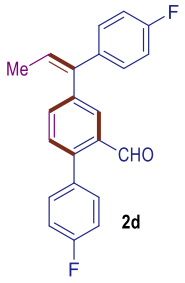




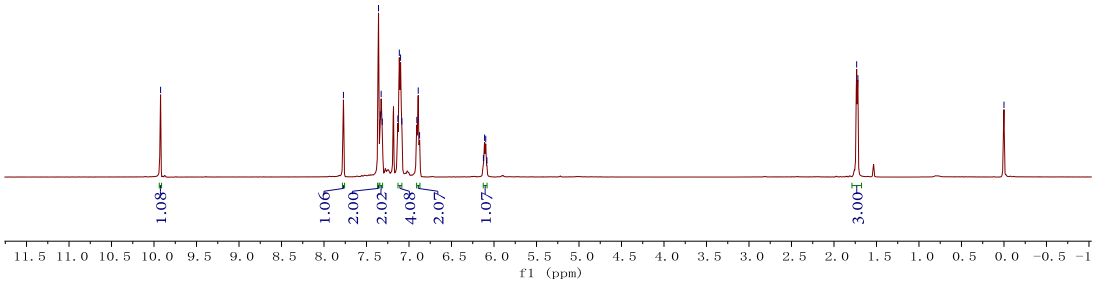

**1d**

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

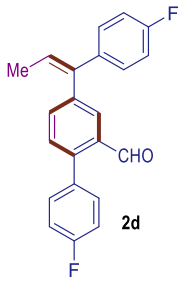


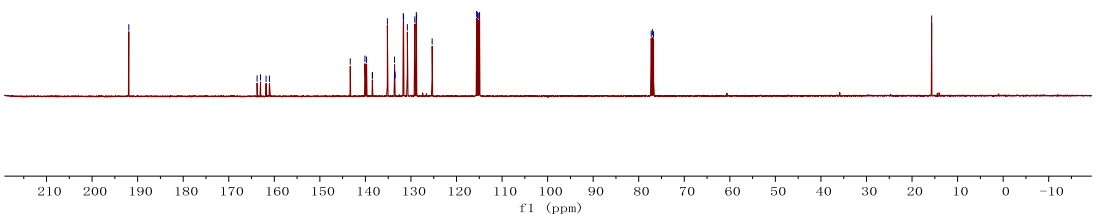

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

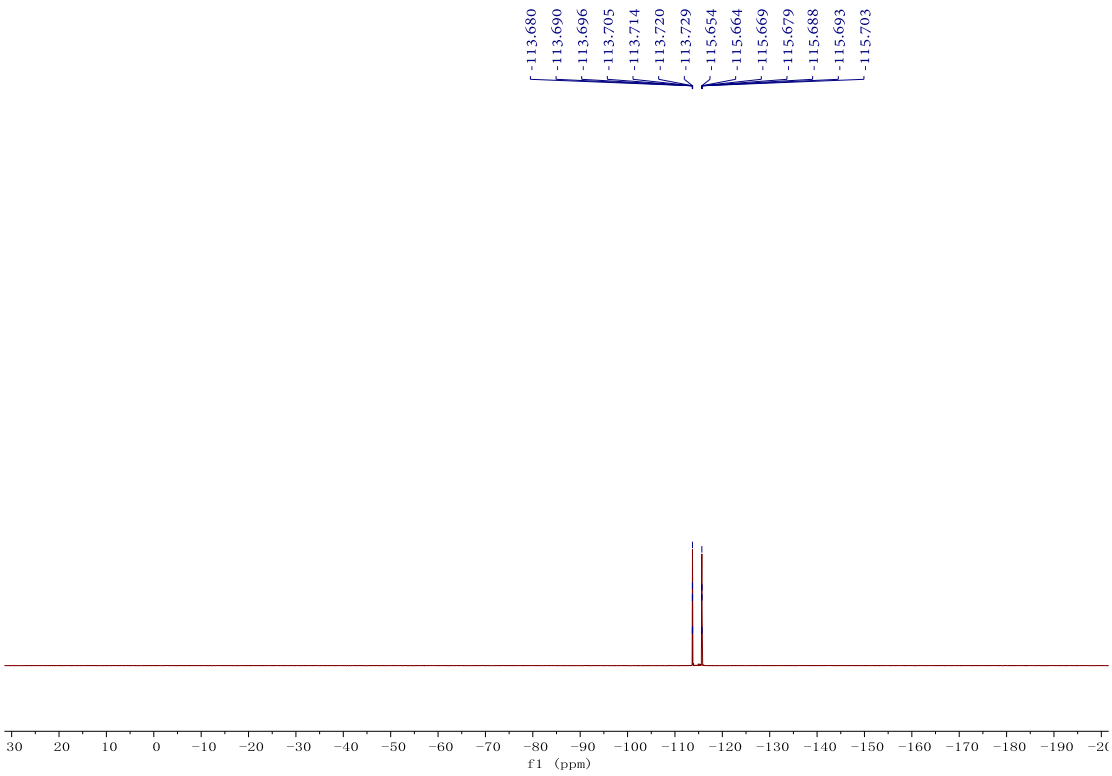


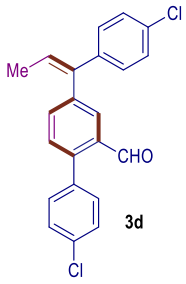





**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

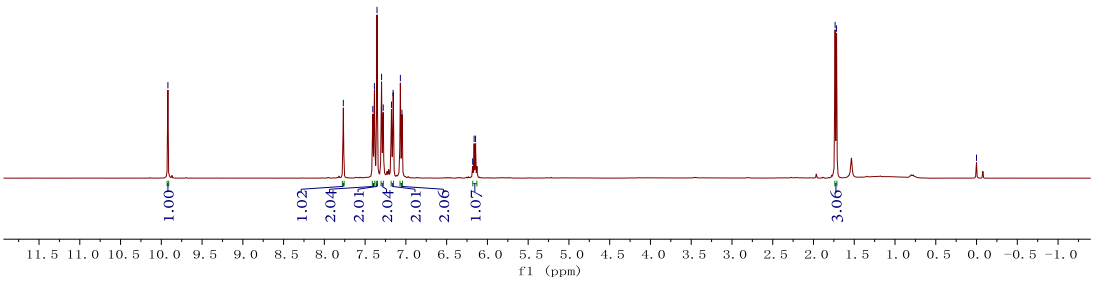



-113.680
-113.690
-113.696
-113.705
-113.714
-113.720
-113.729
-115.654
-115.664
-115.669
-115.679
-115.688
-115.693
-115.703
30 20 10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −20
f1 (ppm)

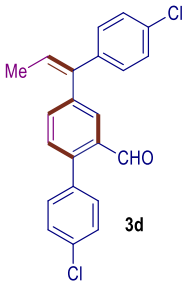




**3d**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

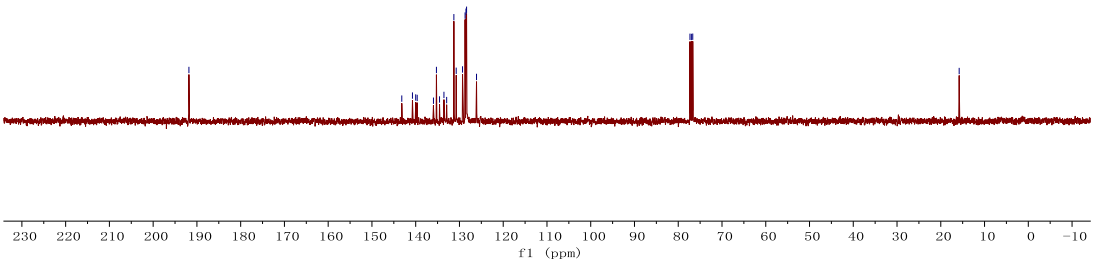


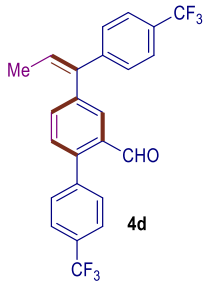




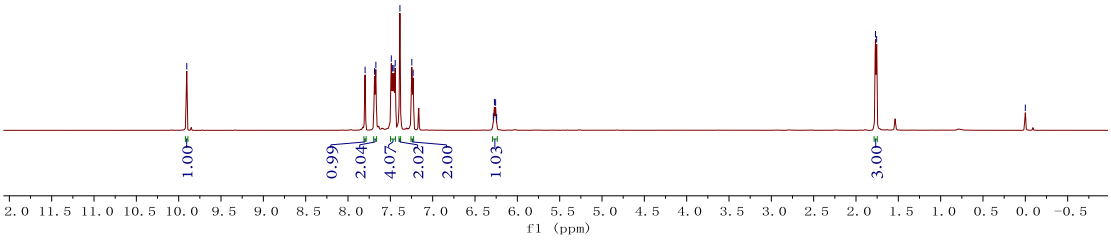

**3d**

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

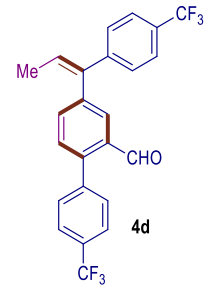


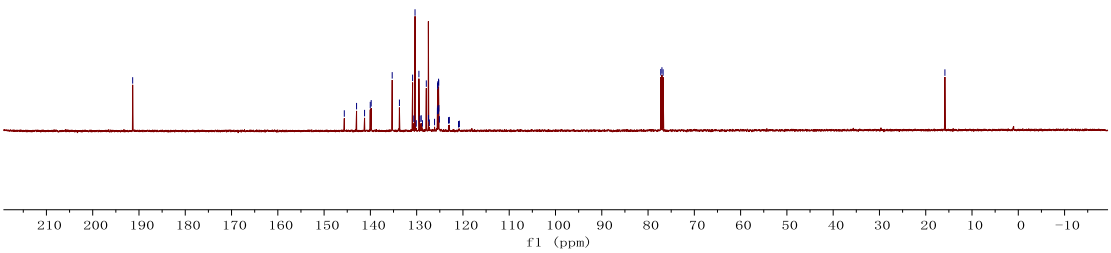

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

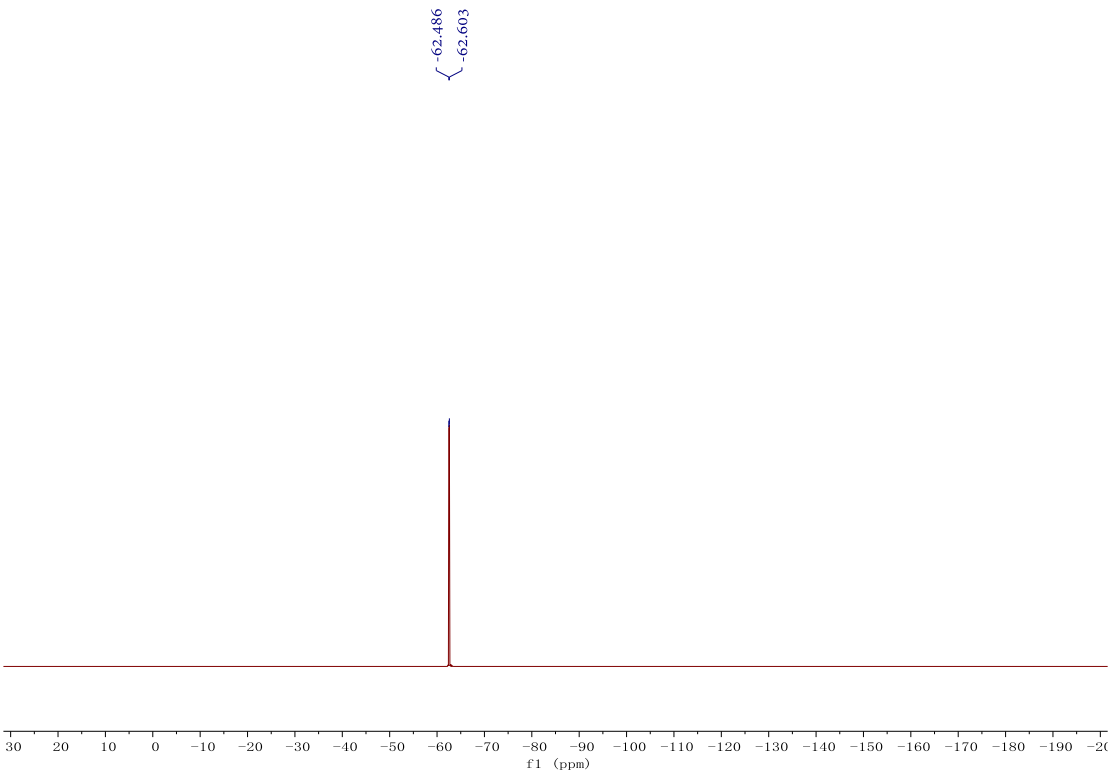


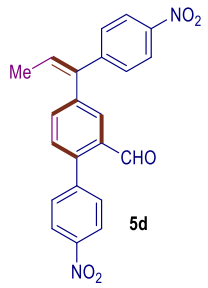




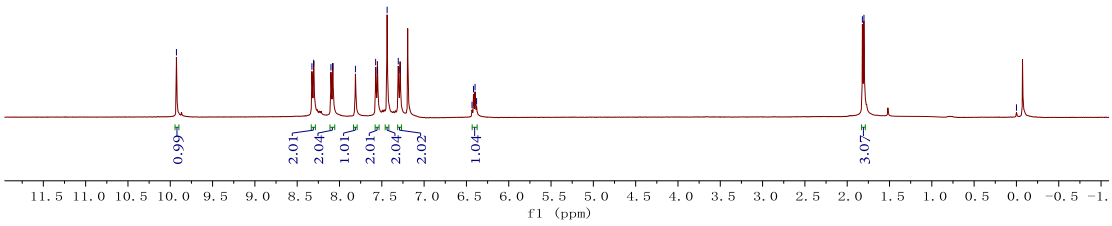

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

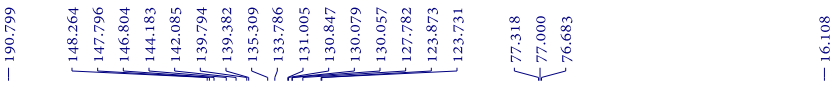


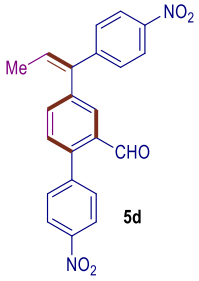

-62.486
-62.603
30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -20
f1 (ppm)

