Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Alkenylation and Arylation of Secondary Alcohols Enabled by Productive Merger of β-Carbon and β-Hydrogen Elimination via Isodesmic Reaction

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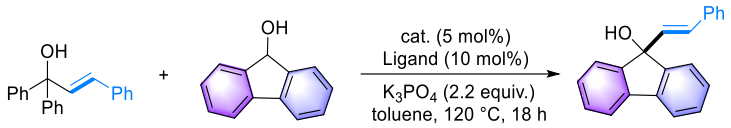
I. General Information

^{1}H and ^{13}C NMR spectra were recorded on a Bruker Avance 600 MHz and 400 MHz instruments. Chemical shifts were reported in parts per million (ppm), and the residual solvent peak was used as an internal reference: proton (chloroform δ 7.26), carbon (chloroform δ 77.0) or tetramethylsilane (TMS δ 0.00) was used as a reference. Multiplicity was indicated as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), dd (doublet of doublet), bs (broad singlet). Coupling constants were reported in Hertz (Hz). All high resolution mass spectra (HRMS) were obtained on a Bruker Apex-2. For thin layer chromatography (TLC), Qingdao Haiyang Chemical were used, and compounds were visualized with a UV light at 254 nm. Flash chromatography separations were performed on Qingdao Haiyang Chemical 300-400 mesh silica gel. All reactions were carried out under nitrogen atmosphere. All commercially available reagents were used as received for the reactions without any purification. Allylic alcohols[1] fluorenols[2], their derivatives[3] and tertiary alcohols[4] are synthesis via the known procedures.

II. Reaction Optimization

2.1. Optimization of α-C-H alkenylation

Table S1 Initial catalyst and ligand screening of the reaction 1a and 2a

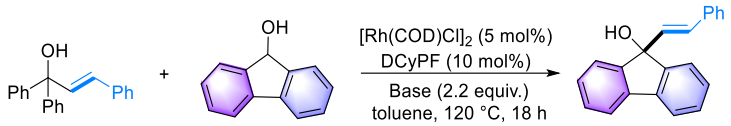


1a **2a** **3aa**

Entry	cat.	Ligand	Yield (%)
1	$Rh(CO)PMe_3$	DCyPF	-
2	$[RuCp^*Cl_2]_2$	DCyPF	-
3	$Pd(OAc)_2$	DCyPF	-
4	$[IrCp^*Cl_2]_2$	DCyPF	-
5	$[Rh(C_2H_4)_2Cl]_2$	DCyPF	26
6	$[Rh(COD)_2]BF_4$	DCyPF	14
7	$[Rh(COD)Cl]_2$	IMes·HCl	13
8	$[Rh(COD)Cl]_2$	IPr·HCl	15
9	$[Rh(COD)Cl]_2$	PCy_3	17
10	$[Rh(COD)Cl]_2$	DPPF	37
11	$[Rh(COD)Cl]_2$	BINAP	41
12	$[Rh(COD)Cl]_2$	DCyPE	trace
13	$[Rh(COD)Cl]_2$	MePhos	trace
14	$[Rh(COD)Cl]_2$	XantPhos	trace
15	$[Rh(COD)Cl]_2$	DCyPF	56

Reaction conditions: 0.2 mmol of **1a**, 0.1 mmol of **2a**, 5 mol % of cat., 0.01 mmol of ligand, 0.22 mmol of K_3PO_4 in 0.5 mL toluene at 120 °C (oil bath) for 18 h.

Table S2 Base screening of the reaction 1a and 2a

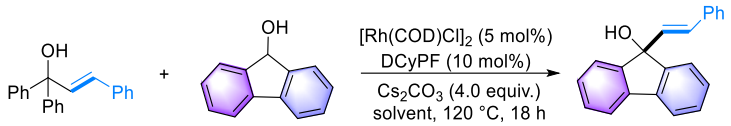


1a **2a** **3aa**

Entry	Base[a]	Yield (%)
1	K_3PO_4	56
2[b]	K_3PO_4	34
3[c]	K_3PO_4	54
4[d]	K_3PO_4	54
5	K_2CO_3	51
6	Cs_2CO_3	63
7	NaOH	trace
8	CsF	30
9	NaH	-
10	DBU	-
11	NaH_2PO_4	-

Reaction conditions: 0.2 mmol of **1a**, 0.1 mmol of **2a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of DCyPF, 0.3 mmol of base in 0.5 mL toluene at 120 °C (oil bath) for 18 h. [b]0.25 mmol of K_3PO_4. [c]0.35 mmol of K_3PO_4 [d]0.40 mmol of K_3PO_4.

Table S3 Solvent screening of the reaction 1a and 2a



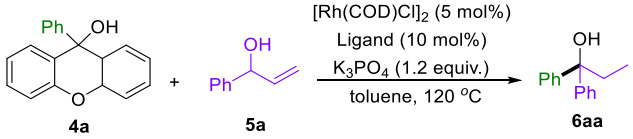
1a **2a** **3aa**

Entry	solvent[a]	Yield (%)
1	toluene	60
2[b]	toluene	63
3[c]	toluene	47
4	CH_3CN	-
5	*p*-Xylene	57
6	o-Xylene	63
7	THF	64
8	2-MeTHF	67
9	EtOH	-
10	PhCl	70
11	DMF	-
12	TBME	67
13	CPME	63
14	1,4-Dioxane	71
15[d]	1,4-Dioxane	82

[a]Reaction conditions: 0.2 mmol of **1a**, 0.1 mmol of **2a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of DCyPF, 0.4 mmol of Cs_2CO_3 in 0.5 mL toluene at 120 °C (oil bath) for 18 h. [b]0.5 mL of toluene. [b]0.2 mL of toluene. [d]0.3 mmol of **1a**, 0.1 mmol of **2a**

1.2. Optimization of α-C-H arylation

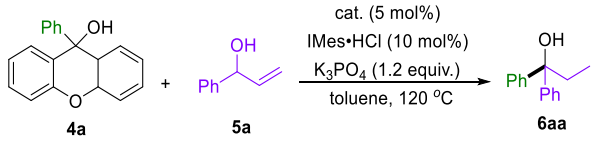
Table S4 Ligand screening of the reaction 4a and 5a



Entry	Ligand	Yield (%)
1	DCyPF	-
2	DCyPE	-
3	$P(Ar^F)_3$	-
4	1,2-Dimethylimidazole	-
5	2-Aminobenzimidazole	-
6	SIMes·HCl	21
7	IMes·HCl	28
8	IPr·HCl	25
9	SIMes·HCl	21
10	SIMes·HBF_4	23

Reaction conditions: 0.1 mmol of **4a**, 0.1 mmol of **5a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of IMes·HCl, 0.12 mmol of K_3PO_4, 40 mg of 4Å MS in 0.5 mL *o*-xylene at 120 °C (oil bath) for 12 h.

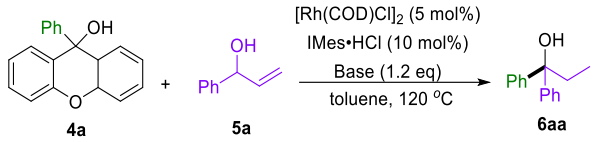
Table S5 Catalyst screening of the reaction 4a and 5a



Entry	cat.	Yield (%)
1	$[RuCp^*Cl_2]_2$	-
2	$Pd(OAc)_2$	-
3	$Ni(OTf)_2$	-
4	$[IrCp^*Cl_2]_2$	-
5	$[Rh(C_2H_4)_2Cl]_2$	16
6	$[Rh(COE)_2Cl]_2$	14
7	$[Rh(OMe)(COD)]_2$	16
8	$[Rh(COD)_2BF_4]$	trace
9	$[Rh(COD)Cl]_2$	28

Reaction conditions: 0.1 mmol of **4a**, 0.1 mmol of **5a**, 5 mol % of *cat*., 0.01 mmol of IMes·HCl, 0.12 mmol of K_3PO_4 in 0.5 mL toluene at 110 ℃ (oil bath) for 12 h.

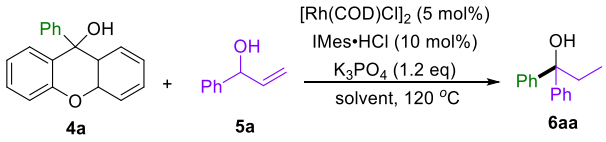
Table S6 Base screening of the reaction 4a and 5a



Entry	Base	Yield (%)
1	KO^{t}Bu	24
2	KO^{t}Amyl	17
3	LiO^{t}Bu	18
4	Cs_2CO_3	27
5	K_2CO_3	-
6	NaOH	20
7	KHDMS	14
8	NaH	10
9	KF	-
10	DBU	-
11	CsF	trace
12	NaH_2PO_4	trace

Reaction conditions: 0.1 mmol of **4**, 0.1 mmol of **5a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of IMes·HCl, 0.12 mmol of K_3PO_4, 40 mg of 4Å MS in 0.5 mL *o*-xylene at 120 °C (oil bath) for 12 h.

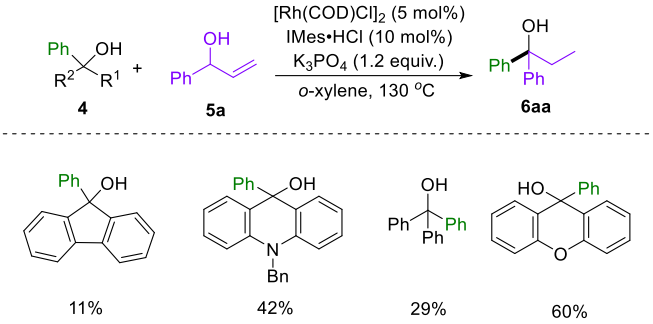
Table S7 Solvent screening of the reaction 4a and 5a



Entry	Solvent[a]	Yield (%)
1	THF	-
2	DCE	-
3	*o*-xylene	40
4[b]	*o*-xylene	50
5[c]	*o*-xylene	60

[a]Reaction conditions: 0.1 mmol of **4**, 0.1 mmol of **5a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of IMes·HCl, 0.12 mmol of K_3PO_4, 40 mg of 4Å MS in 0.5 mL *o*-xylene at 130 °C (oil bath) for 12 h. [b]130 °C for 20 h [c]40 mg of 4Å MS.

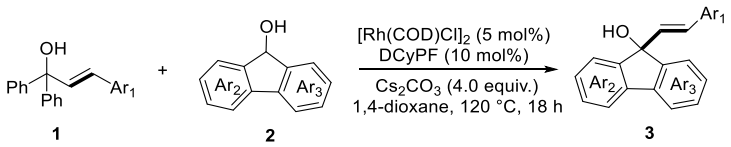
Table S8 The substrates screening of the reaction 4 and 5a



Reaction conditions: 0.1 mmol of **4**, 0.1 mmol of **5a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of IMes·HCl, 0.12 mmol of K_3PO_4, 40 mg of 4Å MS in 0.5 mL *o*-xylene at 130 °C (oil bath) for 20 h.

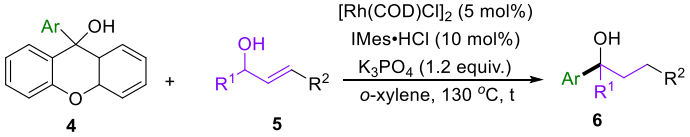
III. Experimental Procedures

Scheme S1 Rh-catalyzed alkenylation of secondary alcohols



General Procedures A: All reactions in this section were performed at 0.1 mmol scale. In a nitrogen glove box, an oven-dried 10 mL reaction tube equipped with a magnetic stirring bar was charged with $[Rh(COD)Cl]_2$ (5 mol%), DCyPF (10 mol%) and 1,4-dioxane (0.3 mL). The resulting mixtures were stirred for 5 to 10 min before **1** (0.3 mmol), **2** (0.1 mmol) and the Cs_2CO_3 (4.0 equiv.) were added. The reaction mixture was sealed with a screw cap, taken out of the glove box and placed in oil-bath at 120 °C and stirred for 18 h. After cooling to room temperature, the reaction mixture was exposed to air, concentrated and further purified by flash column chromatography over silica (petroleum/ethyl acetate) to give the product.

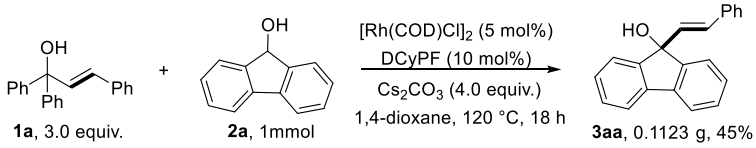
Scheme S2 Rh-catalyzed arylation of secondary allylic alcohols



General Procedures B: All reactions in this section were performed at 0.1 mmol scale. To a vacuum reaction tube equipped with a dried stir bar was added **4** (0.1 mmol), **5** (0.1 mmol), $Rh(COD)Cl]_2$ (5

mol%), IMes·HCl (10 mol%) and K_3PO_4 (1.2 equiv.) and *o*-xylene in the glovebox. The reaction mixture was sealed with a screw cap, taken out of the glove box and placed in oil-bath at 130 ^oC and stirred for corresponding time. After cooling to room temperature, the reaction mixture was exposed to air, concentrated and further purified by flash column chromatography over silica (petroleum/ethyl acetate) to give the product.

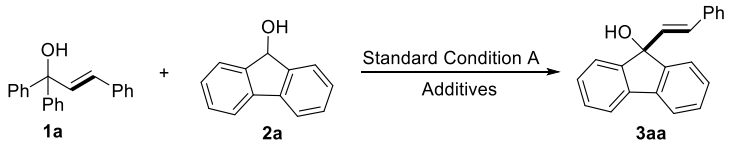
Gram-Scale Reaction C:



In a nitrogen glove box, an oven-dried 50 mL reaction tube equipped with a magnetic stirring bar was charged with $[Rh(COD)Cl]_2$ (5 mol%), DCyPF (10 mol%) and 1,4-dioxane (3.0 mL). The resulting mixtures were stirred for 5 to 10 min before **1** (3 mmol), **2** (1 mmol) and the Cs_2CO_3 (4.0 equiv.) were added. The reaction mixture was sealed with a screw cap, taken out of the glove box and placed in oil-bath at 120 ^oC and stirred for 18 h. After cooling to room temperature, the reaction mixture was exposed to air, concentrated and further purified by flash column chromatography over silica (petroleum/ethyl acetate) to give the product in 45% yield.