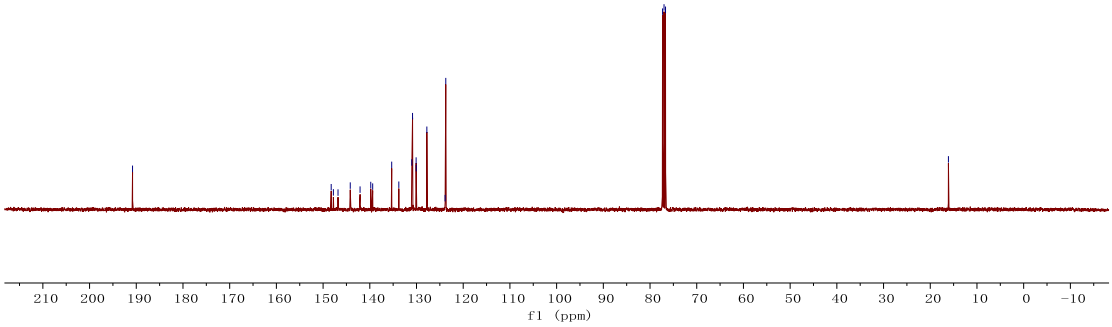

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

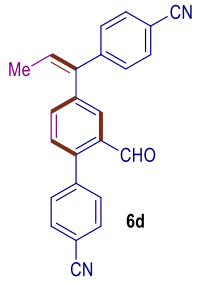


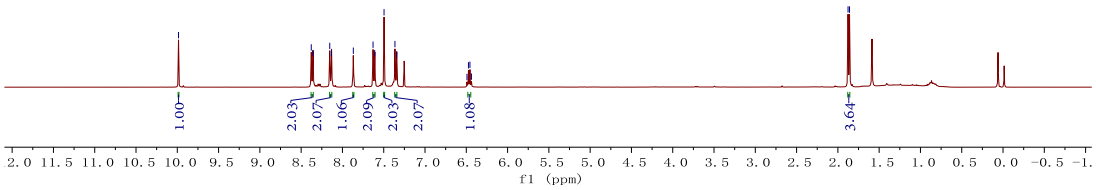



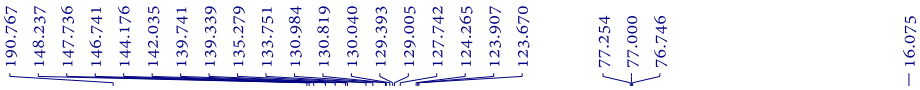

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

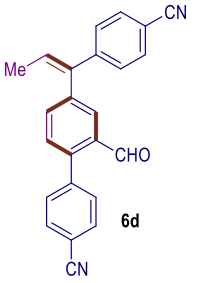


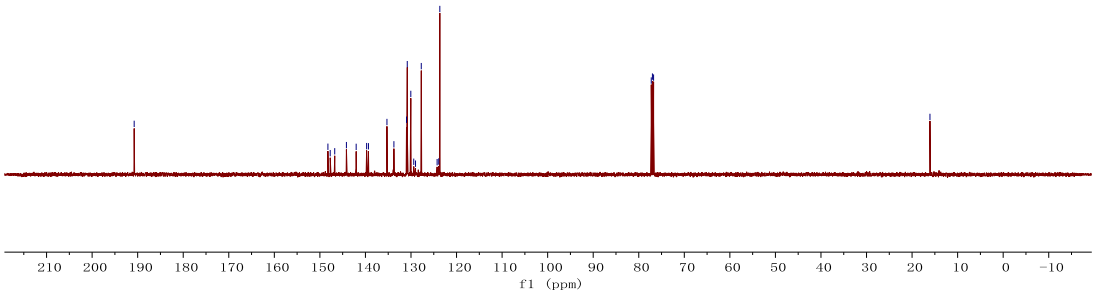

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

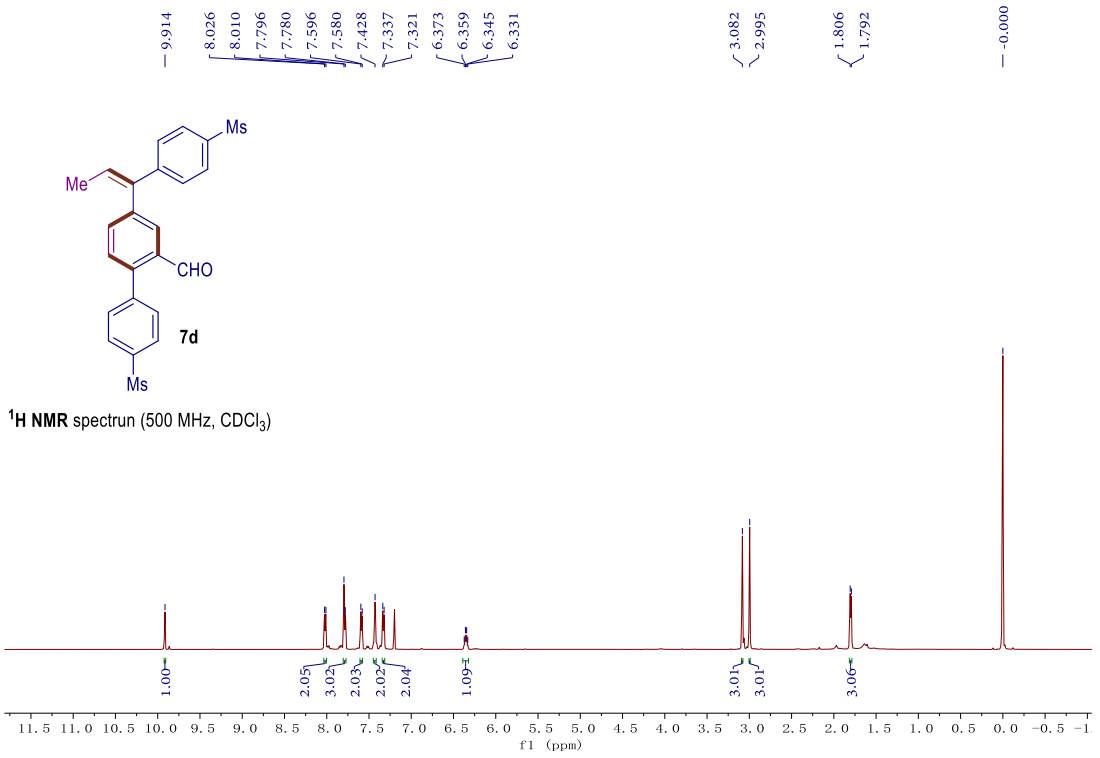


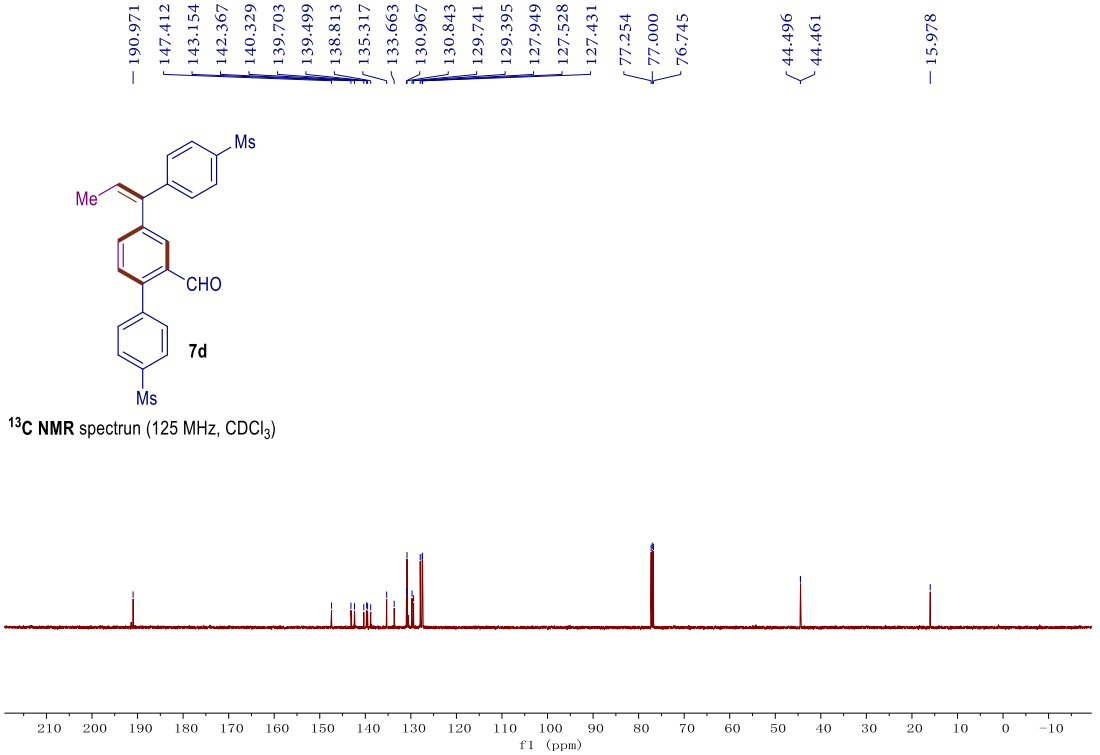




**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

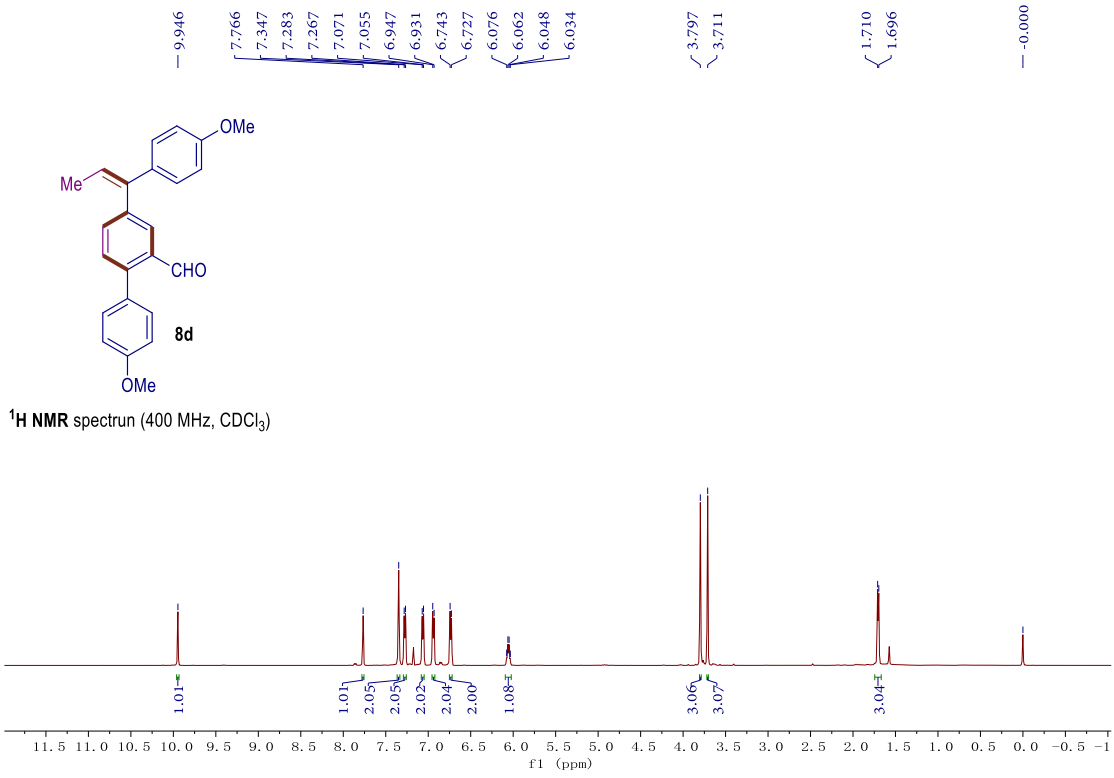




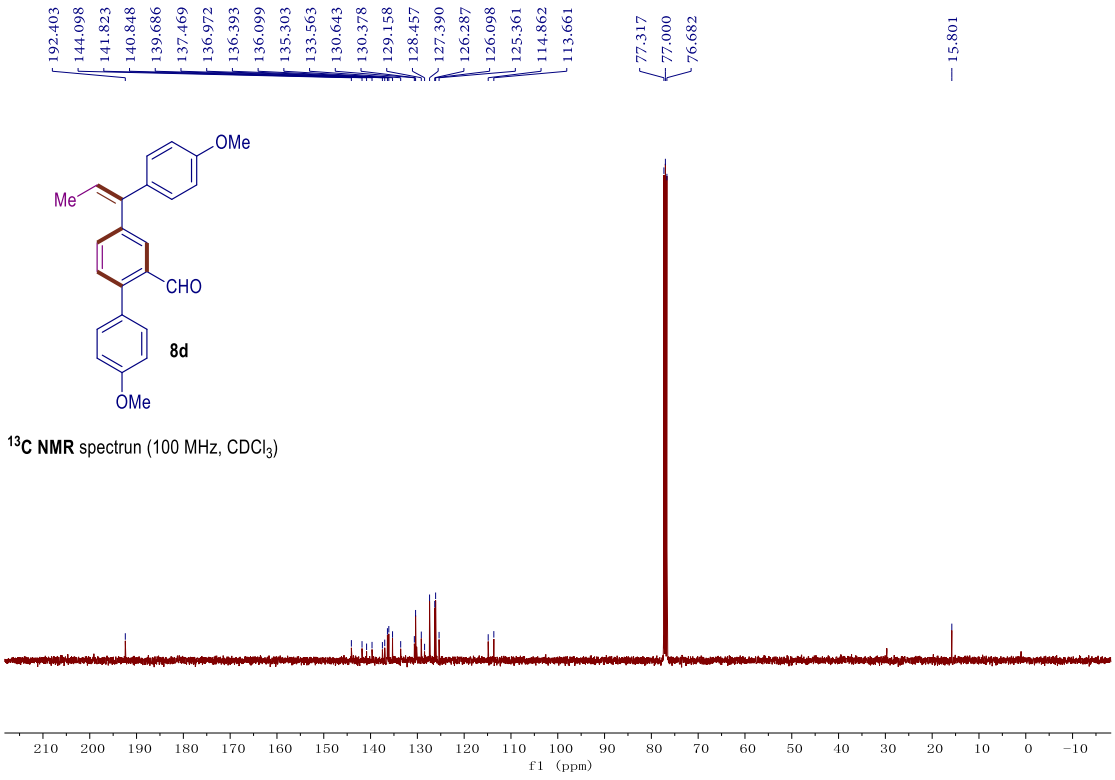

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)



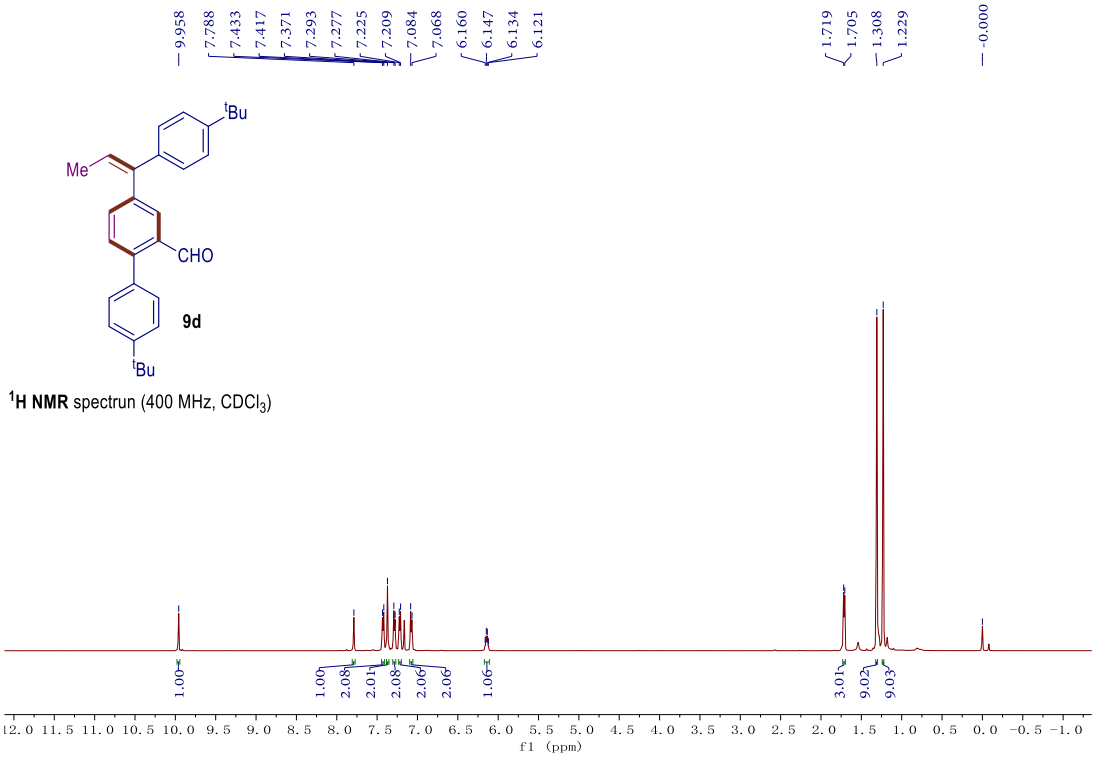

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)



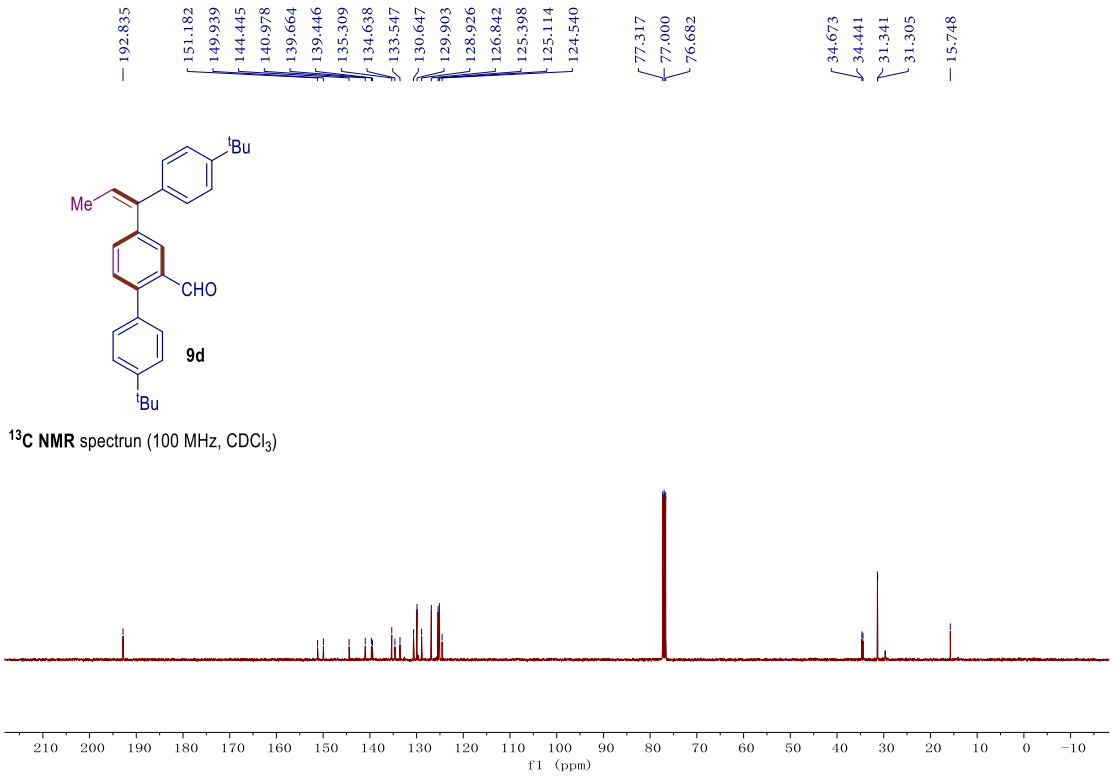

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)



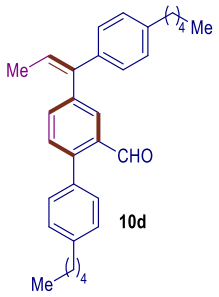

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



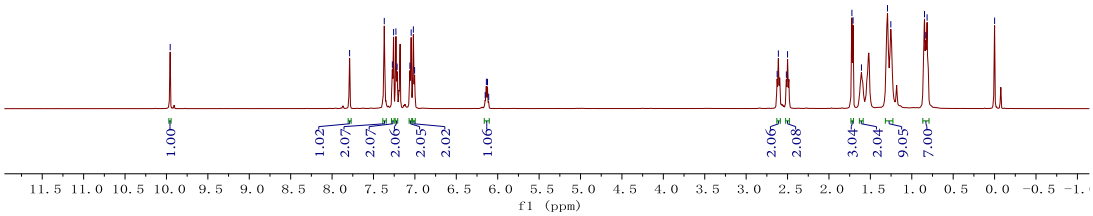

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

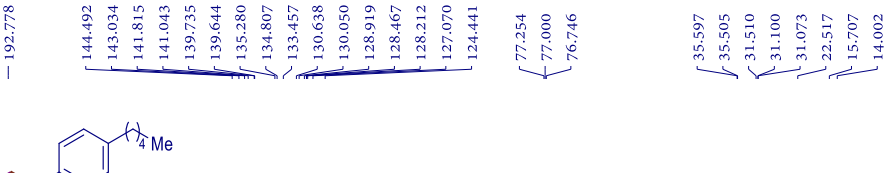


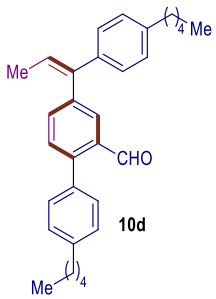

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

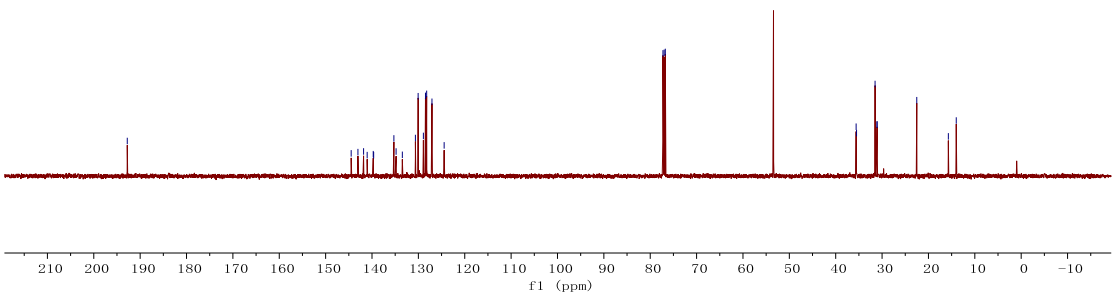

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

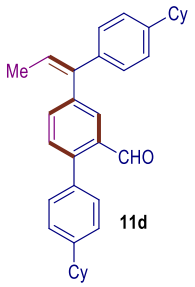


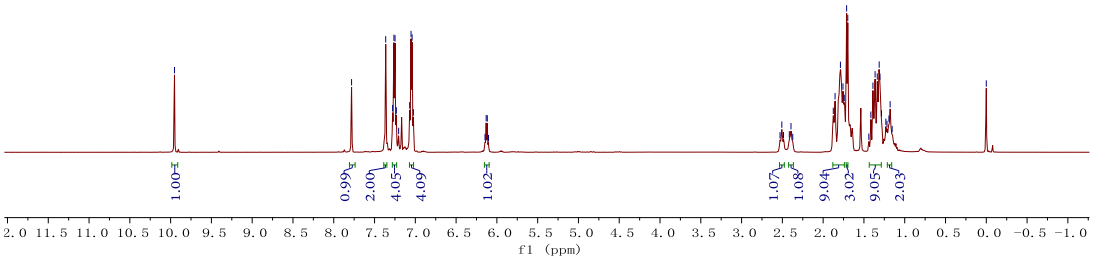




**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

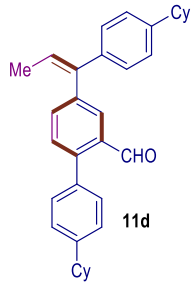


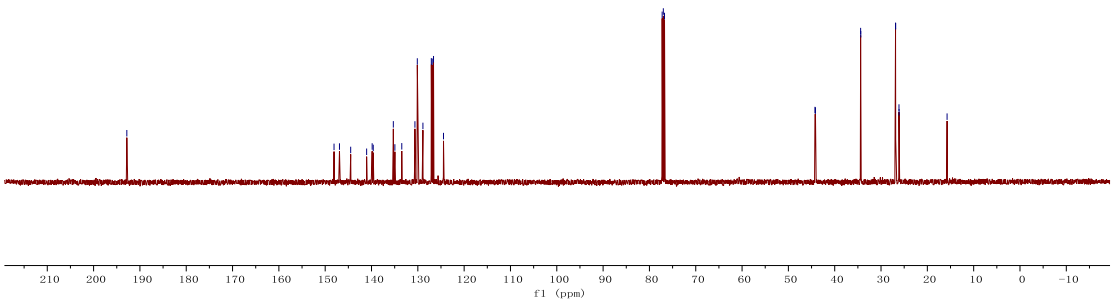

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

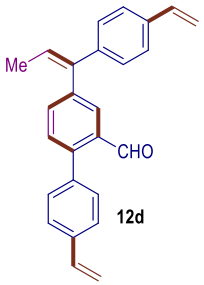




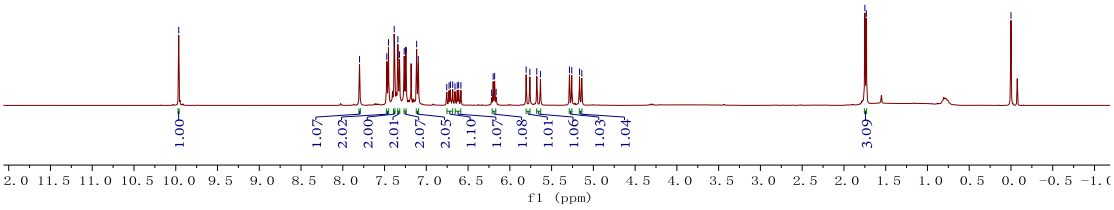



**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

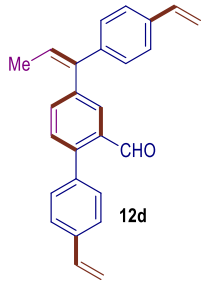


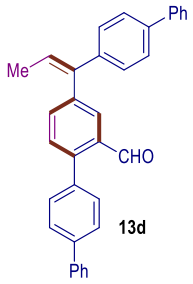

$^{1}$**H NMR** spectrun (400 MHz, $CDCl_3$)



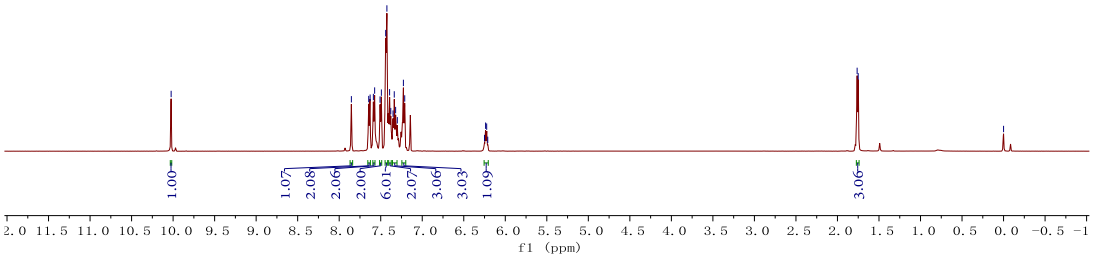




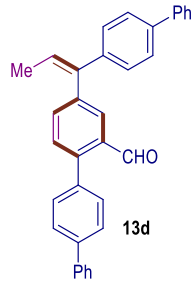

$^{13}$**C NMR** spectrun (100 MHz, $CDCl_3$)

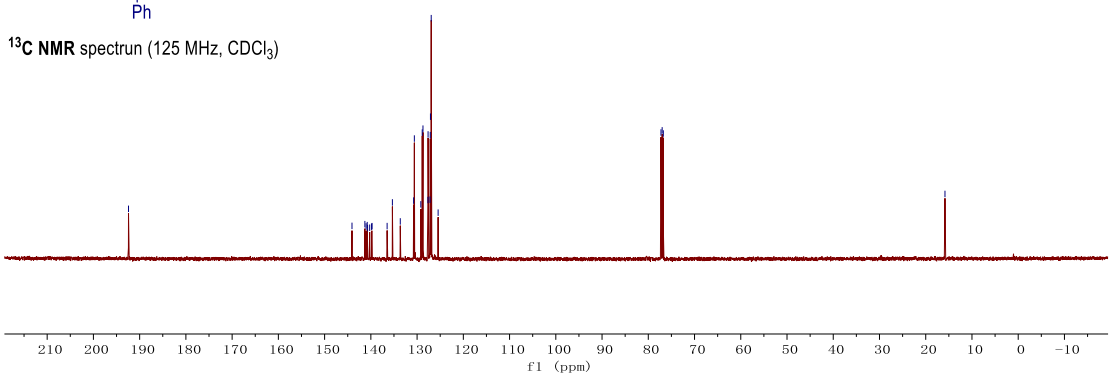

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

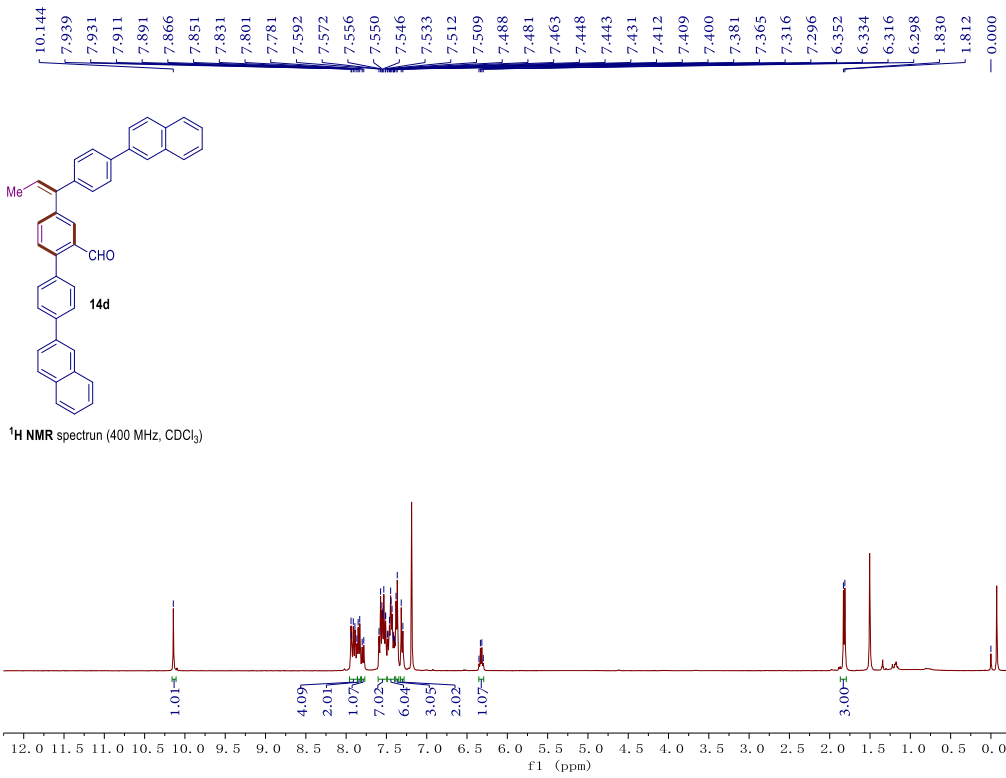




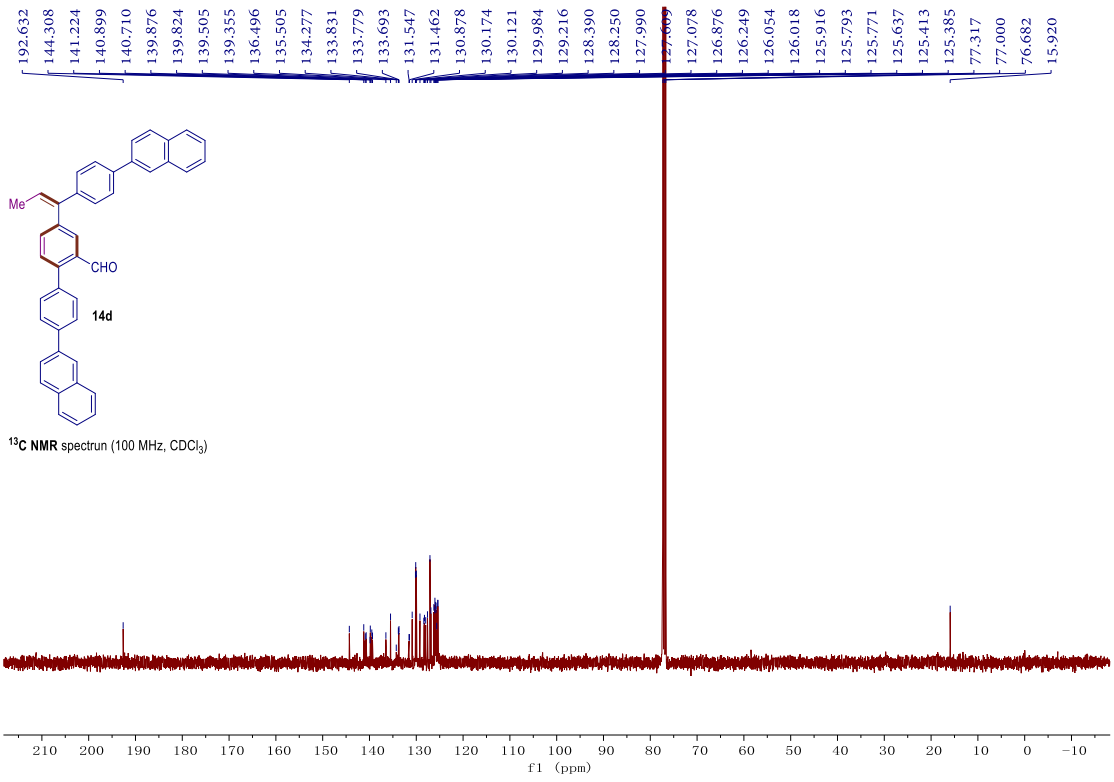



**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

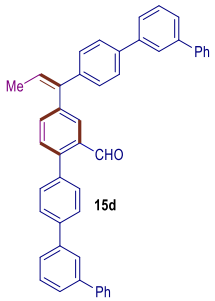




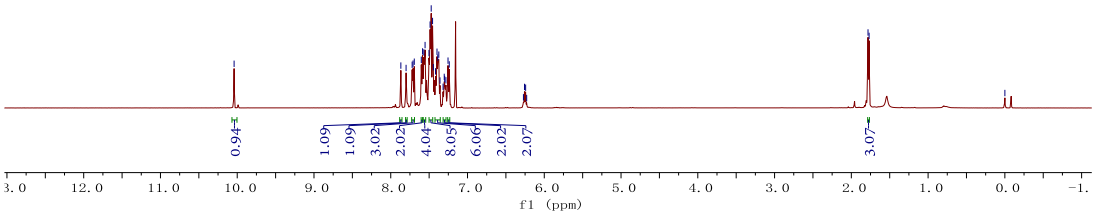

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)