IV. Mechanism study

Scheme S3. Radical experiments

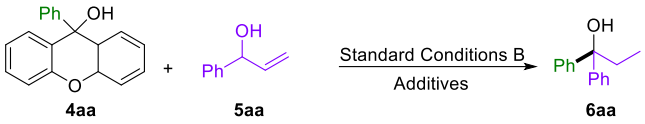


Entry	Additive	Yeild
1	TEMPO	42%
2	BHT	68%

Reaction conditions: 0.3 mmol of **1a**, 0.1 mmol of **2a**, 5 mol % of $[Rh(COD)Cl]_2$, 0.01 mmol of DCyPF, 0.4 mmol of Cs_2CO_3 in 0.3 mL toluene at 120 °C (oil bath) for 18 h.

In a nitrogen glove box, an oven-dried 10 mL reaction tube equipped with a magnetic stirring bar was charged with $[Rh(COD)Cl]_2$ (5 mol%), DCyPF (10 mol%) and toluene (0.3 mL). The resulting

mixtures were stirred for 5 to 10 min before **1a** (0.3 mmol), **2a** (0.10 mmol), additives (0.1 mmol) and Cs_2CO_3 (4.0 equiv.) were added. The reaction mixture was sealed with a screw cap, taken out of the glove box and placed in oil-bath at 120 °C and stirred for 18 h. After cooling to room temperature, the reaction mixture was exposed to air, concentrated and further purified by flash column chromatography over silica (petroleum/ethyl acetate) to give desired product **3aa**.

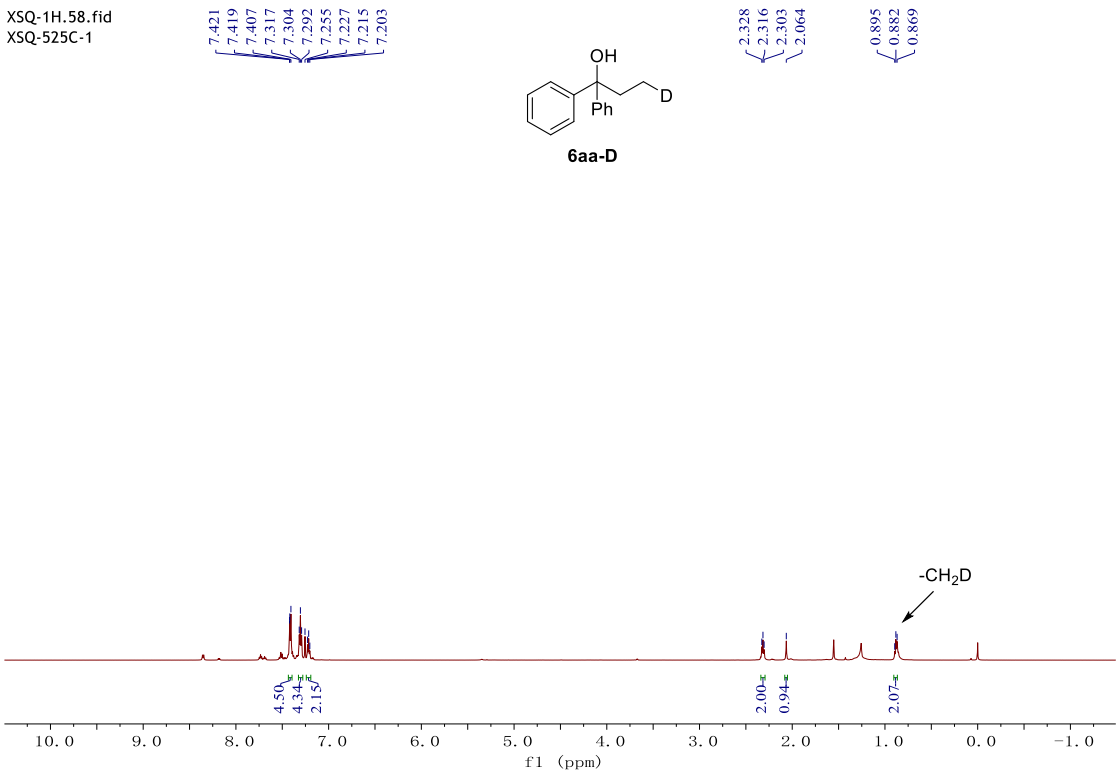


Entry	Additive	Yeild
1	TEMPO	22%
2	BHT	27%

To a vacuum reaction tube equipped with a dried stir bar was added **4** (0.1 mmol), **5** (0.1 mmol), $Rh(COD)Cl]_2$ (5 mol%), IMes·HCl (10 mol%), additives (0.1 mmol) and K_3PO_4 (1.2 equiv.) and *o*-xylene (0.5 mL) in the glovebox. The reaction mixture was sealed with a screw cap, taken out of the glove box and placed in oil-bath at 130 °C and stirred for corresponding time. After cooling to room temperature, the reaction mixture was exposed to air, concentrated and further purified by flash column chromatography over silica (petroleum/ethyl acetate) to give the product **6aa**.

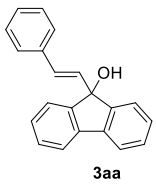
Scheme S4. Isotope labeling experiments

To a vacuum reaction tube equipped with a dried stir bar was added **4a** (0.1 mmol), **5a-D** (0.1 mmol), $Rh(COD)Cl]_2$ (5 mol%), IMes·HCl (10 mol%) and K_3PO_4 (1.2 equiv.) and *o*-xylene (0.5 mL) in the glovebox. The reaction mixture was sealed with a screw cap, taken out of the glove box and placed in oil-bath at 130 °C and stirred for corresponding time. After cooling to room temperature, the reaction mixture was exposed to air, concentrated and further purified by flash column chromatography over silica (petroleum/ethyl acetate) to give the product **6aa-D** in 52% yield, with 93% deuterated.



V. Characterization data of products

(*E*)-9-Styryl-9H-fluoren-9-ol (3aa)[5]



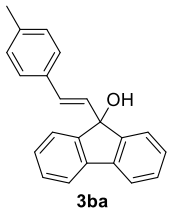
3aa

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 83% yield (23.4 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.8 Hz, 2H), 7.51 (d, *J* = 7.8 Hz, 2H), 7.42-7.35 (m, 4H), 7.31 (t, *J* = 7.2 Hz, 2H), 7.29-7.24 (m, 2H), 7.20 (t, *J* = 7.8 Hz, 1H), 6.94 (d, *J* = 16.2 Hz, 1H), 6.31 (d, *J* = 16.2 Hz, 1H), 2.27 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.39, 139.60, 136.92, 130.71, 129.43, 128.65, 128.54, 128.40, 127.70, 126.76, 124.76, 120.36, 82.51.

(*E*)-9-(4-Methylstyryl)-9H-fluoren-9-ol (3ba)[5]



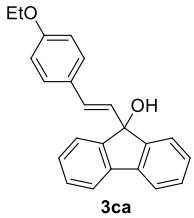
3ba

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 80% yield (23.9 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.8 Hz, 2H), 7.50 (d, *J* = 7.2 Hz, 2H), 7.38 (t, *J* = 7.8 Hz, 2H), 7.30 (t, *J* = 7.2 Hz, 2H), 7.25 (d, *J* = 7.8 Hz, 2H), 7.08 (d, *J* = 7.8 Hz, 2H), 6.89 (d, *J* = 15.8 Hz, 1H), 6.27 (d, *J* = 15.8 Hz, 1H), 2.30 (s, 3H), 1.56 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.50, 139.58, 137.53, 134.12, 129.65, 129.36, 129.34, 128.43, 128.36, 126.66, 124.76, 120.33, 82.52, 21.29.

(*E*)-9-(4-Ethoxystyryl)-9H-fluoren-9-ol (3ca)



3ca

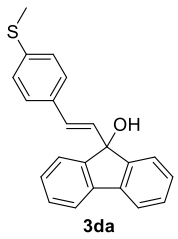
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (5:1) resulting in 84% yield (27.6 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.8 Hz, 2H), 7.51 (d, *J* = 7.2 Hz, 2H), 7.38 (t, *J* = 7.2 Hz, 2H), 7.32-7.27 (m, 4H), 6.84 (d, *J* = 15.6 Hz, 1H), 6.79 (d, *J* = 8.4 Hz, 2H), 6.20 (d, *J* = 15.6 Hz, 1H), 4.00 (q, *J* = 7.2 Hz, 2H), 2.28 (s, 1H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 158.73, 148.58, 139.55, 129.52, 129.32, 128.35, 128.07, 127.91, 124.75, 120.32, 114.66, 82.53, 63.60, 14.93.

HRMS (ESI): $C_{23}H_{20}O_2Na$ [M+Na]+, calculated 351.1356, found: 351.1356.

(*E*)-9-(4-(Methylthio)styryl)-9H-fluoren-9-ol (3da)



3da

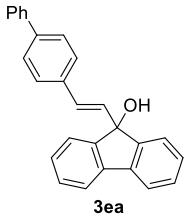
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 43% yield (14.2 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.8 Hz, 2H), 7.51 (d, *J* = 7.8 Hz, 2H), 7.39 (t, *J* = 7.8 Hz, 2H), 7.32-7.27 (m, 4H), 7.16 (d, *J* = 7.8 Hz, 2H), 6.88 (d, *J* = 15.8 Hz, 1H), 6.28 (d, *J* = 15.8 Hz, 1H), 2.45 (s, 3H), 2.26 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.69, 139.70, 131.20, 129.29, 128.73, 128.36, 127.25, 125.99, 124.82, 123.45, 120.72, 120.30, 82.76, 55.63.

HRMS (ESI): $C_{22}H_{18}SONa$ $[M+Na]^+$, calculated: 353.0971, found: 353.0972.

(*E*)-9-(2-([1,1'-Biphenyl]-4-yl)vinyl)-9H-fluoren-9-ol (3ea)[5]



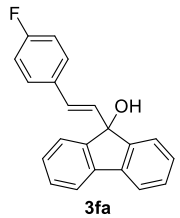
3ea

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 50% yield (18.0 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.67 (d, *J* = 7.8 Hz, 2H), 7.57 (d, *J* = 7.2 Hz, 2H), 7.52 (t, *J* = 8.4 Hz, 4H), 7.44-7.39 (m, 6H), 7.32 (t, *J* = 7.2 Hz, 3H), 6.99 (d, *J* = 15.6 Hz, 1H), 6.36 (d, *J* = 15.6 Hz, 1H), 2.31 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.39, 140.85, 140.47, 139.61, 135.97, 130.82, 129.46, 128.90, 128.43, 128.06, 127.42, 127.35, 127.18, 127.06, 124.78, 120.38, 82.55.

(E)-9-(4-Fluorostyryl)-9H-fluoren-9-ol (3fa)



3fa

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 65% yield (19.7 mg) as a colorless oil.

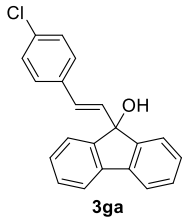
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.2 Hz, 2H), 7.50 (d, *J* = 7.2 Hz, 2H), 7.39 (t, *J* = 7.8 Hz, 2H), 7.34-7.29 (m, 4H), 6.96 (t, *J* = 8.4 Hz, 2H), 6.89 (d, *J* = 15.6 Hz, 1H), 6.22 (d, *J* = 15.6 Hz, 1H), 2.31 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 162.43 (*J* = 246.8 Hz,), 148.18, 139.44, 133.06 (d, *J* = 3.3 Hz), 130.45, 129.46, 128.41, 128.24 (d, *J* = 7.6 Hz), 127.38, 124.72, 120.39, 115.53 (d, *J* = 21.14 Hz), 82.31.

^{19}F NMR (565 MHz, $CDCl_3$) δ -114.54.

HRMS (ESI): $C_{21}H_{15}FNaO$ $[M+Na]^+$, calculated: 325.0999, found: 325.1000.

(*E*)-9-(4-Chlorostyryl)-9H-fluoren-9-ol (3ga)[5]



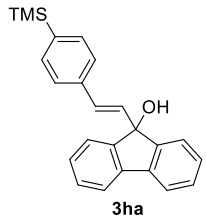
3ga

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 60% yield (19.1 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.8 Hz, 2H), 7.50 (d, *J* = 7.8 Hz, 2H), 7.39 (t, *J* = 7.2 Hz, 2H), 7.34-7.28 (m, 4H), 7.25-7.23 (m, 2H), 6.89 (d, *J* = 15.6 Hz, 1H), 6.27 (d, *J* = 15.6 Hz, 1H), 2.29 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.19, 139.58, 135.44, 133.30, 131.41, 129.52, 128.79, 128.44, 127.95, 127.33, 124.73, 120.41, 82.43.

(*E*)-9-(4-(Trimethylsilyl)styryl)-9H-fluoren-9-ol (3ha)



3ha

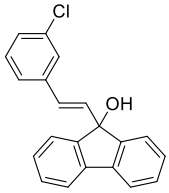
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 66% yield (23.5 mg) as a yellow oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72-7.69 (m, 2H), 7.53 (d, *J* = 7.8 Hz, 2H), 7.48 (d, *J* = 8.1 Hz, 2H), 7.44-7.41 (m, 2H), 7.39 (d, *J* = 8.2 Hz, 2H), 7.35 (d, *J* = 8.4 Hz, 2H), 7.29 (m, 2H), 7.00 (d, *J* = 16.2 Hz, 1H), 6.37 (d, *J* = 15.6 Hz, 1H), 2.34 (s, 1H), 0.28 (s, 9H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.38, 139.62, 133.71, 130.96, 129.44, 128.50, 128.41， 126.05, 124.77, 120.35, 82.51, 1.00.

HRMS (ESI): $C_{24}H_{24}OSiNa$ $[M+Na]^+$, calculated: 379.1489, found: 379.1490.

(*E*)-9-(3-Chlorostyryl)-9H-fluoren-9-ol (3ia)



3ia

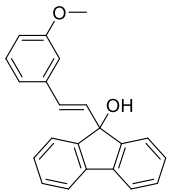
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 41% yield (13.1 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.5 Hz, 2H), 7.49 (d, *J* = 7.4 Hz, 2H), 7.40 (t, *J* = 7.5 Hz, 2H), 7.35 (s, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.24-7.15 (m, 3H), 6.90 (d, *J* = 15.8 Hz, 1H), 6.29 (d, *J* = 15.8 Hz, 1H), 2.29 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.11, 139.59, 138.86, 134.63, 132.36, 129.85, 129.54, 128.45, 127.59, 127.22, 126.62, 125.01, 124.73, 120.41, 82.40.