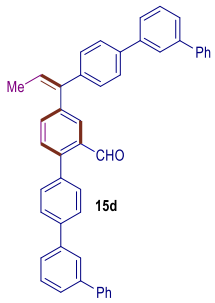

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

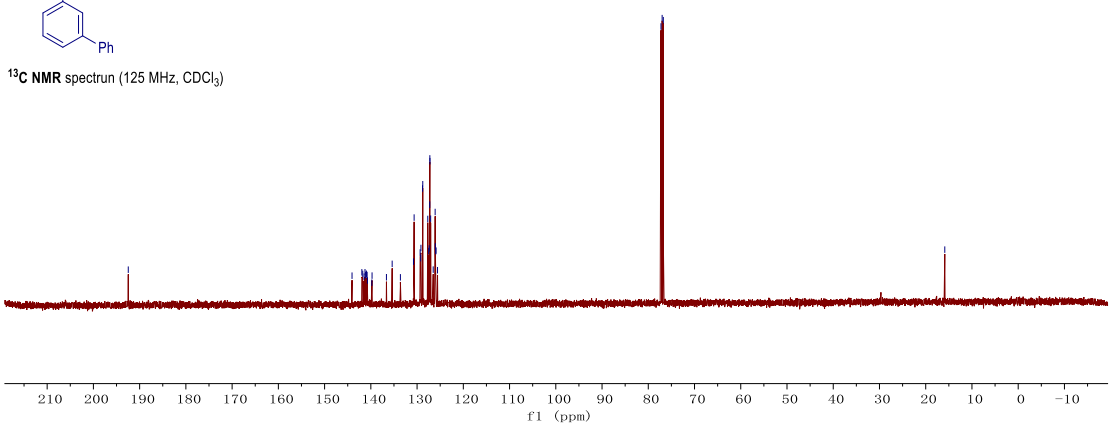

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

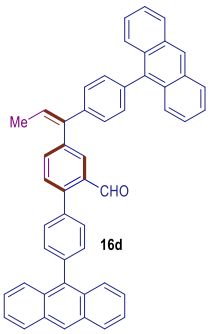




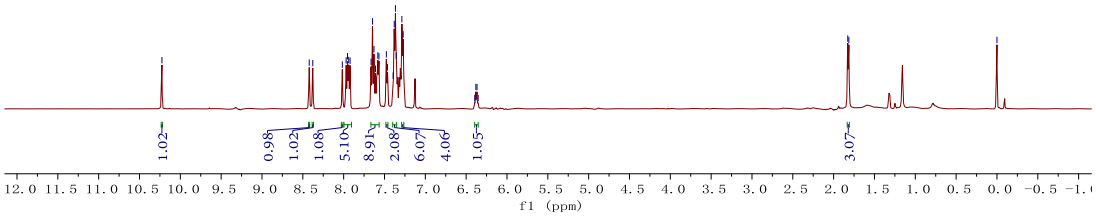



**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

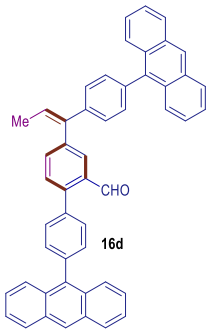


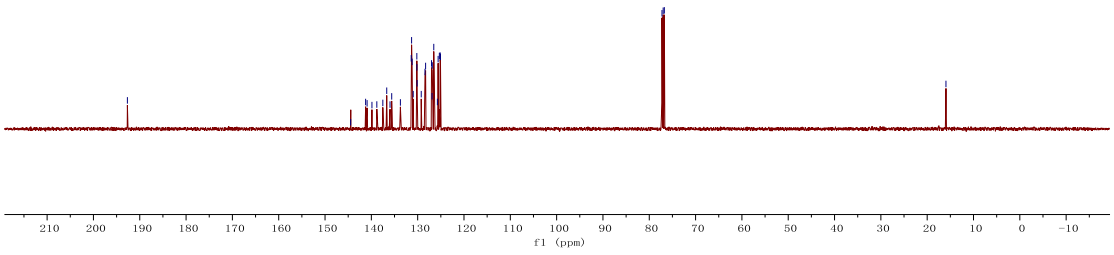

$^{1}$**H NMR** spectrun (500 MHz, $CDCl_3$)

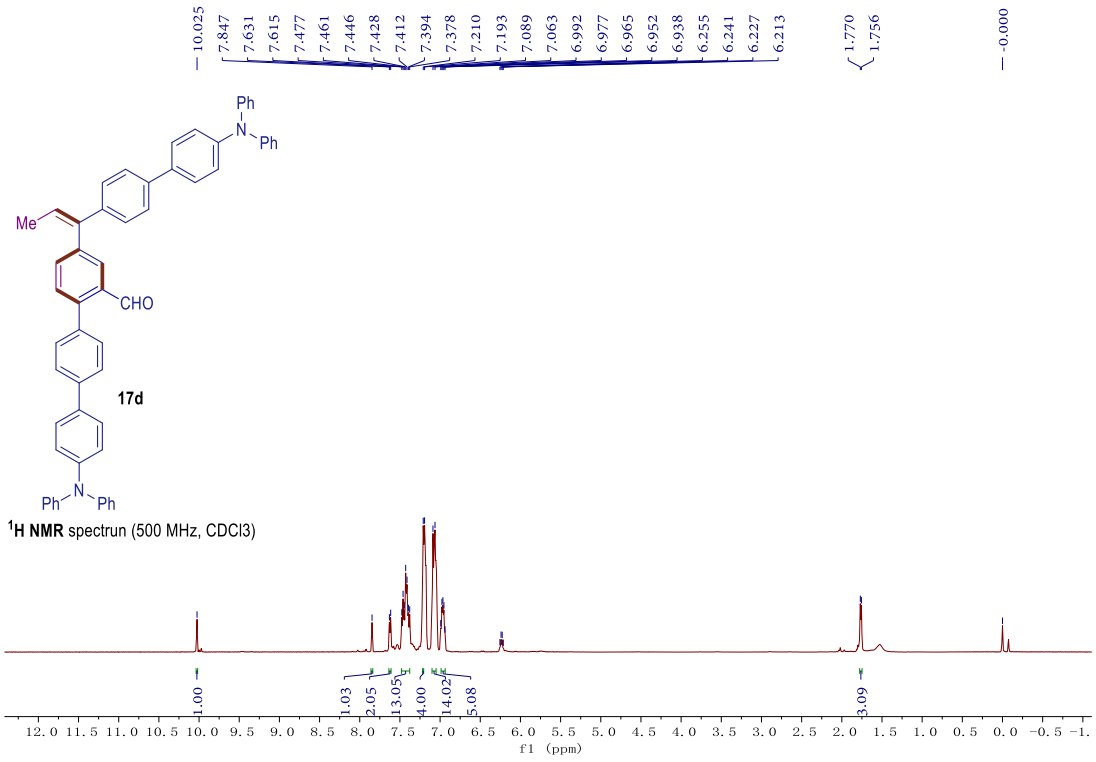


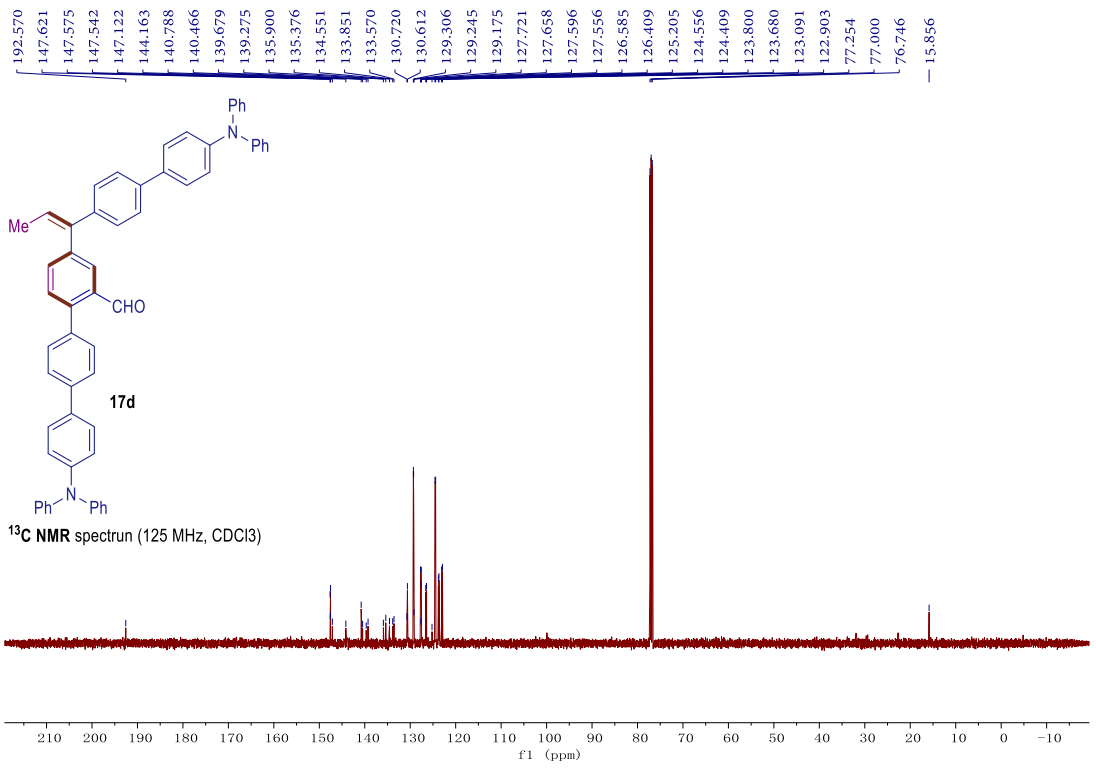


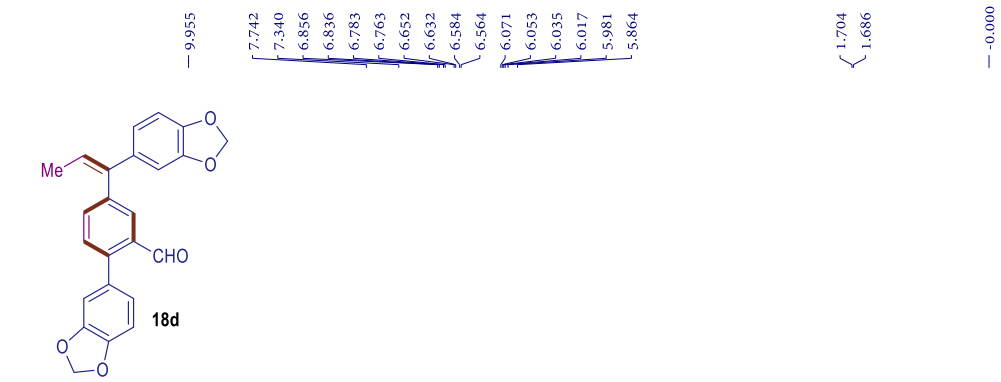



$^{13}$**C NMR** spectrun (125 MHz, $CDCl_3$)

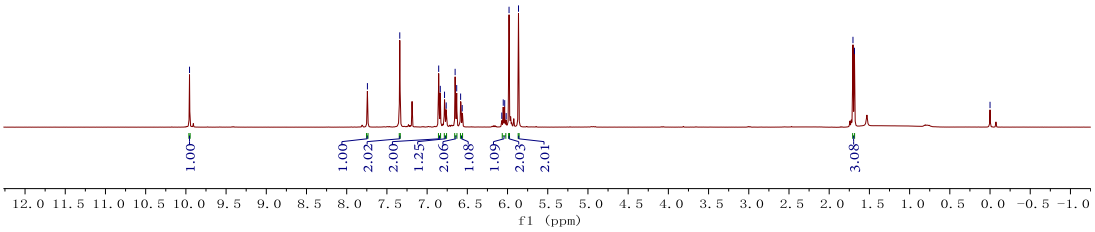


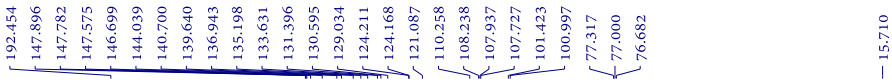

10.025
7.847
7.631
7.615
7.477
7.461
7.446
7.428
7.412
7.394
7.378
7.210
7.193
7.089
7.063
6.992
6.977
6.965
6.952
6.938
6.255
6.241
6.227
6.213
1.770
1.756
-0.000
Ph
N
Ph
Me
CHO
17d
Ph
N
Ph
1H NMR spectrun (500 MHz, CDCl3)
1.00
1.03
2.05
13.05
4.00
14.02
5.08
3.09
12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

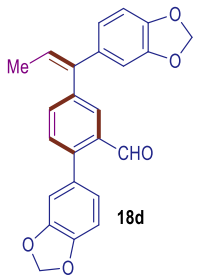

192.570
147.621
147.575
147.542
147.122
144.163
140.788
140.466
139.679
139.275
135.900
135.376
134.551
133.851
133.570
130.720
130.612
129.306
129.245
129.175
127.721
127.658
127.596
127.556
126.585
126.409
125.205
124.556
124.409
123.800
123.680
123.091
122.903
77.254
77.000
76.746
15.856
Ph
N
Ph
Me
CHO
17d
Ph
N
Ph
13C NMR spectrun (125 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