HRMS (ESI): $C_{21}H_{15}ClONa$ $[M+Na]^+$, calculated: 341.0704, found: 341.0707.

(*E*)-9-(3-Methoxystyryl)-9H-fluoren-9-ol (3ja)



3ja

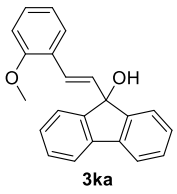
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 75% yield (23.6 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.8 Hz, 2H), 7.50 (d, *J* = 7.2 Hz, 2H), 7.38 (t, *J* = 7.2 Hz, 2H), 7.30 (t, *J* = 7.2 Hz, 2H), 7.18 (t, *J* = 8.4 Hz, 1H), 6.96-6.89 (m, 3H), 6.75 (d, *J* = 8.4 Hz, 1H), 6.30 (d, *J* = 15.8 Hz, 1H), 3.75 (s, 3H), 2.32 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 159.94, 148.37, 139.60, 138.37, 131.02, 129.61, 129.43, 128.46, 128.40, 124.78, 120.35, 119.48, 113.67, 111.79, 82.46, 55.34.

HRMS (ESI): $C_{22}H_{18}O_2Na$ $[M+Na]^+$, calculated: 337.1199, found: 337.1201.

(*E*)-9-(2-Methoxystyryl)-9H-fluoren-9-ol (3ka)



3ka

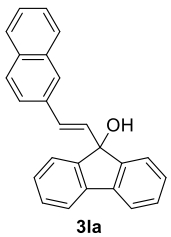
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (5:1) resulting in 67% yield (21.1 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.2 Hz, 2H), 7.53 (d, *J* = 7.2 Hz, 2H), 7.38 (t, *J* = 7.2 Hz, 2H), 7.31 (t, *J* = 7.8 Hz, 3H), 7.21-7.16 (m, 1H), 6.88-6.83 (m, 2H), 6.34 (d, *J* = 16.2 Hz, 1H), 3.83 (s, 3H), 2.31 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 156.92, 148.53, 139.54, 131.04, 129.12, 128.56, 128.19, 127.08, 125.84, 124.65, 123.31, 120.56, 120.12, 111.02, 82.60, 55.47.

HRMS (ESI): $C_{22}H_{18}O_2Na$ $[M+Na]^+$, calculated: 337.1199, found: 337.1200.

(*E*)-9-(2-(Naphthalen-2-yl)vinyl)-9H-fluoren-9-ol (3la)



3la

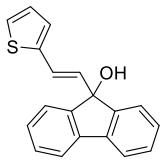
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 84 % yield (28.1 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.76-7.72 (m, 4H), 7.67 (d, *J* = 7.2 Hz, 2H), 7.55 (d, *J* = 7.8 Hz, 3H), 7.43-7.39 (m, 4H), 7.33 (t, *J* = 7.8 Hz, 2H), 7.10 (d, *J* = 15.8 Hz, 1H), 6.45 (d, *J* = 15.8 Hz, 1H), 2.32 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.40, 139.61, 134.37, 133.72, 133.12, 131.12, 129.46, 128.65, 128.43, 128.25, 128.09, 127.76, 126.69, 126.34, 125.95, 124.80, 123.92, 120.39, 82.61.

HRMS (ESI): $C_{25}H_{18}O_2Na$ $[M+Na]^+$, calculated: 357.1250, found: 357.1250.

(*E*)-9-(2-(Thiophen-2-yl)vinyl)-9H-fluoren-9-ol (3ma)



3ma

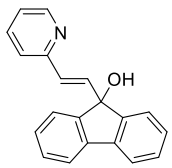
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 43% yield (12.5 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.6 Hz, 2H), 7.51 (d, *J* = 7.5 Hz, 2H), 7.43-7.36 (m, 2H), 7.32 (t, *J* = 7.5 Hz, 2H), 7.11 (d, *J* = 5.0 Hz, 1H), 7.04 (d, *J* = 15.6 Hz, 1H), 6.95 (d, *J* = 3.5 Hz, 1H), 6.93 (dd, *J* = 5.1, 3.5 Hz, 1H), 6.17 (d, *J* = 15.6 Hz, 1H), 2.24 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.26, 142.18, 139.62, 130.36, 129.48, 128.44, 127.46, 126.02, 124.77, 124.44, 122.12, 120.38, 82.30.

HRMS (ESI): $C_{19}H_{14}OSNa$ $[M+Na]^+$, calculated: 313.0658, found: 313.0660.

(*E*)-9-(2-(Pyridin-2-yl)vinyl)-9H-fluoren-9-ol (3na)[5]



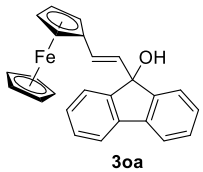
3na

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 41 % yield (11.2 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.8 Hz, 2H), 7.49 (d, *J* = 7.2 Hz, 2H), 7.39 (t, *J* = 7.8 Hz, 2H), 7.34 (s, 1H), 7.31 (t, *J* = 7.8 Hz, 2H), 7.23 – 7.15 (m, 3H), 6.89 (d, *J* = 15.8 Hz, 1H), 6.29 (d, *J* = 15.8 Hz, 1H), 2.28 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 155.52, 149.65, 148.13, 139.69, 136.56, 135.74, 129.45, 128.40, 128.34, 124.86, 122.23, 122.06, 120.35, 82.54.

(*E*)-9-(Ferrocene-2)vinyl)-9H-fluoren-9-ol (3oa)



3oa

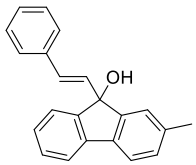
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 44% yield (18.6 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 7.5 Hz, 2H), 7.51 (d, *J* = 7.4 Hz, 2H), 7.39 (t, *J* = 7.4 Hz, 2H), 6.63 (d, *J* = 15.7 Hz, 1H), 5.94 (d, *J* = 15.7 Hz, 1H), 4.31 (s, 2H), 4.20-4.16 (m, 3H), 4.07 (s, 5H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.71, 139.56, 130.08, 129.30, 128.41, 128.34, 127.78, 126.32, 124.59, 120.34, 82.69, 82.59, 69.34, 68.90, 68.55, 67.13, 29.86.

HRMS (ESI): $C_{25}H_{20}FeONa$ $[M+Na]^+$, calculated: 414.0756, found: 414.0755.

(*E*)-2-Methyl-9-styryl-9H-fluoren-9-ol (3ab)



3ab

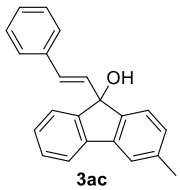
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 76% yield (23.3 mg) as a yellow oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.62 (d, *J* = 7.8 Hz, 1H), 7.55 (d, *J* = 7.8 Hz, 1H), 7.49 (d, *J* = 7.8 Hz, 1H), 7.38 (d, *J* = 7.8 Hz, 3H), 7.32 (s, 1H), 7.28 (t, *J* = 7.2 Hz, 3H), 7.20 (t, *J* = 7.8 Hz, 2H), 6.96 (d, *J* = 16.2 Hz, 1H), 6.30 (d, *J* = 15.6 Hz, 1H), 2.39 (s, 3H), 2.25 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.60, 148.27, 139.77, 138.51, 136.96, 136.91, 130.87, 130.14, 129.39, 128.66, 128.36, 127.91, 127.66, 126.75, 125.43, 124.70, 120.14, 120.04, 82.40, 21.75.

HRMS (ESI): $C_{22}H_{18}ONa$ $[M+Na]^+$, calculated: 321.1250, found: 321.1249.

(*E*)-3-Methyl-9-styryl-9H-fluoren-9-ol (3ac)



3ac

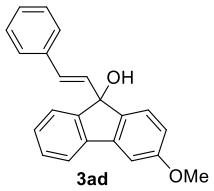
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 48% yield (14.3 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.64 (d, *J* = 7.8 Hz, 1H), 7.52 – 7.46 (m, 2H), 7.42 – 7.34 (m, 4H), 7.32-7.27 (m, 3H), 7.20 (t, *J* = 7.8 Hz, 1H), 7.13 (d, *J* = 7.2 Hz, 1H), 6.93 (d, *J* = 15.9 Hz, 1H), 6.31 (d, *J* = 15.9 Hz, 1H), 2.43 (s, 3H), 2.22 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.82, 145.60, 139.78, 139.66, 139.44, 136.99, 130.91, 129.36, 129.19, 128.65, 128.37, 128.29, 127.65, 126.75, 124.74, 124.51, 121.03, 120.24, 82.28, 21.76.

HRMS (ESI): $C_{22}H_{18}NaO$ $[M+Na]^+$, calculated: 321.1250, found: 321.1257.

(*E*)-3-Methoxy-9-styryl-9H-fluoren-9-ol (3ad)[5]

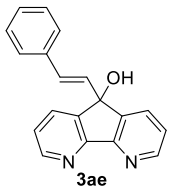


The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (5:1) resulting in 58% yield (18.2 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.62 (d, *J* = 7.2 Hz, 1H), 7.49 (d, *J* = 7.2 Hz, 1H), 7.42-7.35 (m, 4H), 7.31 (t, *J* = 7.8 Hz, 1H), 7.27 (t, *J* = 7.2 Hz, 2H), 7.21-7.17 (m, 2H), 6.92 (d, *J* = 15.6 Hz, 1H), 6.83 (dd, *J* = 7.8, 1.8 Hz, 1H), 6.31 (d, *J* = 15.6 Hz, 1H), 3.87 (s, 3H), 2.26 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 161.23, 149.42, 141.24, 140.62, 139.36, 137.06, 131.06, 129.33, 129.31, 128.92, 128.65, 128.54, 128.35, 127.64, 126.76, 126.33, 125.59, 124.69, 120.29, 113.91, 106.04, 82.04, 55.76.

(*E*)-5-Styryl-5H-cyclopenta[2,1-b:3,4-b']dipyridin-5-ol (3ae)[5]

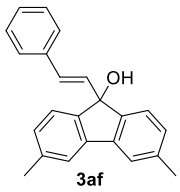


The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 43% yield (12.3 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.57-8.52 (m, 2H), 7.85 (d, *J* = 7.6 Hz, 2H), 7.35 (d, *J* = 6.9 Hz, 2H), 7.29 (t, *J* = 7.5 Hz, 2H), 7.23 (m, 3H), 6.99 (d, *J* = 15.9 Hz, 1H), 6.22 (d, *J* = 15.7 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.32, 151.37, 143.66, 136.33, 132.54, 130.10, 128.79, 128.67, 128.17, 126.81, 124.02, 78.74.

(*E*)-3,6-Dimethyl-9-styryl-9H-fluoren-9-ol (3af)[5]

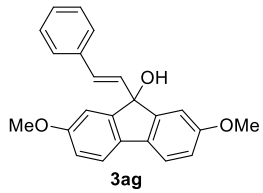


The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 75% yield (23.4 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.45 (s, 1H), 7.38-7.34 (m, 4H), 7.27-7.25 (m, 3H), 7.19 (t, *J* = 7.8 Hz, 1H), 7.11 (d, *J* = 7.8 Hz, 2H), 6.91 (d, *J* = 15.9 Hz, 1H), 6.30 (d, *J* = 15.9 Hz, 1H), 2.42 (s, 6H), 2.18 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.07, 139.83, 139.28, 137.11, 131.18, 129.03, 128.62, 128.22, 127.57, 126.74, 124.45, 120.90, 82.05, 21.73.

(*E*)-3,6-Dimethoxy-9-styryl-9H-fluoren-9-ol (3ag)



3ag

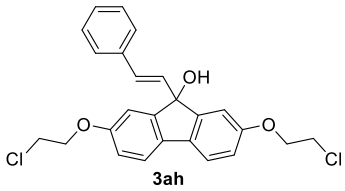
The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 53% yield (18.3 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.45 (s, 2H), 7.38-7.34 (m, 4H), 7.29-7.23 (m, 3H), 7.19 (t, *J* = 7.8 Hz, 1H), 7.11 (d, *J* = 7.8 Hz, 2H), 6.91 (d, *J* = 15.6 Hz, 1H), 6.30 (d, *J* = 15.6 Hz, 1H), 2.42 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.07, 139.83, 139.28, 137.11, 131.18, 129.03, 128.62, 128.22, 127.57, 126.74, 124.45, 120.90, 82.05, 21.73.

HRMS (ESI): $C_{23}H_{20}NaO_3^+$ $[M+Na]^+$ calculated 367.1305, found 367.1307

(*E*)-2,7-Bis(2-chloroethoxy)-9-styryl-9H-fluoren-9-ol (3ah)[5]



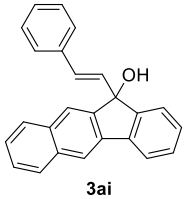
3ah

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 32% yield (14.1 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.3 Hz, 1H), 7.37 (d, *J* = 7.4 Hz, 2H), 7.29 (t, *J* = 7.7 Hz, 2H), 7.22 (d, *J* = 7.4 Hz, 2H), 7.04 (d, *J* = 2.4 Hz, 1H), 6.94 (d, *J* = 16.0 Hz, 1H), 6.93-6.88 (m, 2H), 6.25 (d, *J* = 15.9 Hz, 1H), 4.25 (t, *J* = 5.9 Hz, 4H), 3.80 (t, *J* = 5.9 Hz, 4H), 2.28 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 158.41, 150.15, 136.82, 132.95, 130.56, 128.78, 128.71, 127.83, 126.82, 120.61, 116.24, 111.34, 82.30, 68.68, 42.02.

(*E*)-11-Styryl-11H-benzo[b]fluoren-11-ol (3ai)



3ai

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 67% yield (22.4 mg) as a colorless oil.