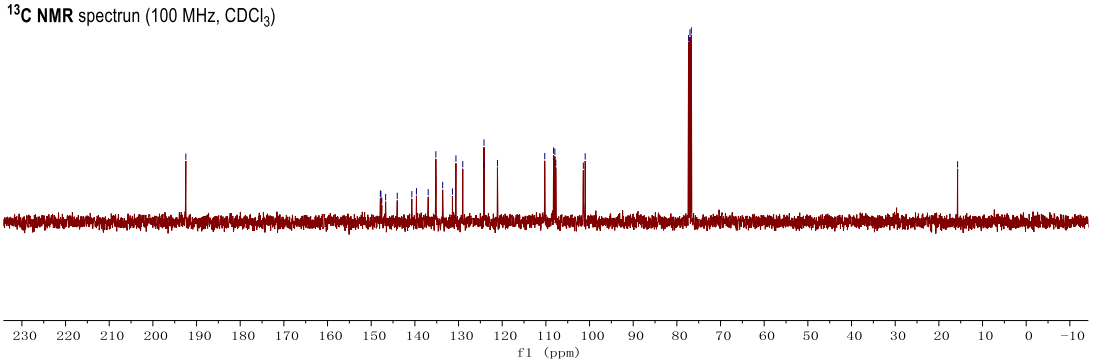

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

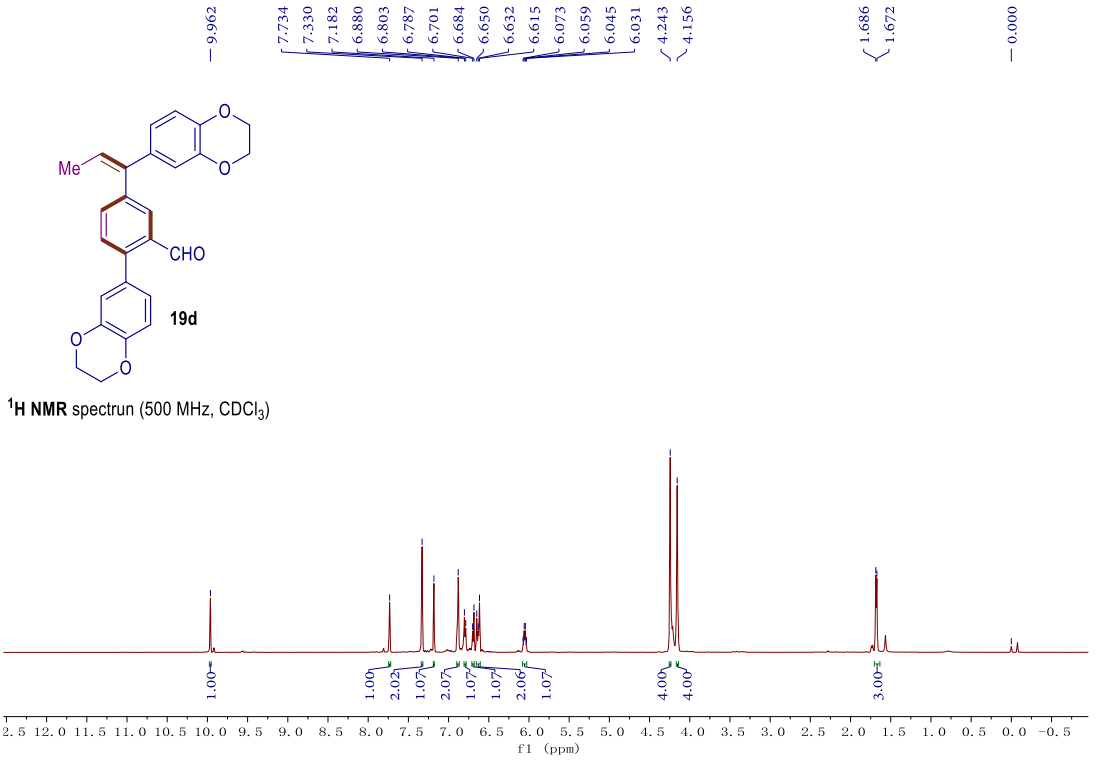


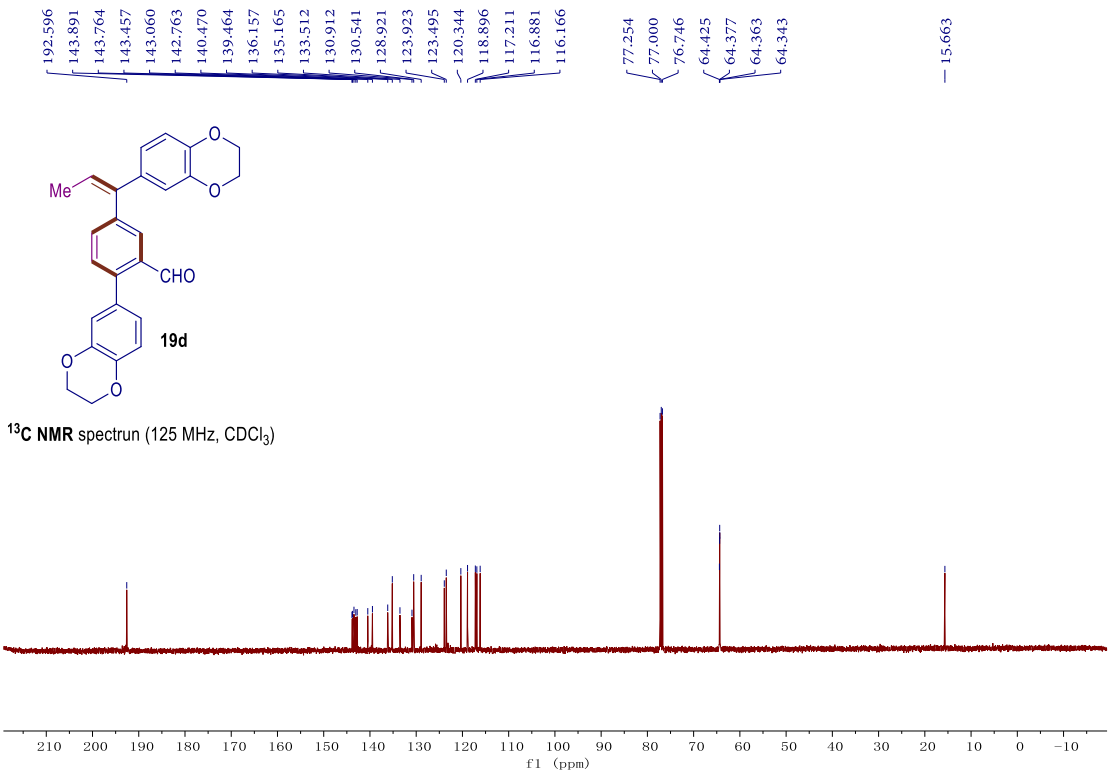




**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

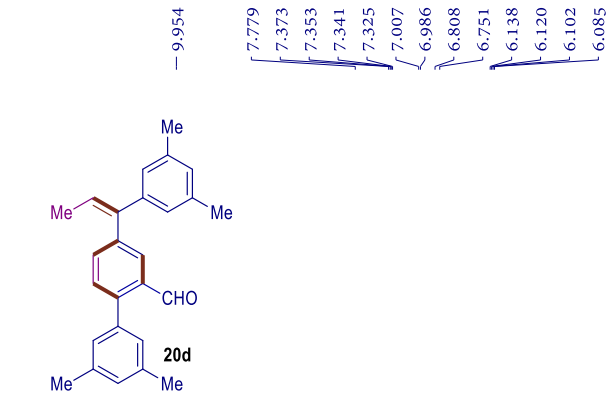




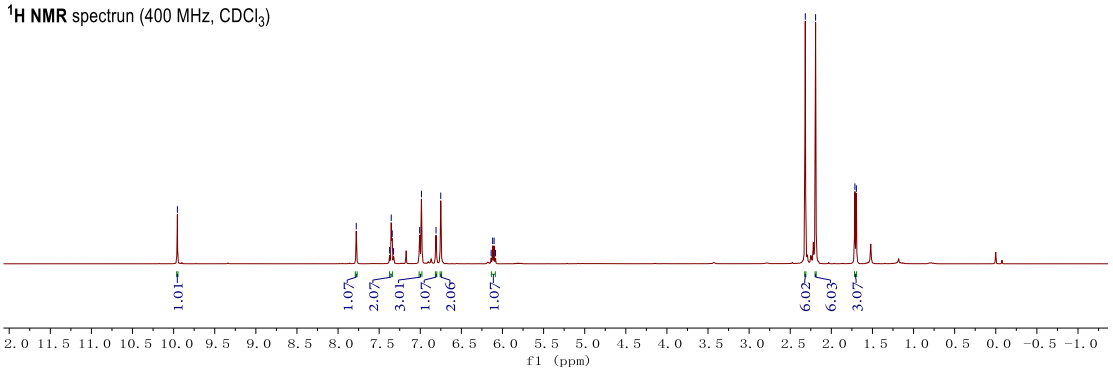

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

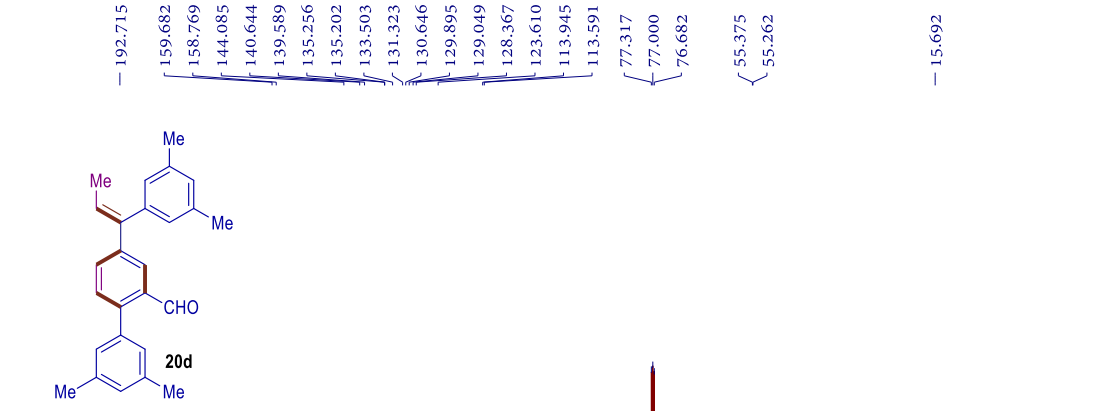



**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)




**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

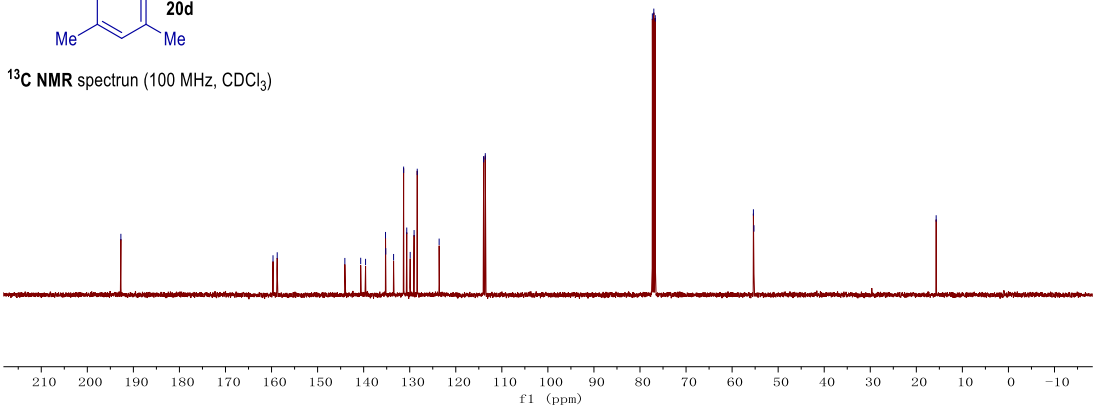


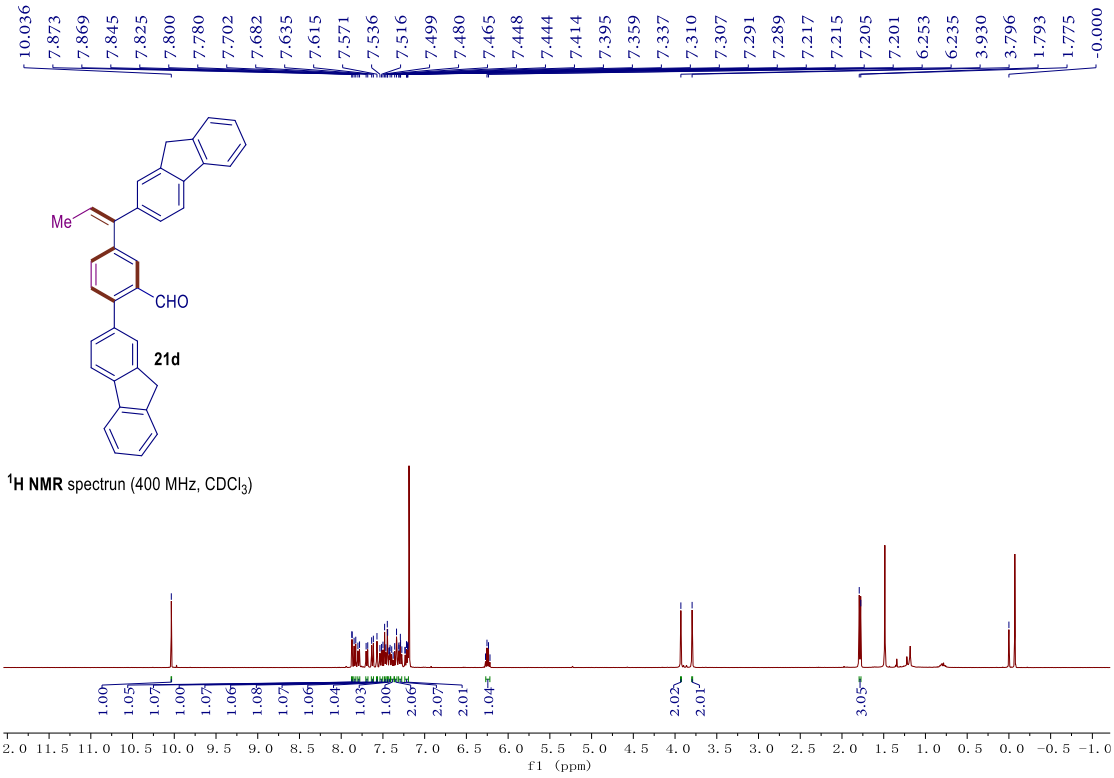





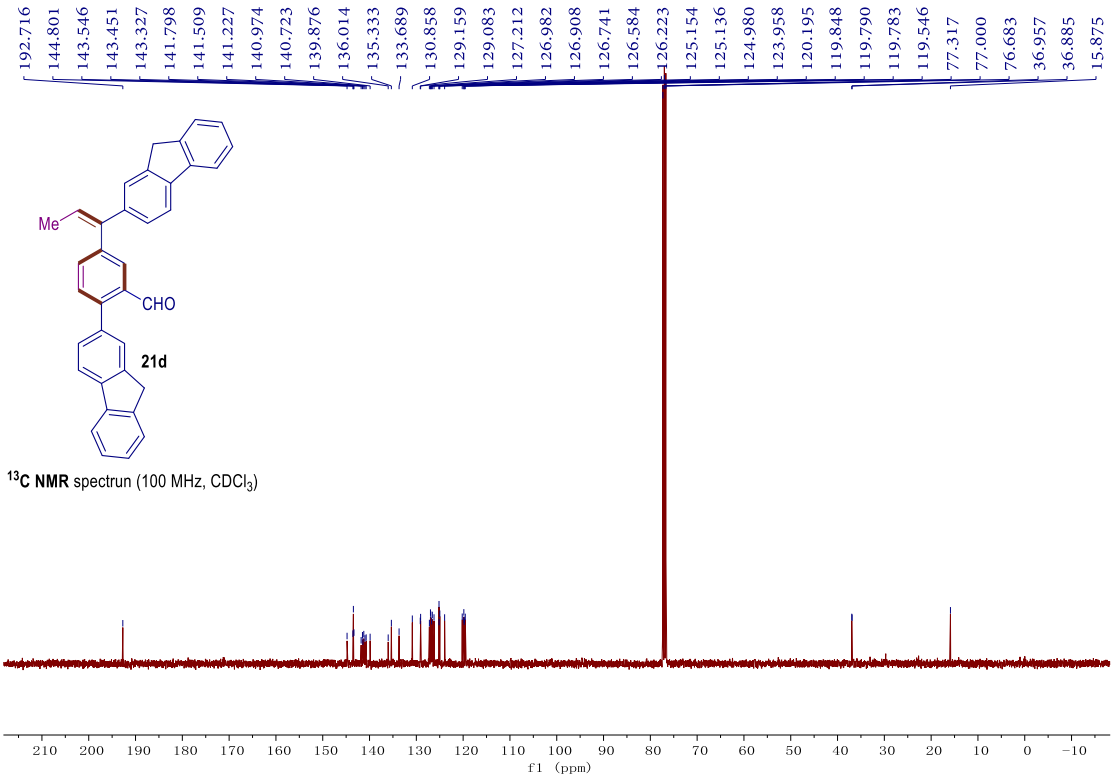


**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

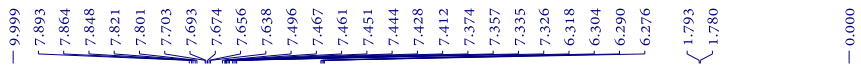


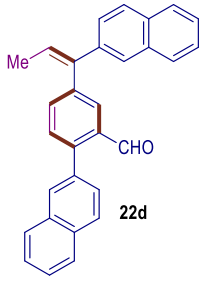



**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)



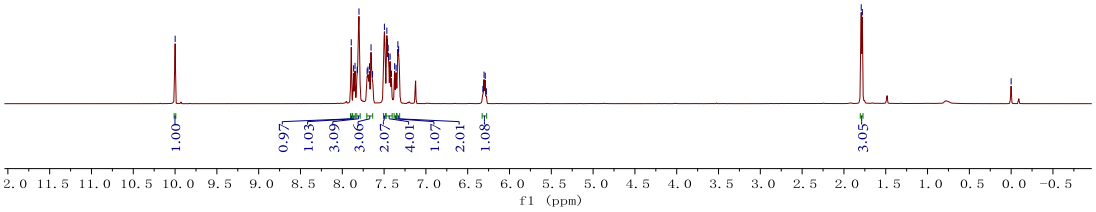

**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)

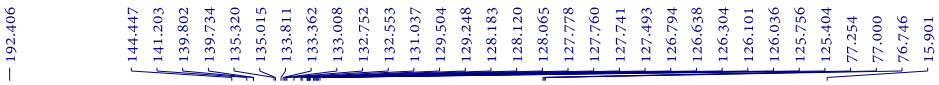


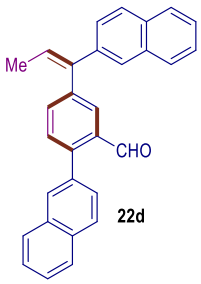




**22d**

$^{1}$**H NMR** spectrun (500 MHz, $CDCl_3$)

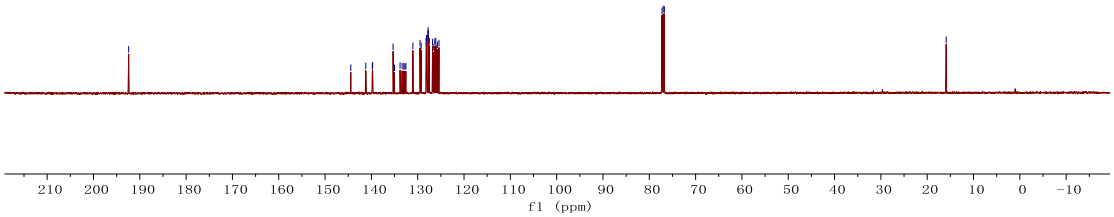


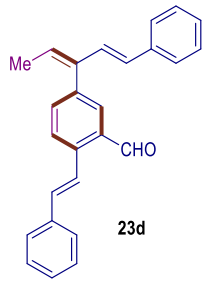




**22d**

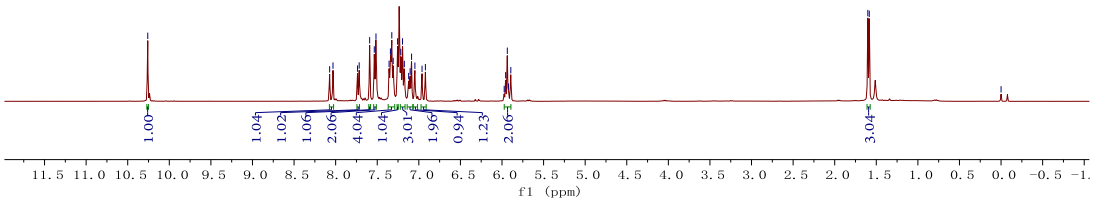