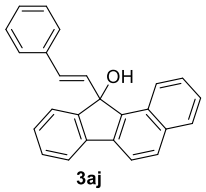
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.07 (s, 1H), 7.94 (s, 1H), 7.89 (d, *J* = 7.8 Hz, 1H), 7.86-7.79 (m, 2H), 7.57 (d, *J* = 7.8 Hz, 1H), 7.52 – 7.42 (m, 3H), 7.40-7.34 (m, 3H), 7.28 (t, *J* = 7.8 Hz, 2H), 7.20 (t, *J* = 7.2 Hz, 1H), 6.97 (d, *J* = 15.6 Hz, 1H), 6.43 (d, *J* = 15.6 Hz, 1H), 2.41 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.82, 146.62, 139.19, 137.79, 136.94, 134.62, 133.95, 131.29, 129.69,

129.06, 128.74, 128.69, 128.50, 128.42, 127.75, 126.83, 126.67, 126.18, 125.12, 124.08, 120.95, 118.76, 82.14.

HRMS (ESI): $C_{25}H_{18}NaO^+$ $[M+Na]^+$ calculated 357.1250, found 357.1246.

(*E*)-11-Styryl-11H-benzo[a]fluoren-11-ol (3aj)[5]



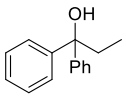
3aj

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (10:1) resulting in 68% yield (22.7 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.66 (d, *J* = 8.4 Hz, 1H), 8.23 (d, *J* = 7.8 Hz, 1H), 7.92 (d, *J* = 7.8 Hz, 1H), 7.83 (d, *J* = 7.8 Hz, 1H), 7.65-7.63 (m, 2H), 7.58 (d, *J* = 7.2 Hz, 1H), 7.54 (t, *J* = 7.8 Hz, 1H), 7.47 (t, *J* = 7.8, 1H), 7.36-7.32 (m, 3H), 7.26 (t, *J* = 7.2 Hz, 2H), 7.19 (t, *J* = 12.6 Hz, 1H), 7.01 (d, *J* = 15.9 Hz, 1H), 6.29 (d, *J* = 15.9 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.56, 147.00, 140.65, 136.99, 135.00, 134.39, 130.54, 129.52, 128.95, 128.66, 127.70, 127.62, 127.19, 126.76, 126.09, 124.61, 124.24, 123.42, 122.10, 82.30.

1,1-Diphenylpropan-1-ol (6aa)[6]



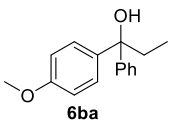
6aa

The title compound was prepared according to the general procedure as described. Silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 60% yield (12.8 mg) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.43-7.40 (m, 4H), 7.30 (t, *J* = 7.8 Hz, 4H), 7.25-7.19 (m, 2H), 2.32 (q, *J* = 7.3 Hz, 2H), 2.06 (s, 1H), 0.88 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 147.06, 128.25, 126.90, 126.25, 78.61, 34.60, 8.29.

1-(4-Methoxyphenyl)-1-phenylpropan-1-ol (6ba)[7]



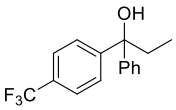
6ba

The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 11.9 mg of colorless oil in 49% yield.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41-7.37 (m, 2H), 7.35-7.29 (m, 4H), 7.24-7.19 (m, 1H), 6.84 (d, *J* = 8.8 Hz, 2H), 3.78 (s, 3H), 2.29 (q, *J* = 7.3 Hz, 2H), 2.02 (s, 1H), 0.87 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 158.47, 147.21, 139.44, 128.18, 127.52, 126.77, 126.21, 113.55, 78.35, 55.36, 34.71, 8.35.

1-Phenyl-1-(4-(trifluoromethyl)phenyl)propan-1-ol (6ca)[8]



6ca

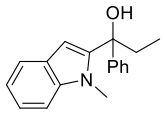
The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 8.5 mg of colorless oil in 30% yield.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.57-7.51 (m, 4H), 7.41 (d, *J* = 7.2 Hz, 2H), 7.33 (t, *J* = 7.8 Hz, 2H), 7.27-7.22 (m, 1H), 2.33 (qd, *J* = 7.2, 4.7 Hz, 2H), 2.11 (s, 1H), 0.89 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 150.92, 146.41, 129.06 (q, *J* = 32.5 Hz), 127.39, 126.58, 126.19, 125.18 (q, *J* = 3.9 Hz), 124.36 (q, *J* = 272.1 Hz), 78.42, 34.51, 8.12.

^{19}F NMR (565 MHz, $CDCl_3$) δ -62.46.

1-(1-Methyl-1H-indol-2-yl)-1-phenylpropan-1-ol (6da)



6da

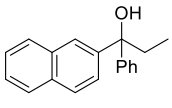
The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 12.0 mg of colorless oil in 45% yield.

^{1}H NMR (400 MHz, CDCl3) δ 7.63 (dd, *J* =12 Hz, 1H), 7.34-7.26 (m, 3H), 7.25 (s, 1H), 7.10 (ddd, *J* = 7.9, 6.1, 1.9 Hz, 1H), 6.69 (s, 1H), 3.38 (s, 3H), 2.35 (ddt, *J* = 19.0, 13.9, 7.0 Hz, 2H), 1.99 (s, 1H), 0.91 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 144.04, 143.83, 138.50, 128.10, 126.90, 126.78, 126.07, 121.96, 120.79, 119.58, 109.24, 100.57, 75.85, 36.48, 31.45, 7.93.

HRMS (ESI): $C_{18}H_{20}NO$ $[M+H]^+$, calculated: 266.1539, found: 266.1540.

1-(Naphthalen-2-yl)-1-phenylpropan-1-ol (6ea)[9]



6ea

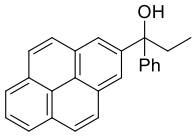
The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 10.8 mg of colorless oil in 41% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (s, 1H), 7.84 (d, *J* = 6.8 Hz, 1H), 7.78 (d, *J* = 8.4 Hz, 1H), 7.74 (d, *J* = 8.8 Hz, 1H), 7.50-7.38 (m, 5H), 7.31 (t, *J* = 7.2 Hz, 2H), 7.22 (t, *J* = 7.6 Hz, 1H), 2.43 (q, *J* = 7.2 Hz, 2H), 2.17 (s, 1H), 0.91 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.99, 144.37, 133.26, 132.52, 128.42, 128.32, 128.00, 127.62, 127.03, 126.42, 126.18, 126.01, 125.23, 124.45, 78.79, 34.47, 8.31.

HRMS (ESI): $C_{19}H_{18}ONa$ $[M+Na]^+$, calculated: 285.1250, found: 285.1252.

1-Phenyl-1-(pyren-2-yl)propan-1-ol (6fa)



6fa

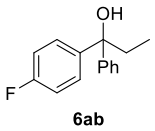
The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 3.9 mg of colorless oil in 12% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.44 (d, *J* = 8.4 Hz, 1H), 8.22 (dd, *J* = 18.0, 9.2 Hz, 2H), 8.12 (d, *J* = 7.2 Hz, 1H), 8.08-8.01 (m, 3H), 7.93 (t, *J* = 7.6 Hz, 1H), 7.80 (d, *J* = 9.6 Hz, 1H), 7.39 (d, *J* = 7.2 Hz,, 2H), 7.29-7.22 (m, 2H), 7.20 (t, *J* = 7.2Hz, 1H), 2.70 (dq, *J* = 14.4, 7.2 Hz, 1H), 2.59 (dq, *J* = 14.4, 7.2 Hz, 1H), 2.40 (s, 1H), 0.91 (t, *J* = 7.6 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.99, 139.56, 131.41, 131.24, 130.44, 128.86, 127.62, 127.48, 126.90, 126.64, 126.30, 126.24, 126.13, 126.02, 125.19, 124.94, 124.85, 124.13, 79.59, 35.92, 8.64.

HRMS (ESI): $C_{25}H_{20}ONa$ $[M+Na]^+$, calculated: 359.1406, found: 359.1408.

1-(4-Fluorophenyl)-1-phenylpropan-1-ol (6ab)[8]



6ab

The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 9.6 mg of colorless oil in 42% yield.

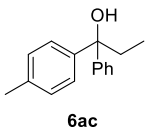
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41-7.36 (m, 4H), 7.31 (t, *J* = 7.8 Hz, 2H), 7.23 (t, *J* = 7.3 Hz, 1H), 6.98 (t, *J* = 8.4 Hz, 2H), 2.30 (m, 2H), 2.05 (s, 1H), 0.87 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 146.89, 128.00(d, *J* = 12.1 Hz), 127.88, 127.80, 126.91, 126.03, 115.06, 114.89, 114.68, 78.14, 34.57, 8.09.

^{13}C NMR (151 MHz, $CDCl_3$) δ 161.78 (d, *J* = 245.5 Hz), 146.89, 142.88 (d, *J* = 3.1 Hz), 128.35, 128.00 (d, *J* = 7.9 Hz), 127.07, 126.19, 114.95 (d, *J* = 21.1 Hz), 78.30, 34.74, 8.24.

^{19}F NMR (565 MHz, $CDCl_3$) δ -116.47.

1-Phenyl-1-(p-tolyl)propan-1-ol (6ac)[8]



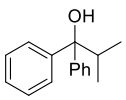
6ac

The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 7.0 mg of colorless oil in 31% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45-7.36 (d, *J* = 7.2 Hz, 2H), 7.32-7.26 (m, 2H), 7.20 (t, *J* = 7.1 Hz, 1H), 7.11 (d, *J* = 8.0 Hz, 2H), 2.34-2.26 (m, 5H), 0.87 (t, *J* = 7.3 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.21, 144.23, 136.50, 128.96, 128.20, 126.79, 126.21, 126.19, 78.51, 34.62, 21.11, 8.33.

2-Methyl-1,1-diphenylpropan-1-ol (6ad)[6]



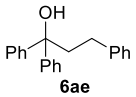
6ad

The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 4.6 mg of colorless oil in 20% yield.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.50 (d, *J* = 7.2 Hz, 4H), 7.28 (t, *J* = 7.8 Hz, 4H), 7.17 (t, *J* = 7.2 Hz, 2H), 2.89 (p, *J* = 6.7 Hz, 1H), 2.04 (s, 1H), 0.89 (d, *J* = 7.2 Hz, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.85, 128.23, 126.49, 125.84, 80.60, 35.20, 17.33.

1,1,3-Triphenylpropan-1-ol (6ae)[10]



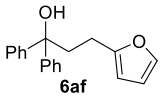
6ae

The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 15.5 mg of colorless oil in 54% yield.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.45 (d, *J* = 7.8 Hz, 4H), 7.33 (t, *J* = 7.2 Hz, 4H), 7.26 (m, 4H), 7.17 (m，3H), 2.61 (s, 4H), 2.15 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.93, 142.47, 128.57, 128.53, 128.39, 127.08, 126.14, 125.97, 78.37, 44.14, 30.42.

3-(Furan-2-yl)-1,1-diphenylpropan-1-ol (6af)



6af

The title compound was prepared according to the general procedure as described, silica gel flash column chromatography was performed using hexanes and ethyl acetate (100:1) resulting in 10.9 mg of colorless oil in 39% yield.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.44 (d, *J* = 7.2 Hz, 4H), 7.32 (t, *J* = 7.8 Hz, 4H), 7.29 (s, 1H), 7.24 (t, *J* = 7.2 Hz, 2H), 6.26 (d, *J* = 1.4 Hz, 1H), 5.96 (d, *J* = 3.1 Hz, 2H), 2.64 (s, 4H), 2.15 (s, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 156.06, 146.69, 141.06, 128.41, 127.15, 126.15, 110.28, 104.86, 78.08, 22.97.

HRMS (ESI): $C_{19}H_{18}O_2Na$ $[M+Na]^+$, calculated: 301.1199, found: 301.1200.

VI. References

1. (a) A.-M. Carroll, M. McCarthy, P. M. Lacey, C. P. Saunders, D. J. Connolly, A. Farrell, B. V. Rokade, R. Goddard, P. Fristrup, P.-O. Norrby and P. J. Guiry, Synthetic and Mechanistic Studies in Enantioselective Allylic Substitutions Catalysed by Palladium Complexes of a Modular Class of Axially Chiral Quinazoline-Containing Ligands, *Tetrahedron*, 2020, **76**, 130780; (b) J. Rodriguez, D. Vesseur, A. Tabey, S. Mallet-Ladeira, K. Miqueu and D. Bourissou, Au(I)/Au(III) Catalytic Allylation Involving π-Allyl Au(III) Complexes, *ACS Catal.*, 2022, **12**, 993-1003.

2. W. Yang, C. Chen and K. S. Chan, Hydrodebromination of Allylic and Benzylic Bromides with Water Catalyzed by a Rhodium Porphyrin Complex, *Dalton Trans.*, 2018, **47**, 12879-12883

3. (a) H. Li, R.-Y. Zhu, W.-J. Shi, K.-H. He and Z.-J. Shi, Synthesis of Fluorenone Derivatives through Pd-Catalyzed Dehydrogenative Cyclization, *Org. Lett.*, 2012, **14**, 4850-4853; (b) G. An, L. Wang and J. Han, Palladium Catalyzed Regioselective Cyclization of Arylcarboxylic Acids via Radical Intermediates with Diaryliodonium Salts, *Org. Lett.*, 2021, **23**, 8688-8693.

4. T. Nishimura, T. Katoh and T. Hayashi, Rhodium-Catalyzed Aryl Transfer from Trisubstituted Aryl Methanols to α,β-Unsaturated Carbonyl Compounds, *Angew. Chem. Int. Ed.*, 2007, **46**, 4937-4939.

5. Z.-Q. Liu, C. Liang, Z. Luo, Y.-F. Wu, C.-M. Hong, Q.-H. Li and T.-L. Liu, Transfer Vinylation and Dienylation via Rhodium(I)-Catalyzed Deketonation of Allylic Alcohols, *ACS Catal.*, 2022, **12**, 7030-7036.

6. M. Hatano, S. Suzuki and K. Ishihara, Highly Efficient Alkylation to Ketones and Aldimines with Grignard Reagents Catalyzed by Zinc(II) Chloride, *J. Am. Chem. Soc.*, 2006, **128**, 9998-9999.

7. T. Pieterse, M. Visser, C. Marais and B. C. B. Bezuidenhoudt, $Al(OTf)_3$: An Efficient Lewis Acid Additive for Domino Addition–Elimination of Grignard Reagents to Activated Ketones, *Synlett*, 2016, **27**, 1541-1546.

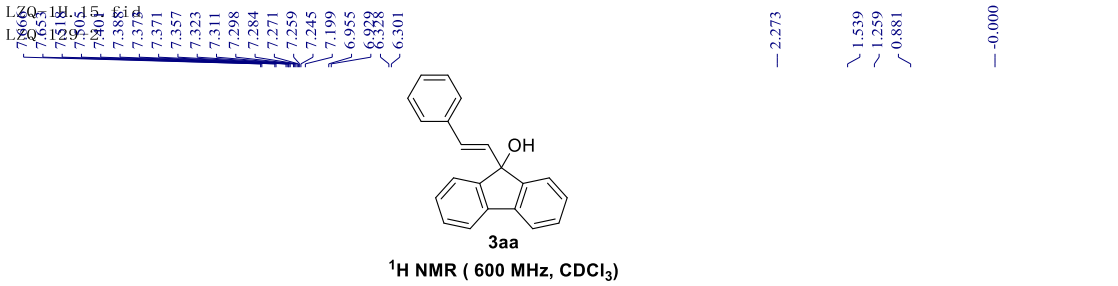
8. Y.-X. Liao, C.-H. Xing and Q.-S. Hu, Rhodium(I)/Diene-Catalyzed Addition Reactions of Arylborons with Ketones, *Org. Lett.*, 2012, **14**, 1544-1547.

9. K. Osakama and M. Nakajima, Asymmetric Direct 1,2-Addition of Aryl Grignard Reagents to Aryl Alkyl Ketones, *Org. Lett.*, 2016, **18**, 236-239.

10. M. N. Abualhasan, J. A. D. Good, K. Wittayanarakul, N. G. Anthony, G. Berretta, O. Rath, F. Kozielski, O. B. Sutcliffe and S. P. Mackay, Doing the Methylene Shuffle – Further Insights into the

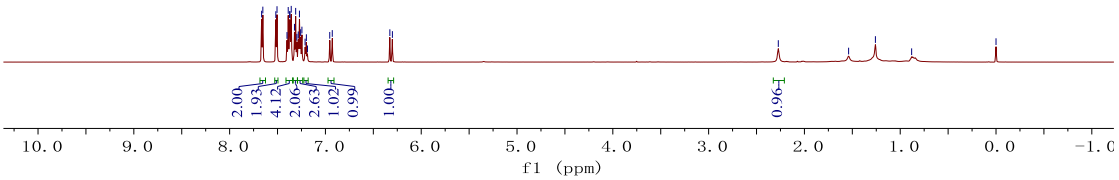
Inhibition of Mitotic Kinesin Eg5 with S-trityl l-cysteine, *Eur. J. Med. Chem.*, 2012, **54**, 483-498.

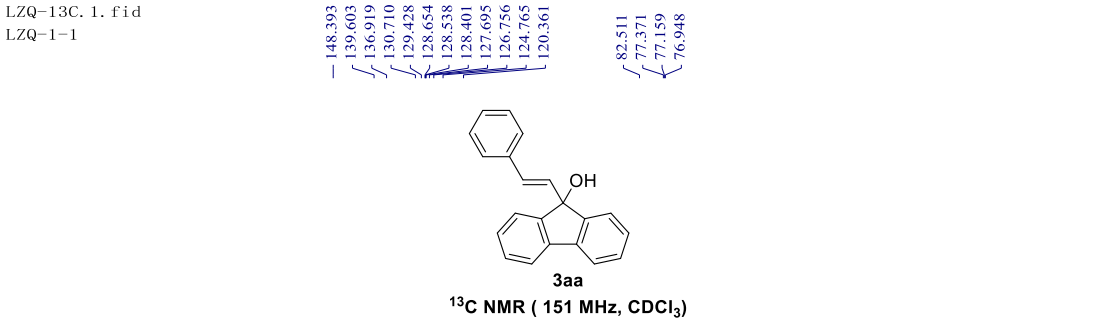
VII. NMR spectra of the products



3aa

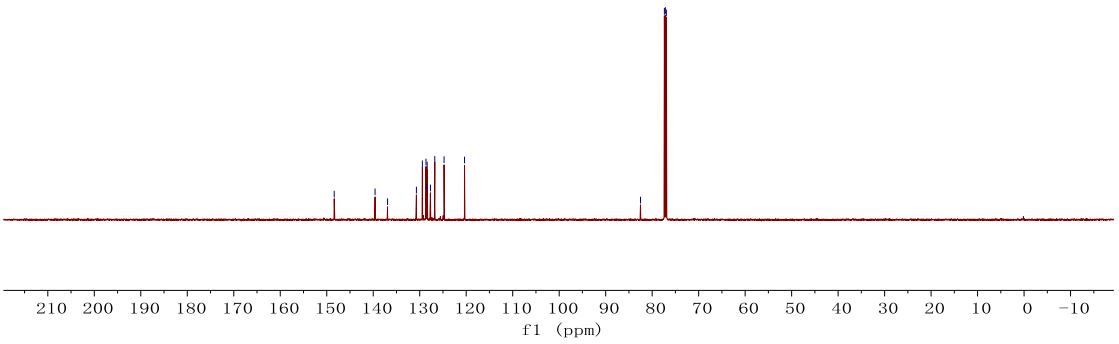
^{1}H NMR (600 MHz, $CDCl_3$)

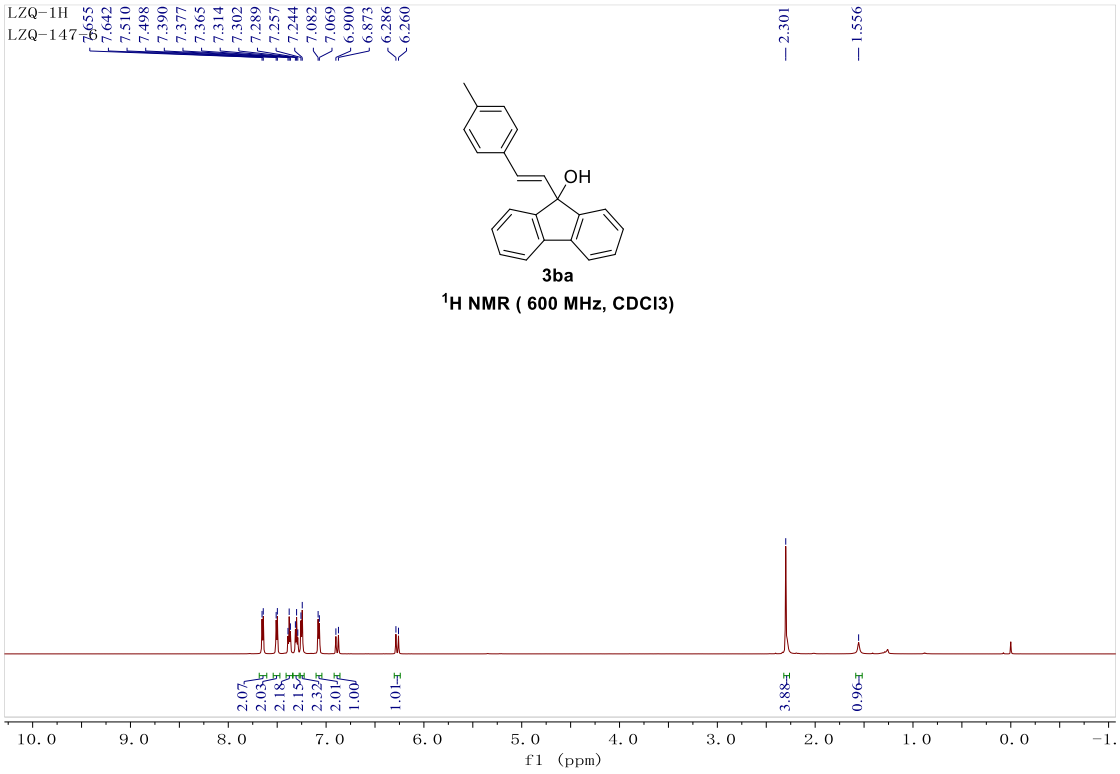




3aa

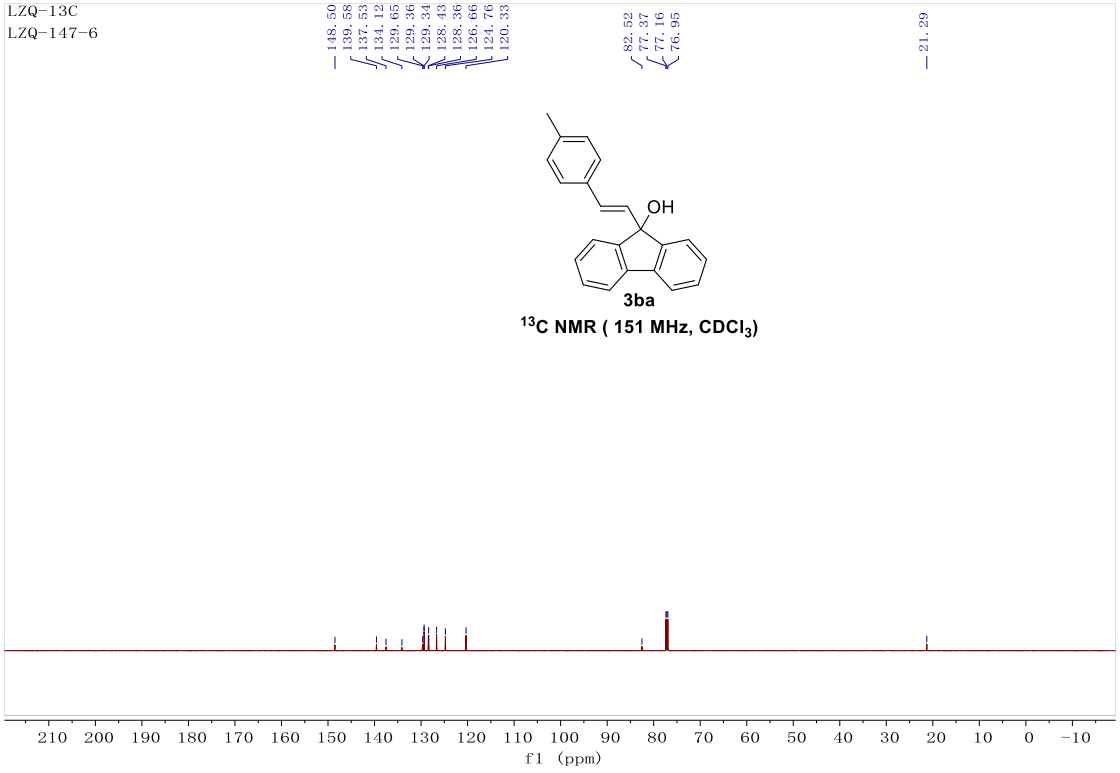
^{13}C NMR (151 MHz, $CDCl_3$)





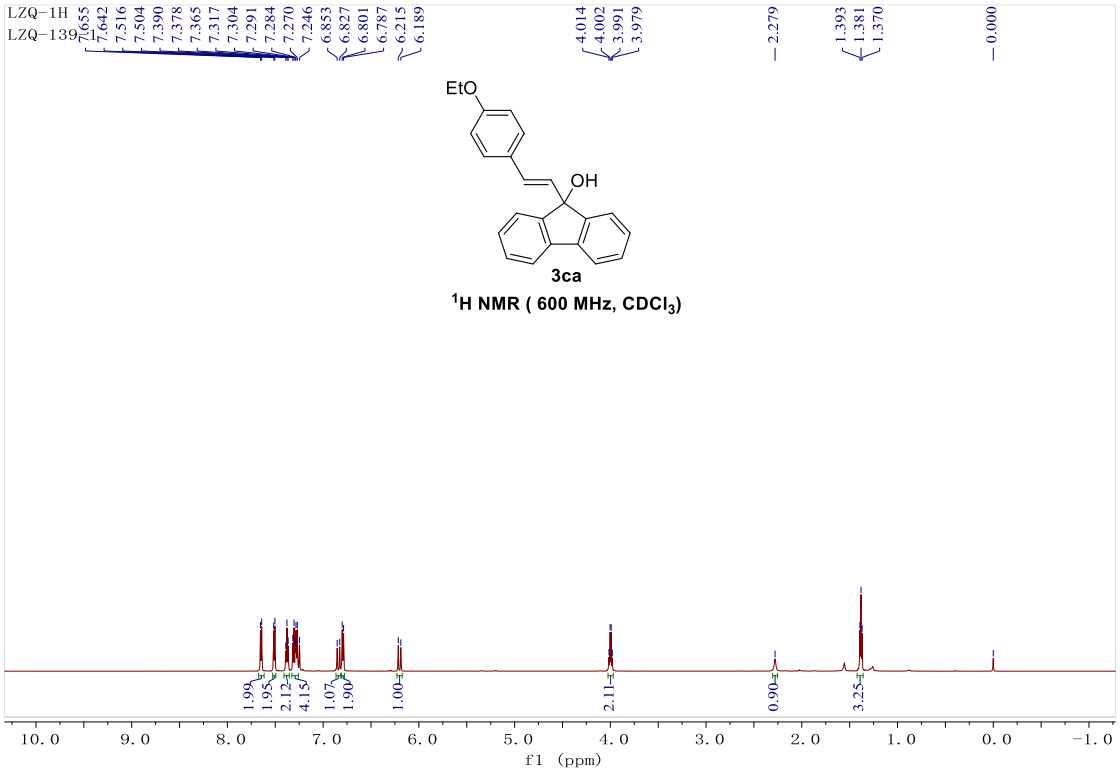
3ba

^{1}H NMR (600 MHz, CDCl3)