$^{13}$**C NMR** spectrun (125 MHz, $CDCl_3$)

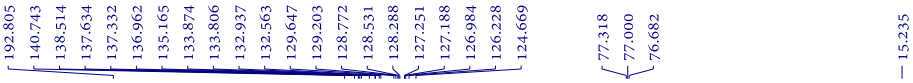


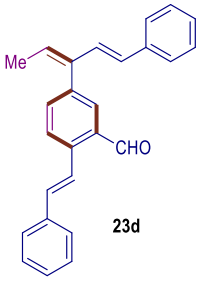




**23d**

$^{1}$**H NMR** spectrun (400 MHz, $CDCl_3$)

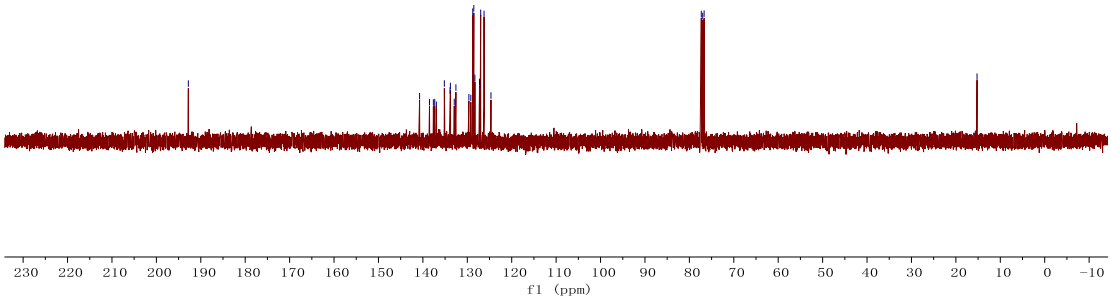


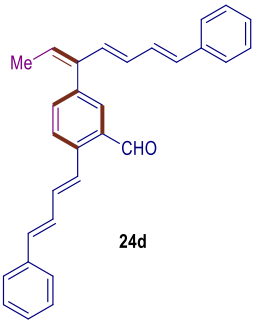




**23d**

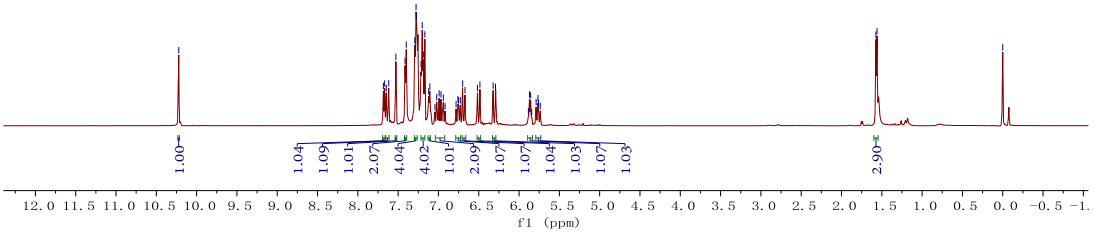
$^{13}$**C NMR** spectrun (100 MHz, $CDCl_3$)



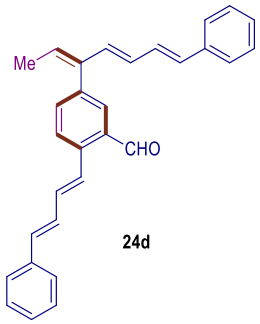




**24d**

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

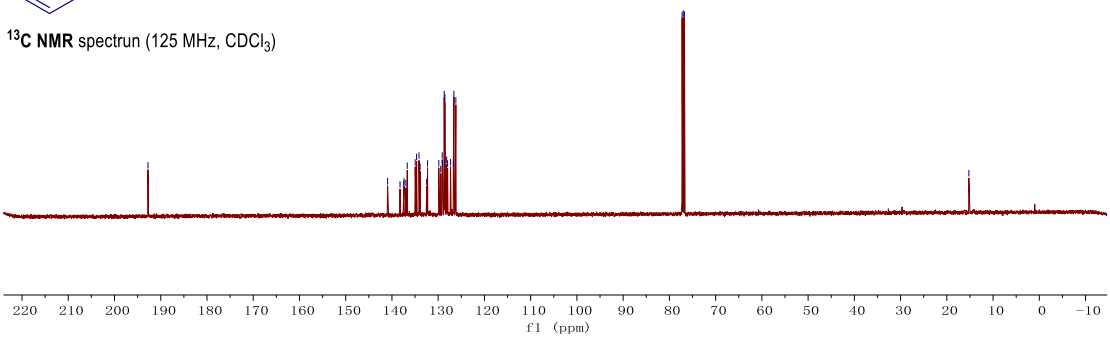


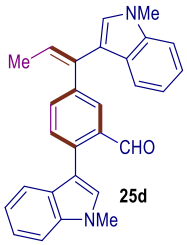




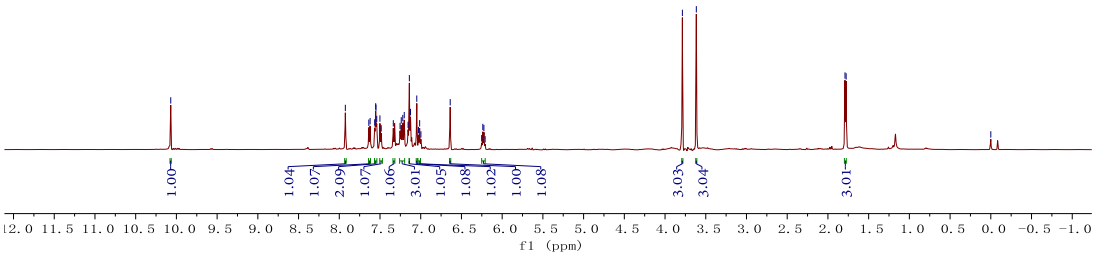

**24d**

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

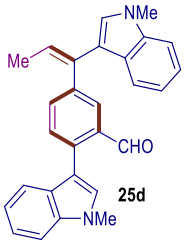


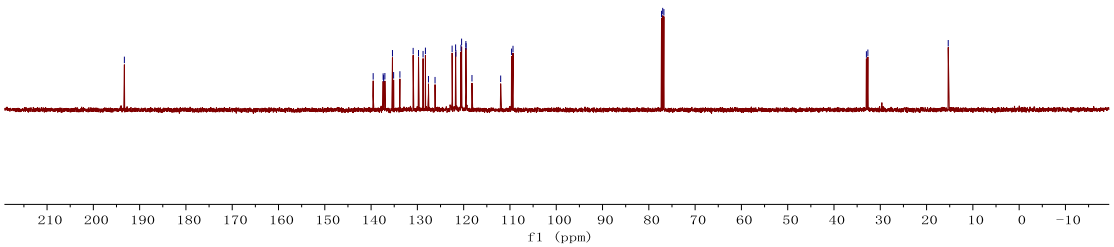

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

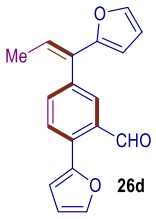






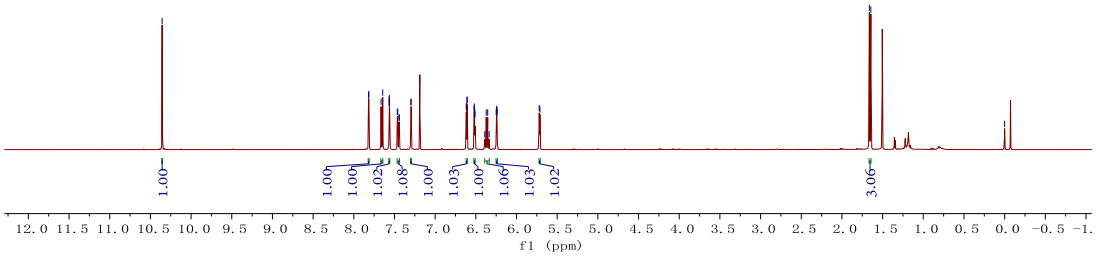

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)



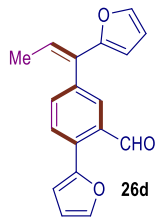




**26d**

**$^{1}$H NMR** spectrun (400 MHz, $CDCl_3$)

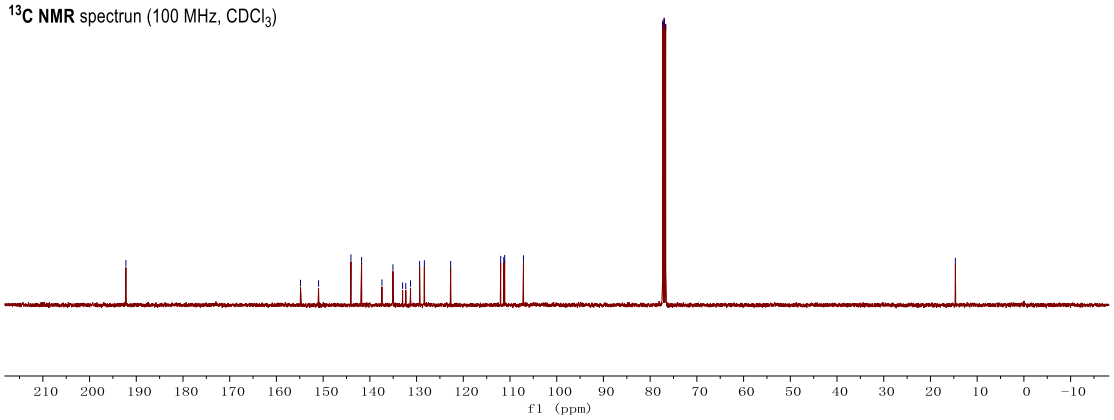


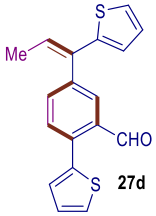





**26d**

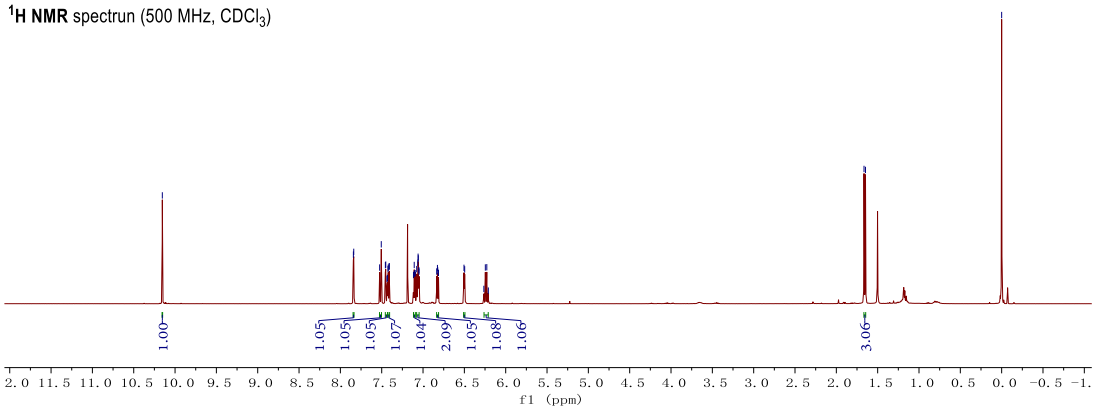
**$^{13}$C NMR** spectrun (100 MHz, $CDCl_3$)