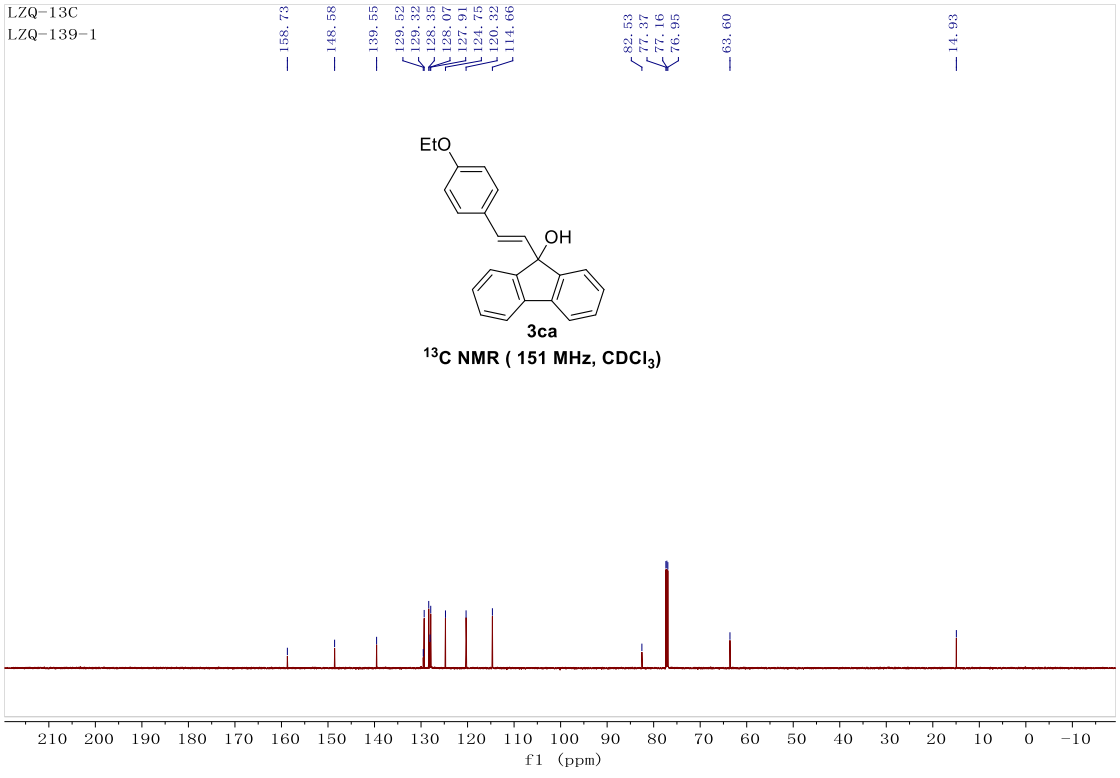
3ba

^{13}C NMR (151 MHz, $CDCl_3$)



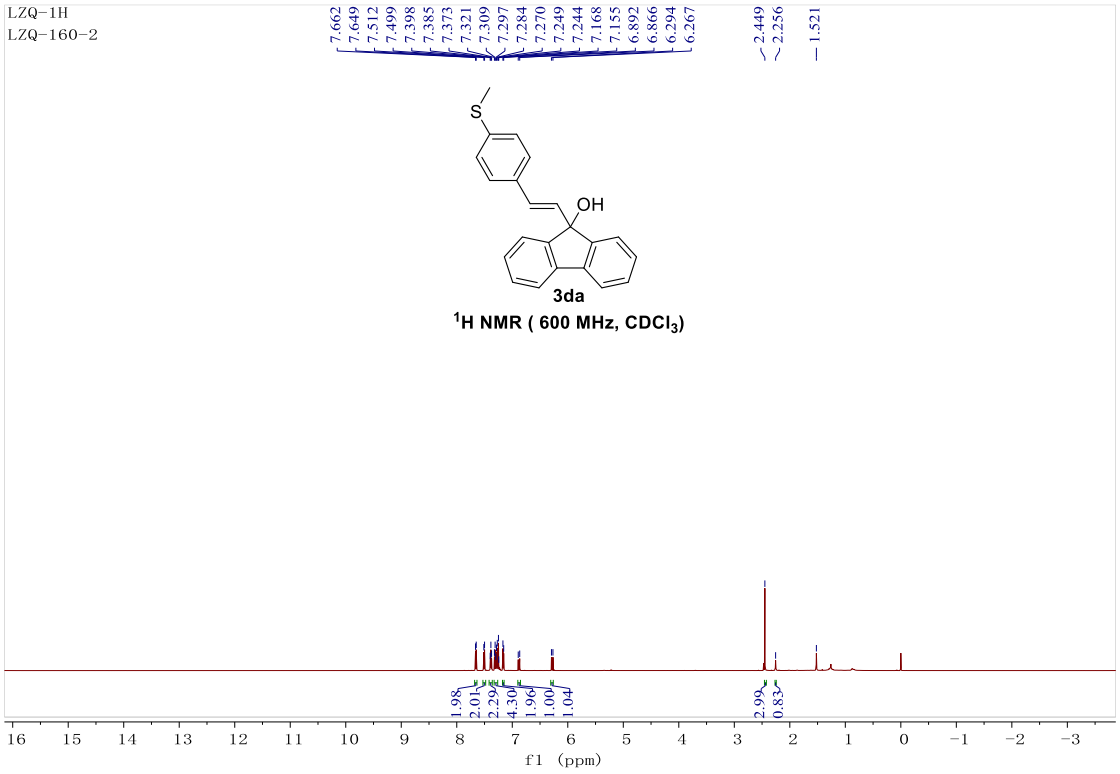
3ca

^{1}H NMR (600 MHz, $CDCl_3$)



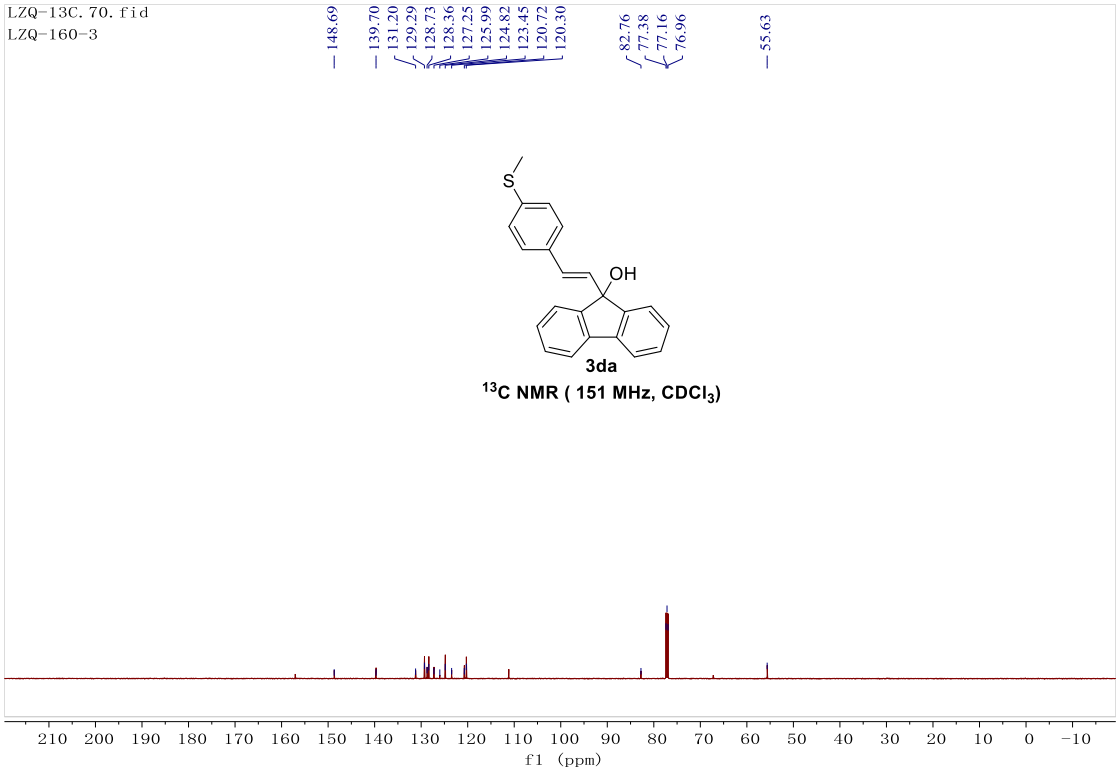
3ca

^{13}C NMR (151 MHz, $CDCl_3$)



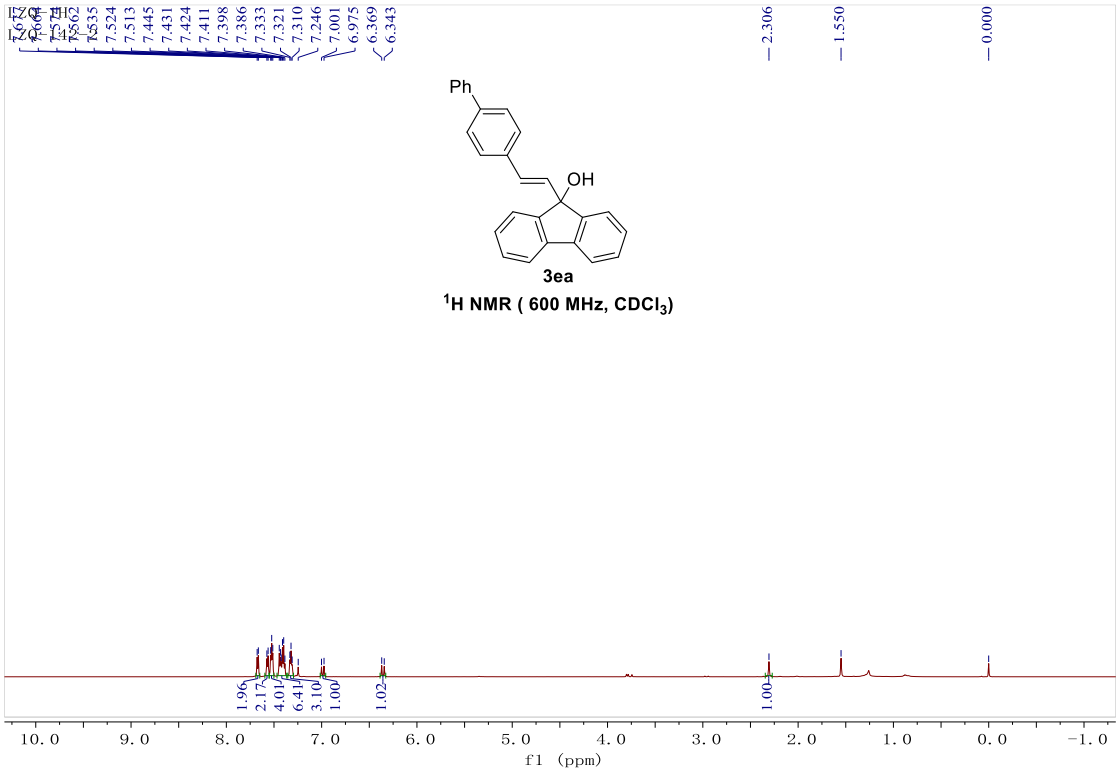
3da

^{1}H NMR (600 MHz, $CDCl_3$)



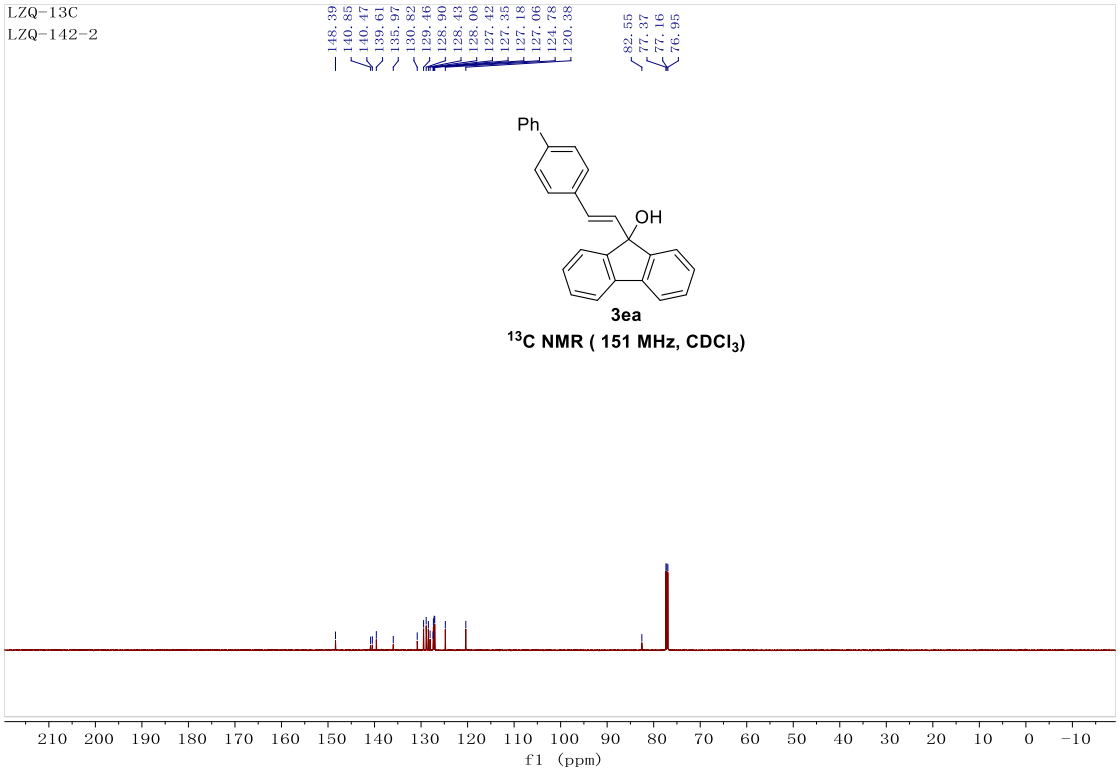
3da

^{13}C NMR (151 MHz, $CDCl_3$)



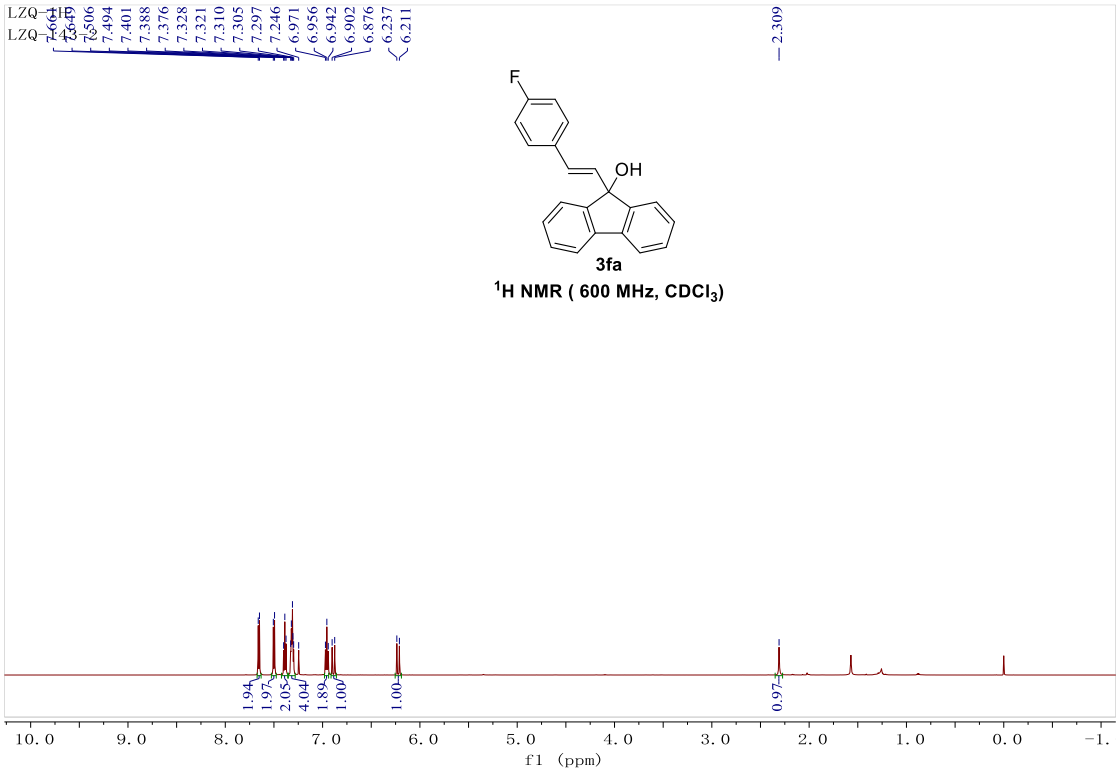
3ea

^{1}H NMR (600 MHz, $CDCl_3$)



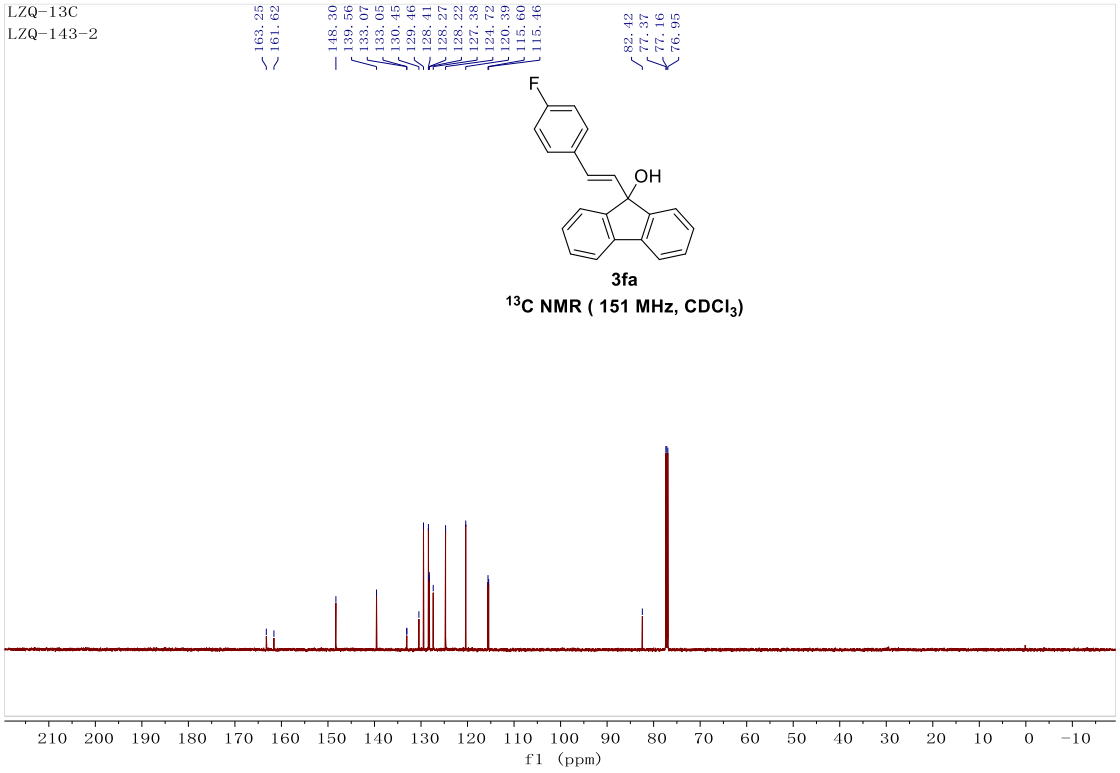
3ea

^{13}C NMR (151 MHz, $CDCl_3$)



3fa

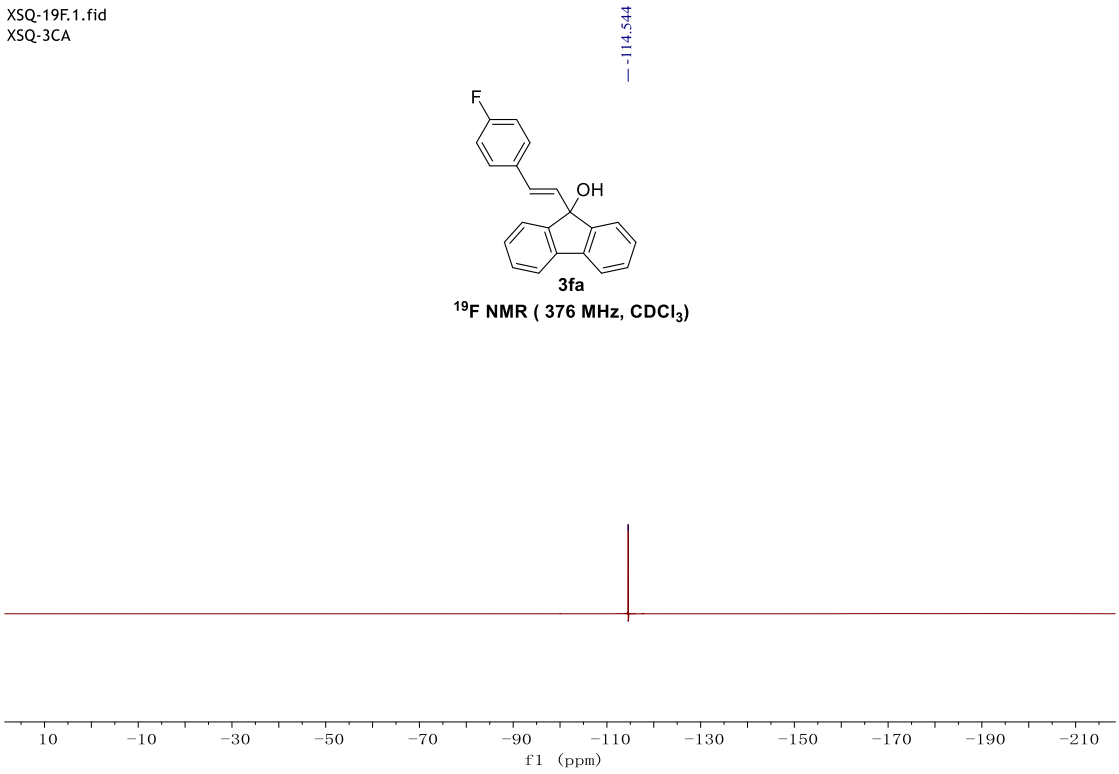
^{1}H NMR (600 MHz, $CDCl_3$)



3fa

^{13}C NMR (151 MHz, $CDCl_3$)

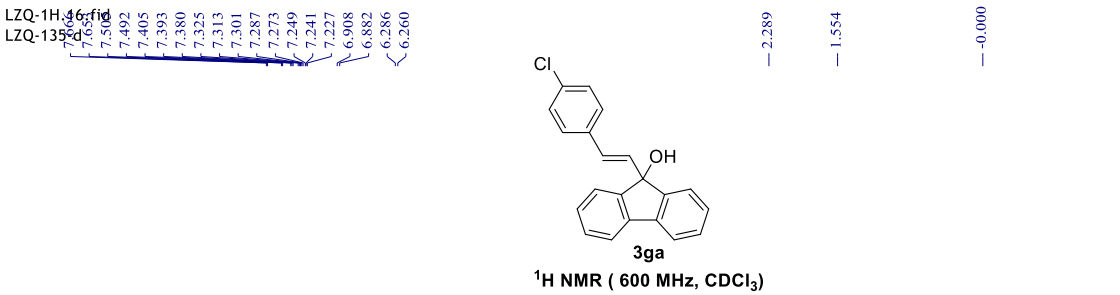
XSQ-19F.1.fid
XSQ-3CA



3fa

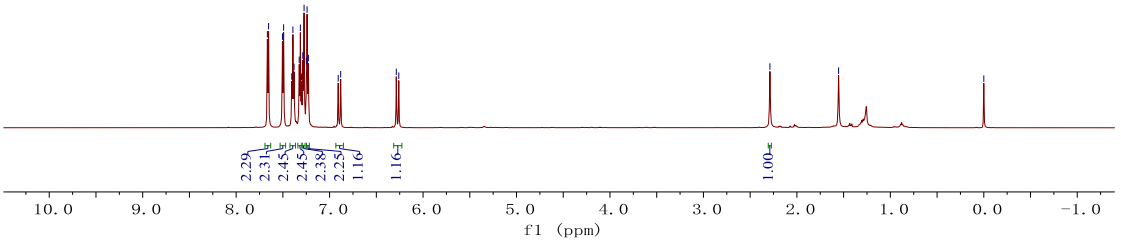
^{19}F NMR (376 MHz, $CDCl_3$)

LZQ-1H.16.fid
LZQ-135-d

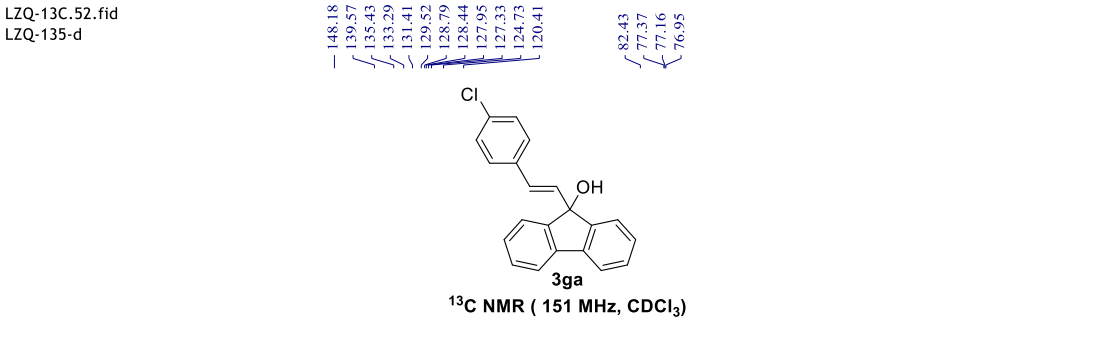


3ga

^{1}H NMR (600 MHz, $CDCl_3$)