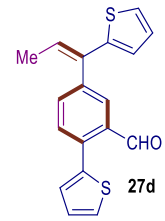




**27d**

$^{1}$**H NMR** spectrun (500 MHz, $CDCl_3$)

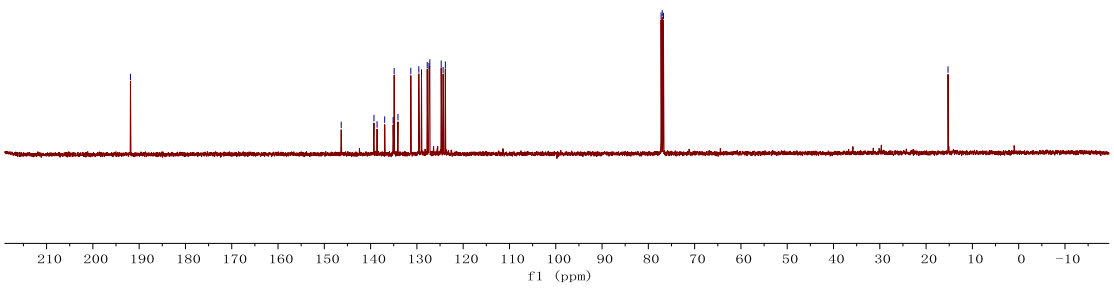


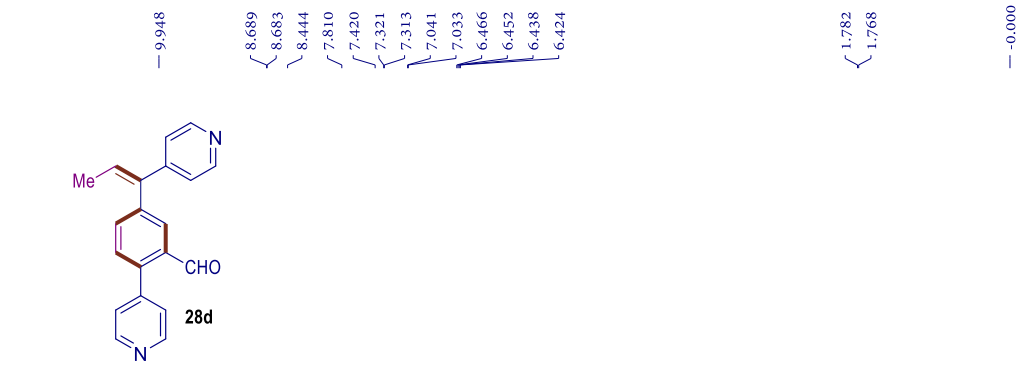




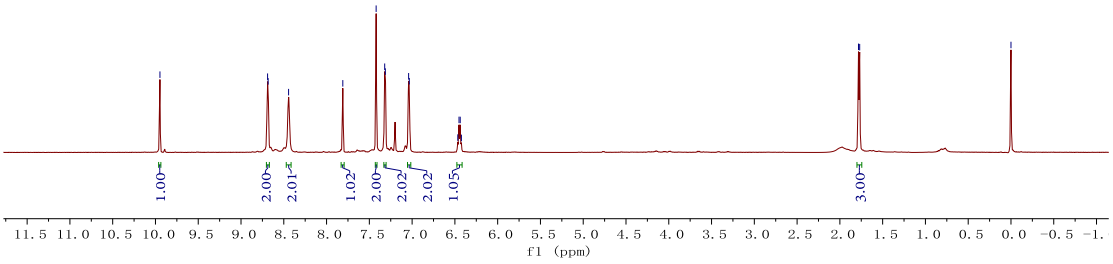

**27d**

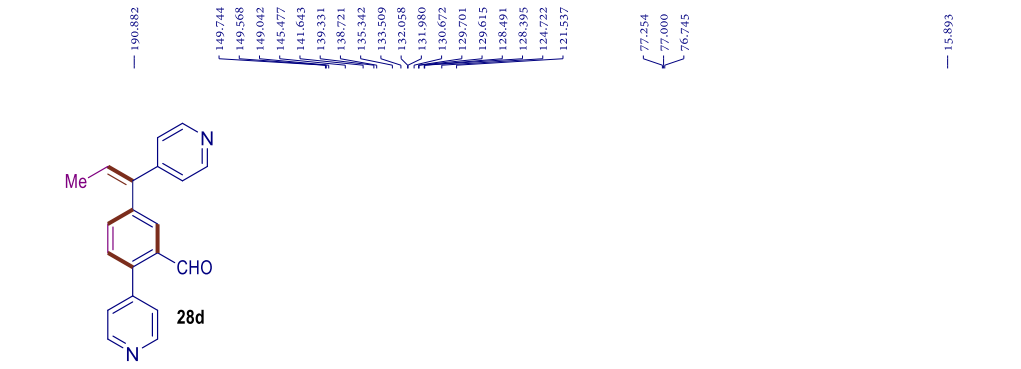
$^{13}$**C NMR** spectrun (125 MHz, $CDC_{l3}$)



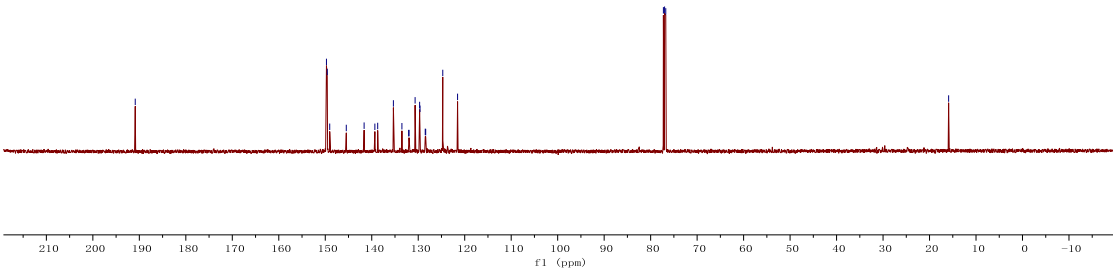


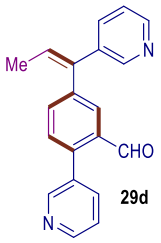

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)



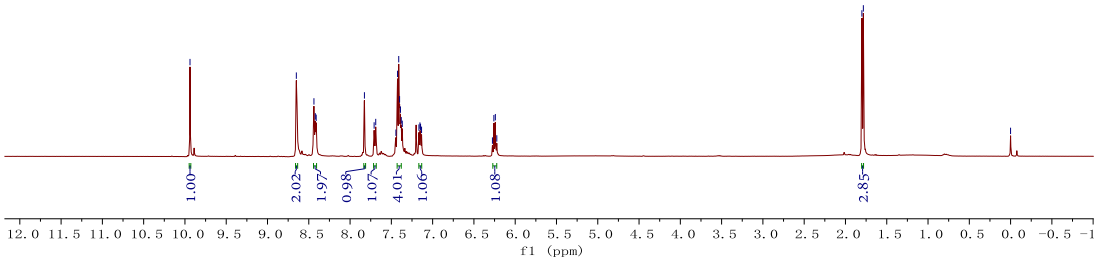

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)



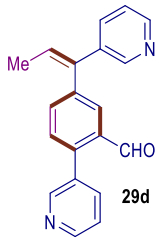




**29d**

$^{1}$**H NMR** spectrun (400 MHz, $CDCl_3$)

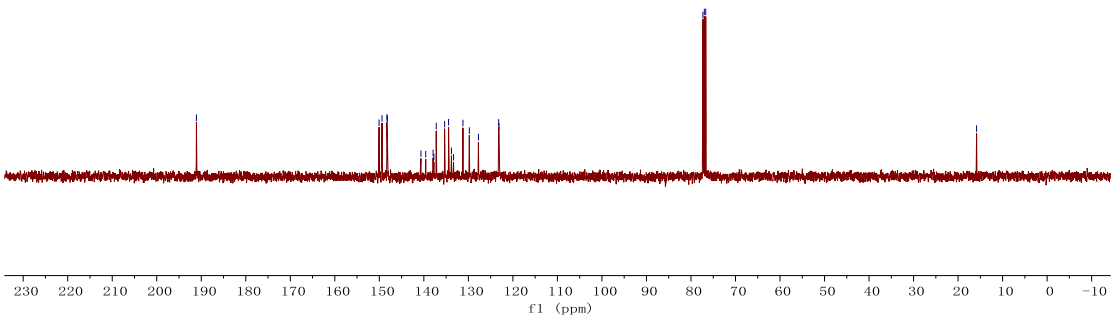


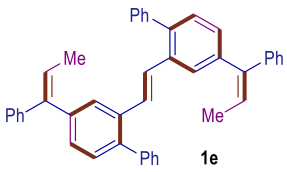





**29d**

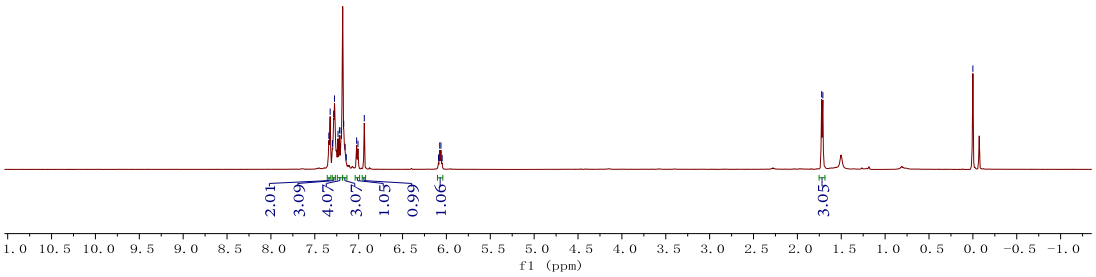
$^{13}$**C NMR** spectrun (100 MHz, $CDCl_3$)

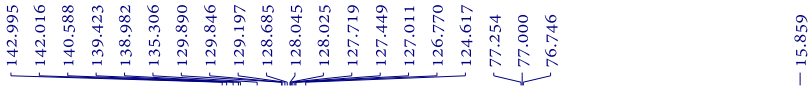


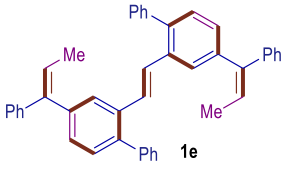




**1e**

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

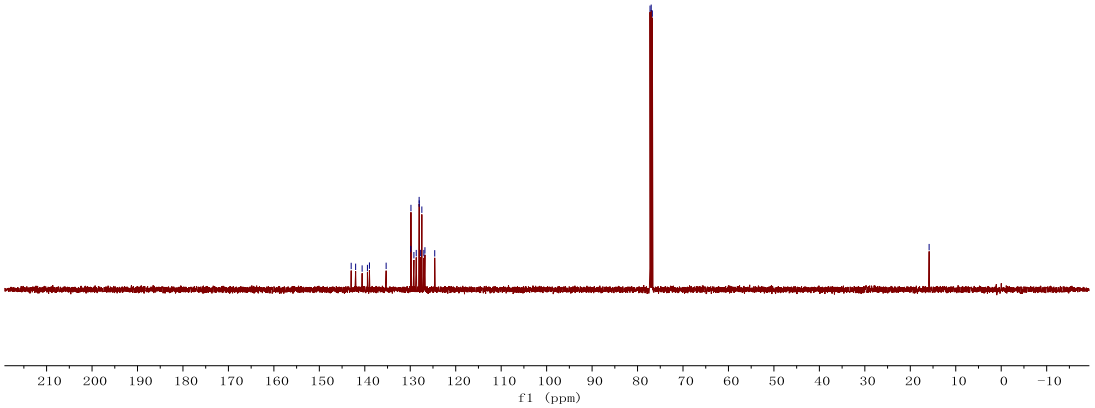


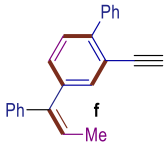



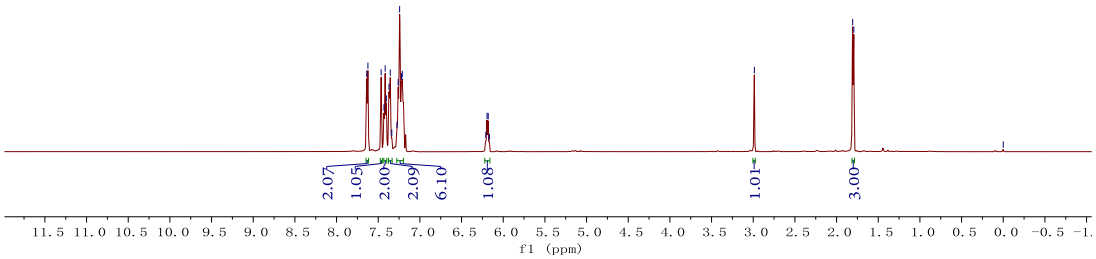

**1e**

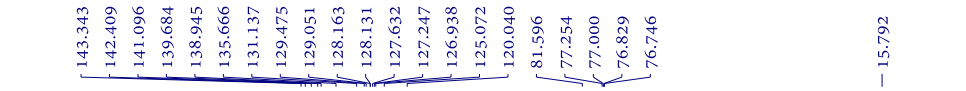
**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

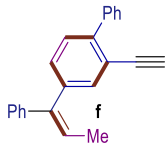


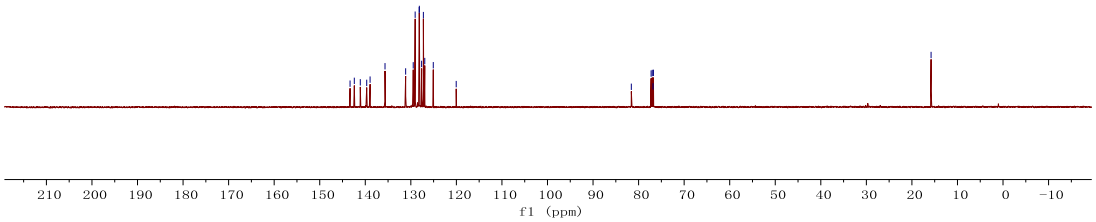

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

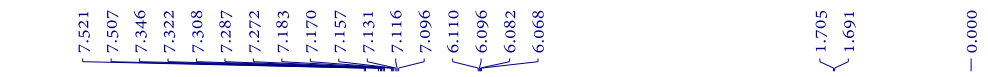


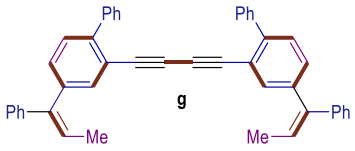



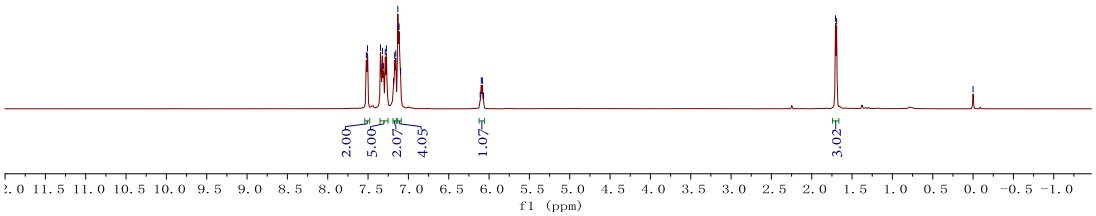

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

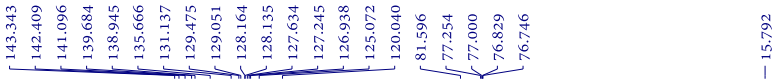


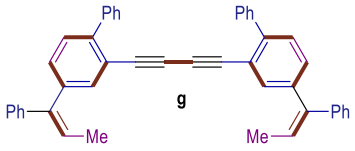


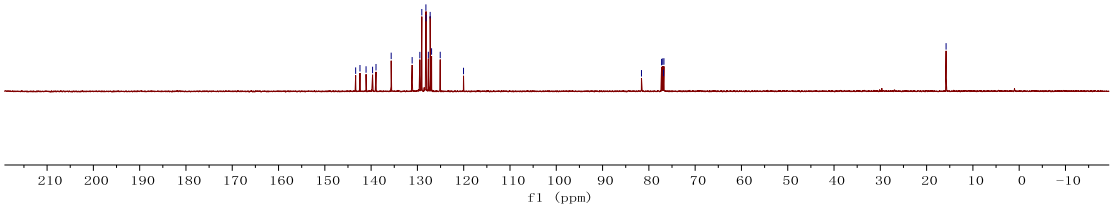

**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)

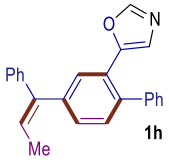


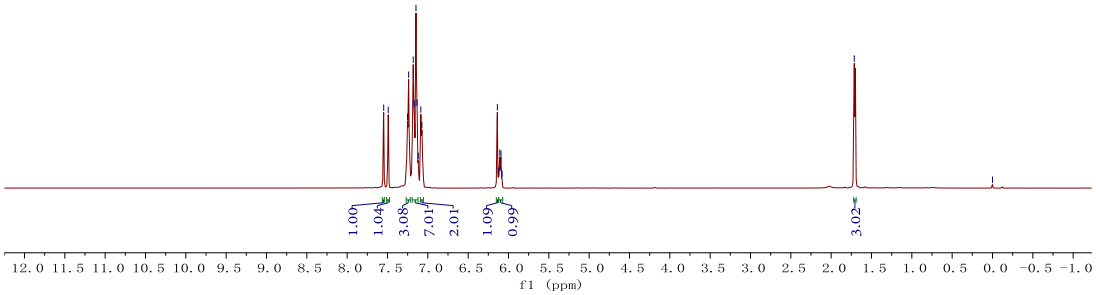

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)



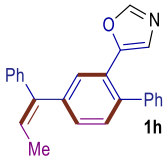




**1h**

$^{1}$**H NMR** spectrun (500 MHz, $CDCl_3$)

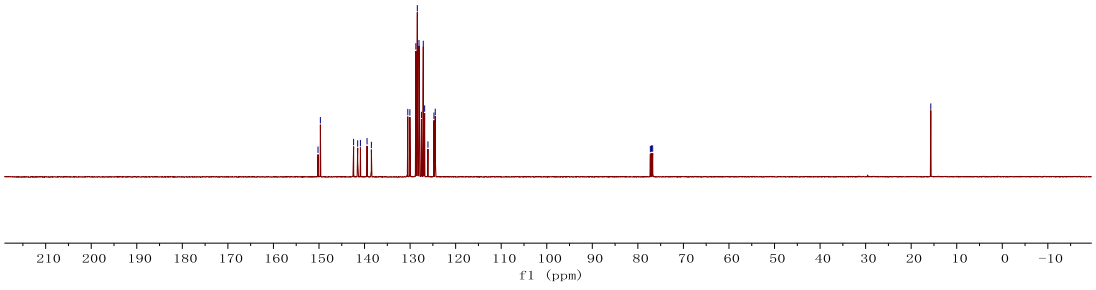


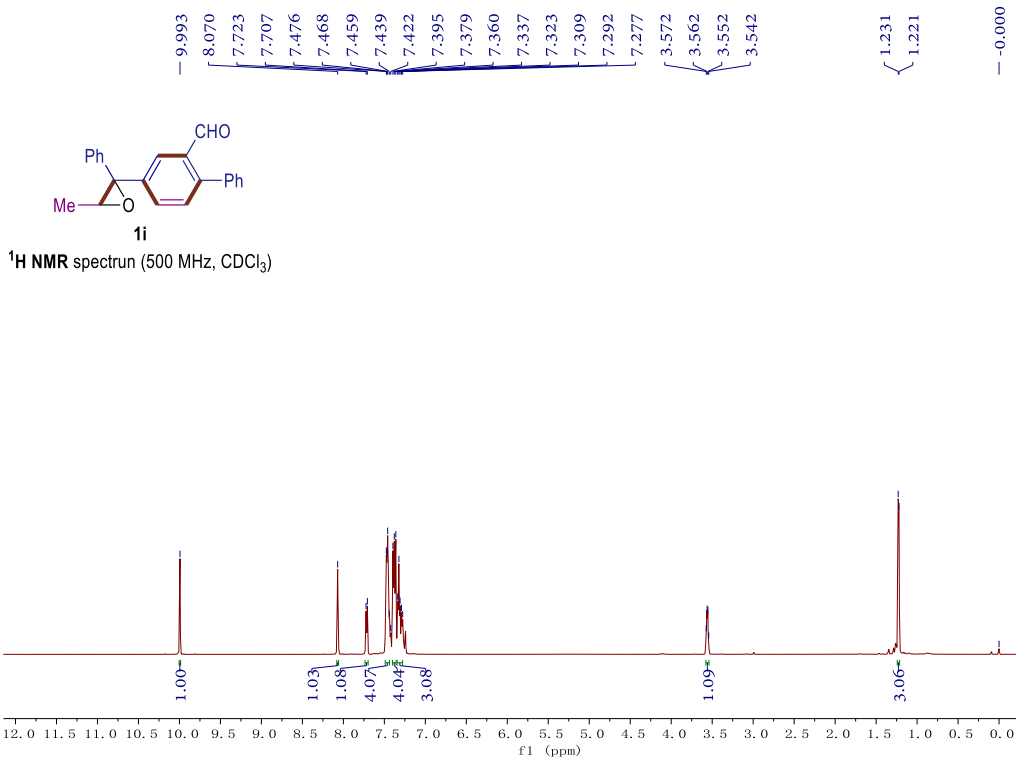





**1h**

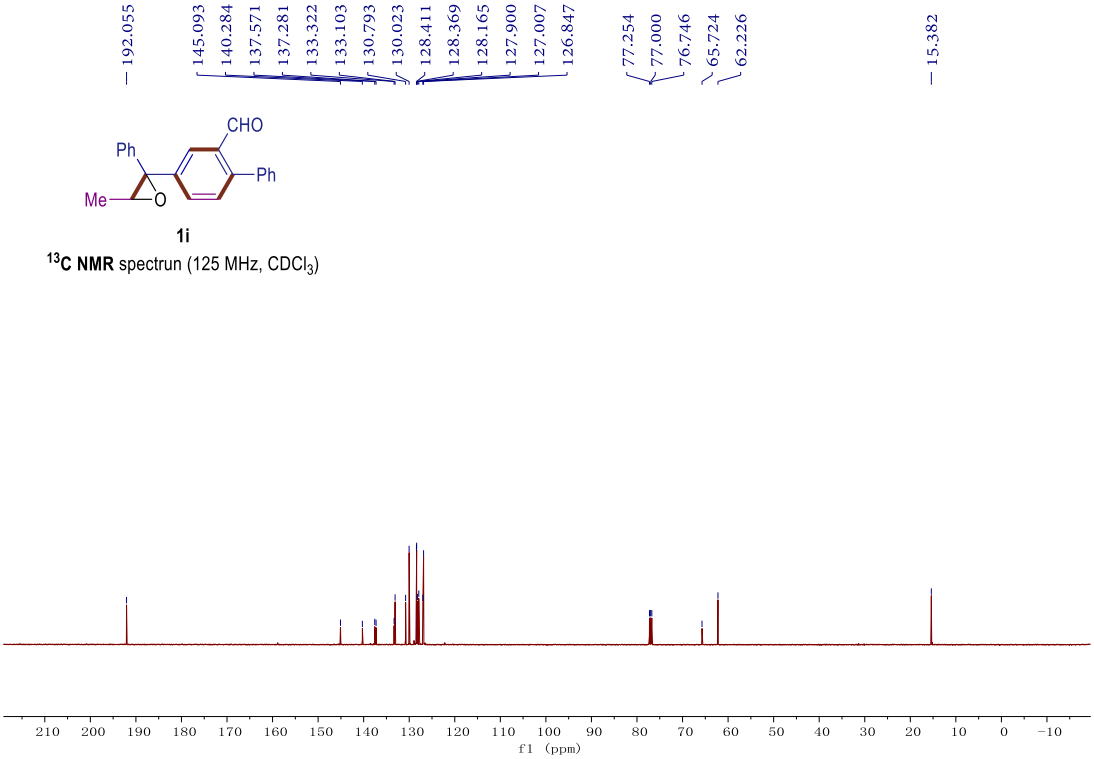
$^{13}$**C NMR** spectrun (125 MHz, $CDCl_3$)






**1i**

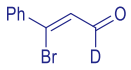
**$^{1}$H NMR** spectrun (500 MHz, $CDCl_3$)



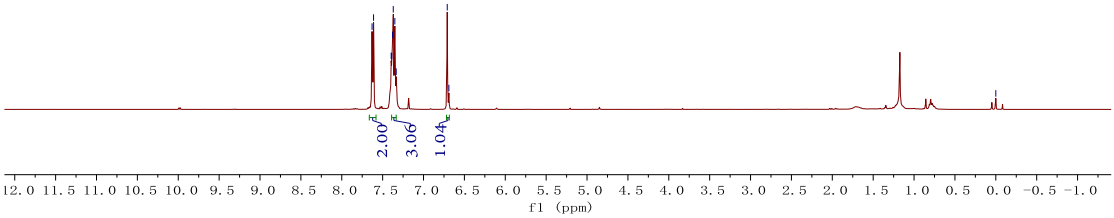

**1i**

**$^{13}$C NMR** spectrun (125 MHz, $CDCl_3$)

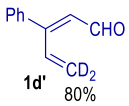




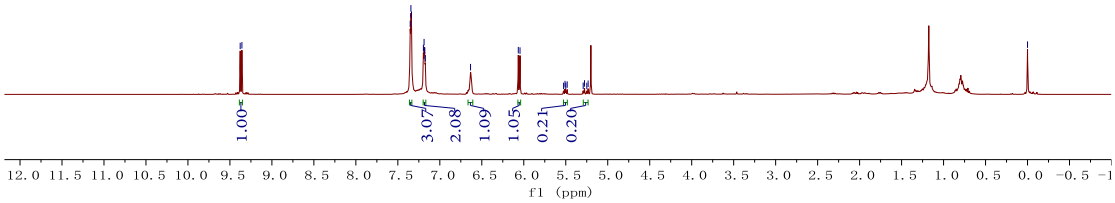

**$^1$H NMR** spectrun (400 MHz, $CDCl_3$)

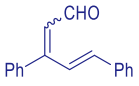




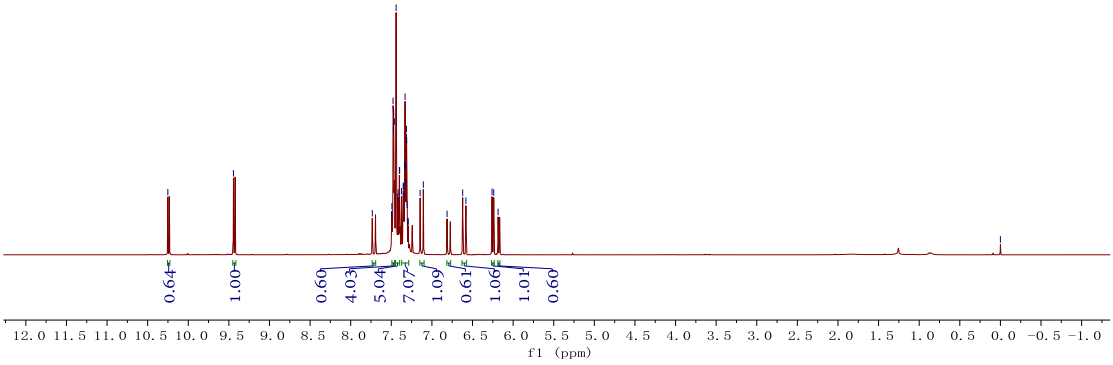

**1d'**
80%



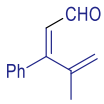




*Z*/*E* = 5:3

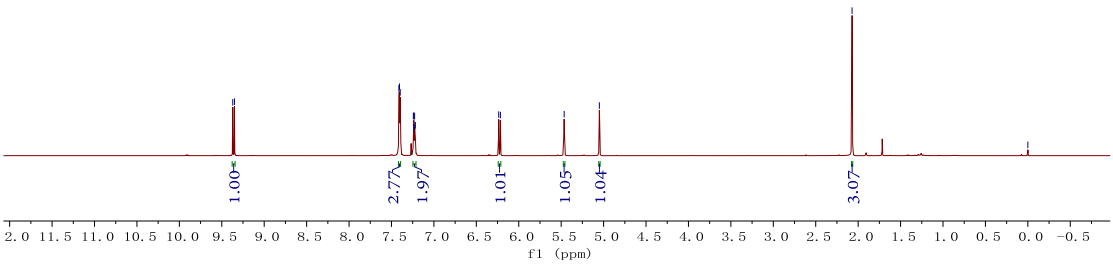
**$^1$H NMR** spectrun (400 MHz, $CDCl_3$)

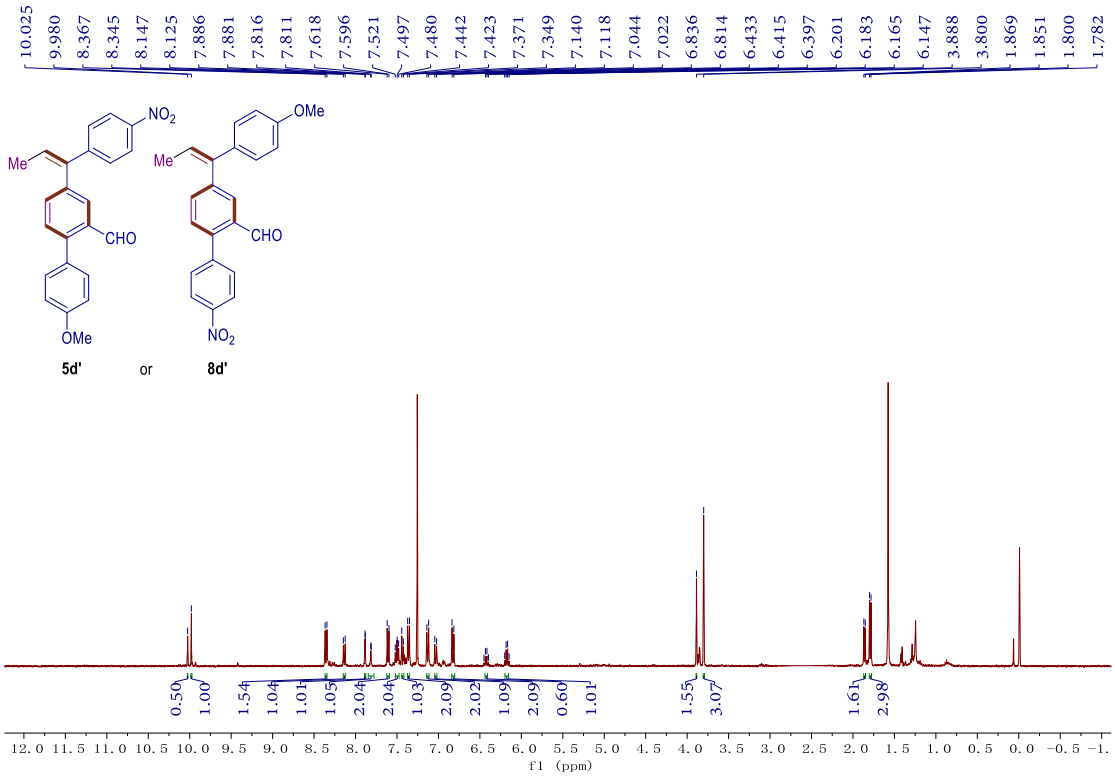







**$^1$H NMR** spectrun (400 MHz, $CDCl_3$)

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6.814
6.433
6.415
6.397
6.201
6.183
6.165
6.147
3.888
3.800
1.869
1.851
1.800
1.782
NO2
Me
CHO
OMe
OMe
Me
CHO
NO2
5d'
or
8d'
0.50
1.00
1.54
1.04
1.01
1.05
2.04
2.04
1.03
2.09
2.02
1.09
2.09
0.60
1.01
1.55
3.07
1.61
2.98
f1 (ppm)