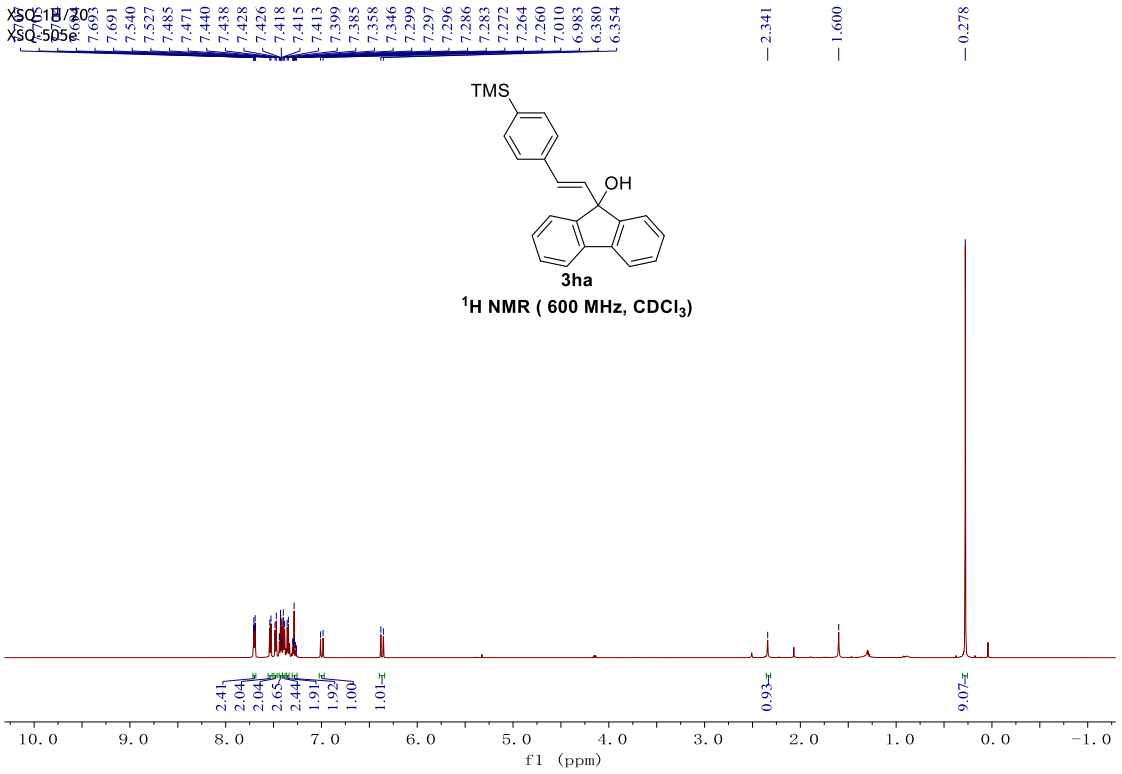


LZQ-13C.52.fid
LZQ-135-d



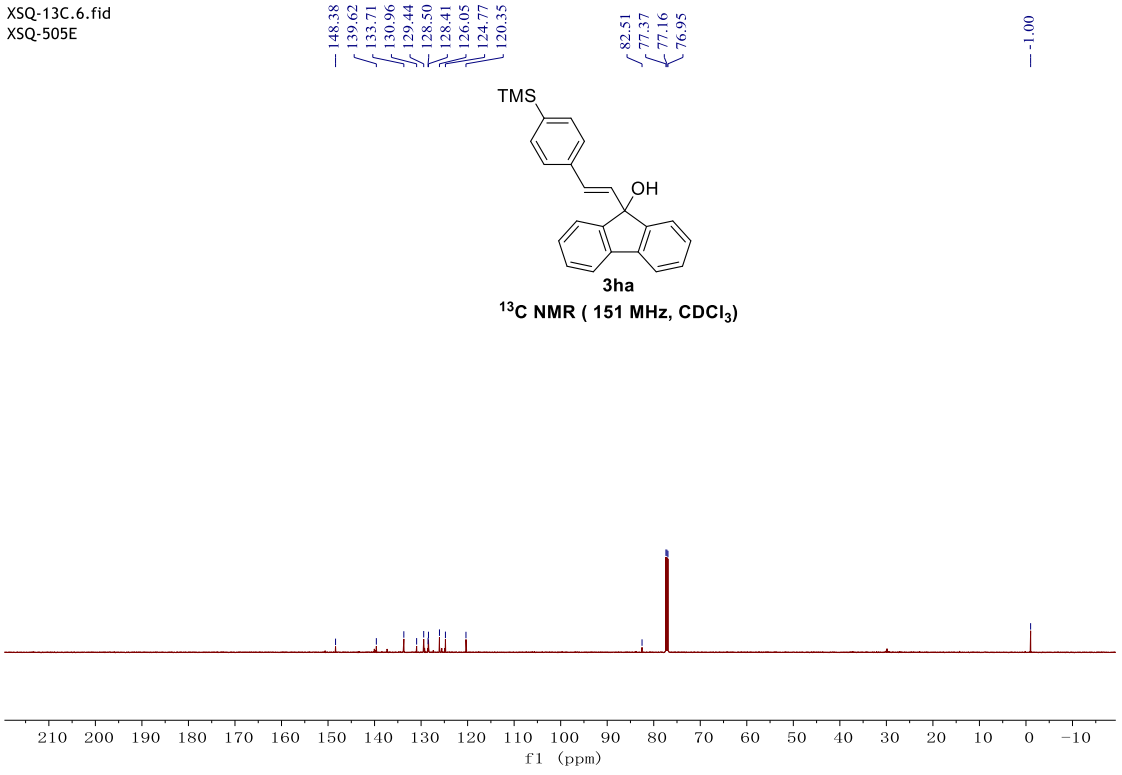
3ga

^{13}C NMR (151 MHz, $CDCl_3$)



3ha

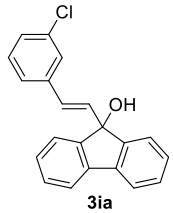
^{1}H NMR (600 MHz, $CDCl_3$)



3ha

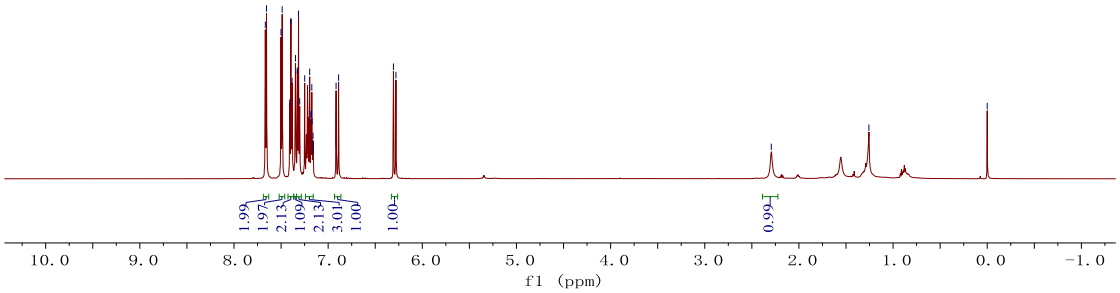
^{13}C NMR (151 MHz, $CDCl_3$)

XSQ-1H.5.fid
XSQ-31A

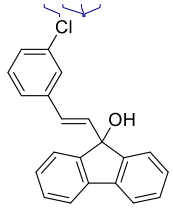


3ia

^{1}H NMR (600 MHz, $CDCl_3$)

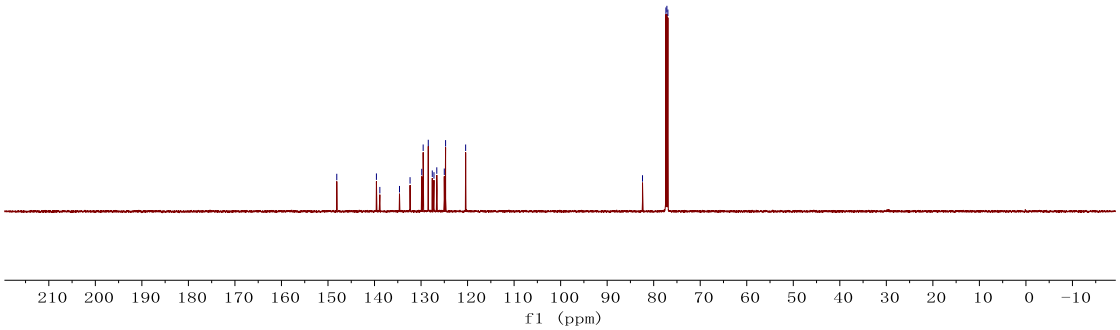


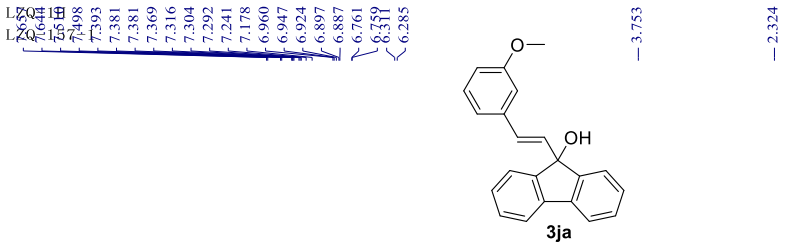
XSQ-13C.3.fid
XSQ-31A



3ia

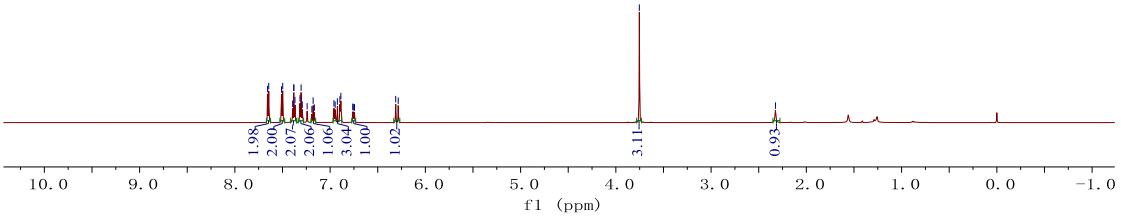
^{13}C NMR (151 MHz, $CDCl_3$)

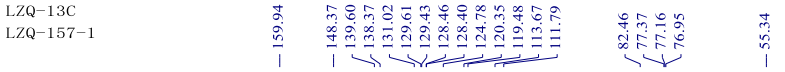


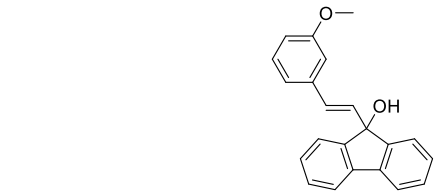


3ja

^{1}H NMR (600 MHz, $CDCl_3$)

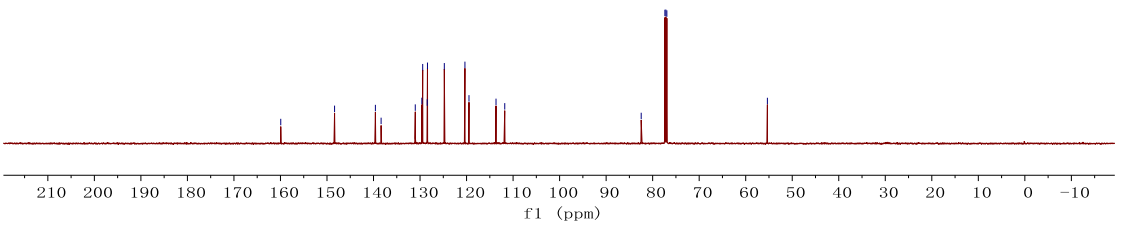


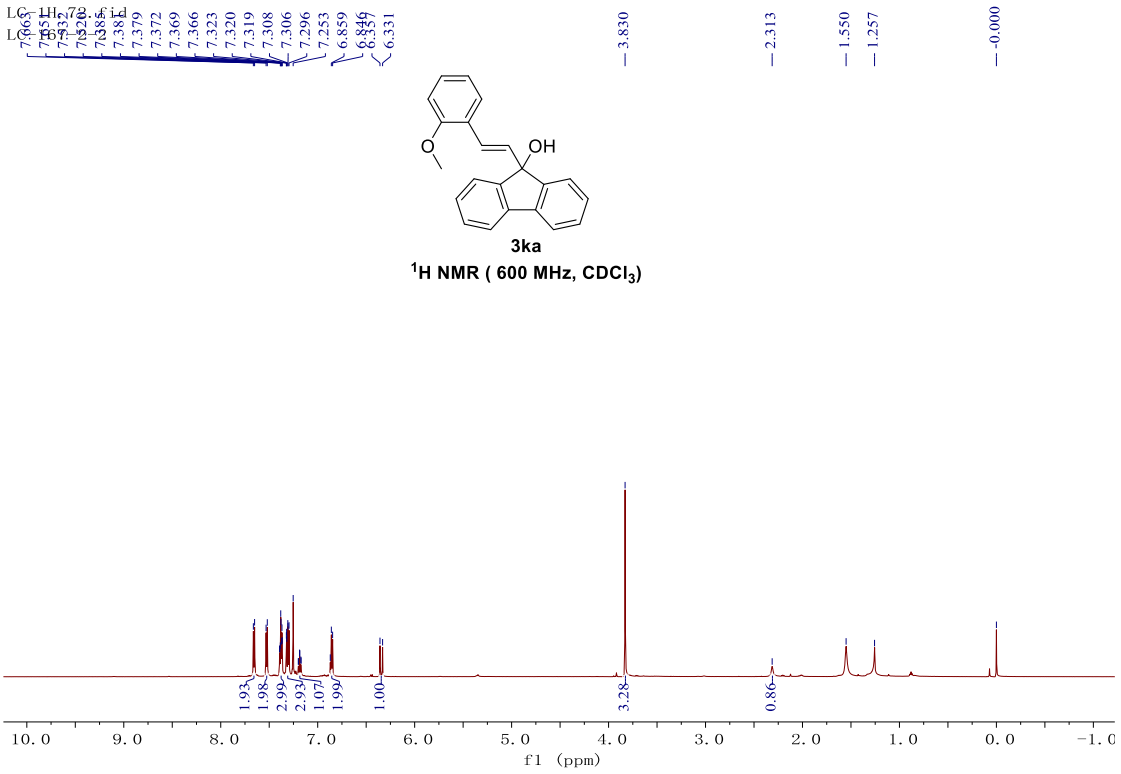




3ja

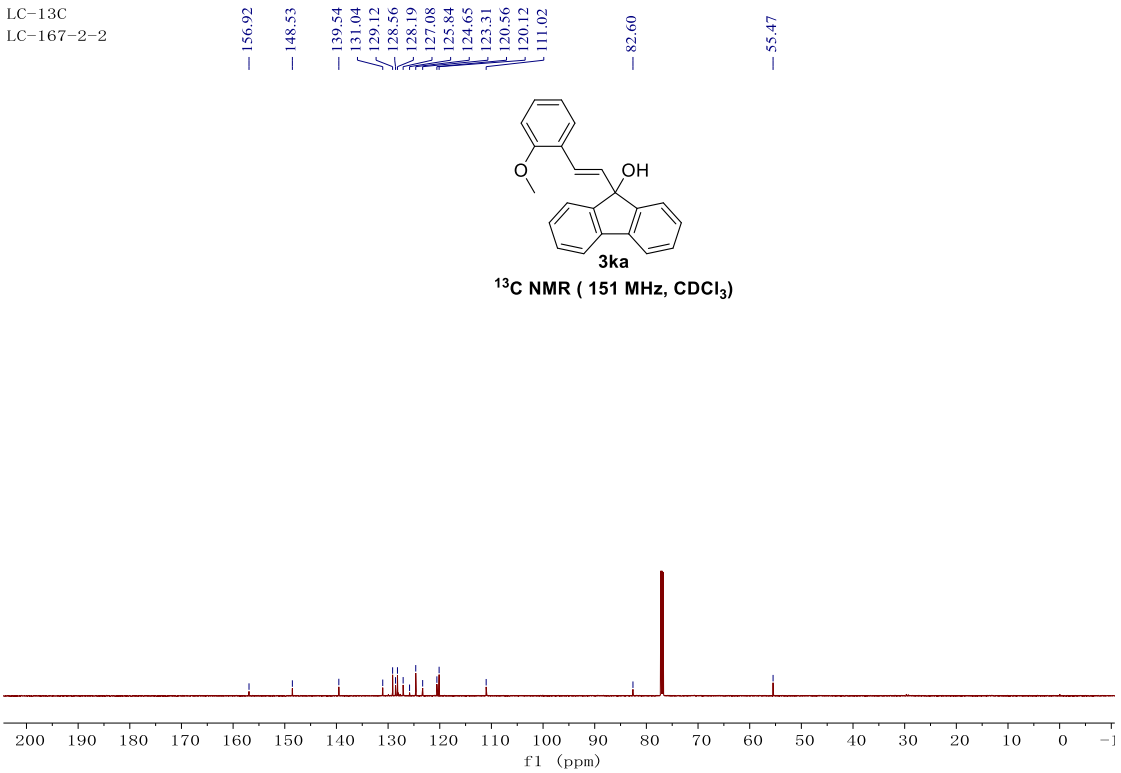
^{13}C NMR (151 MHz, $CDCl_3$)





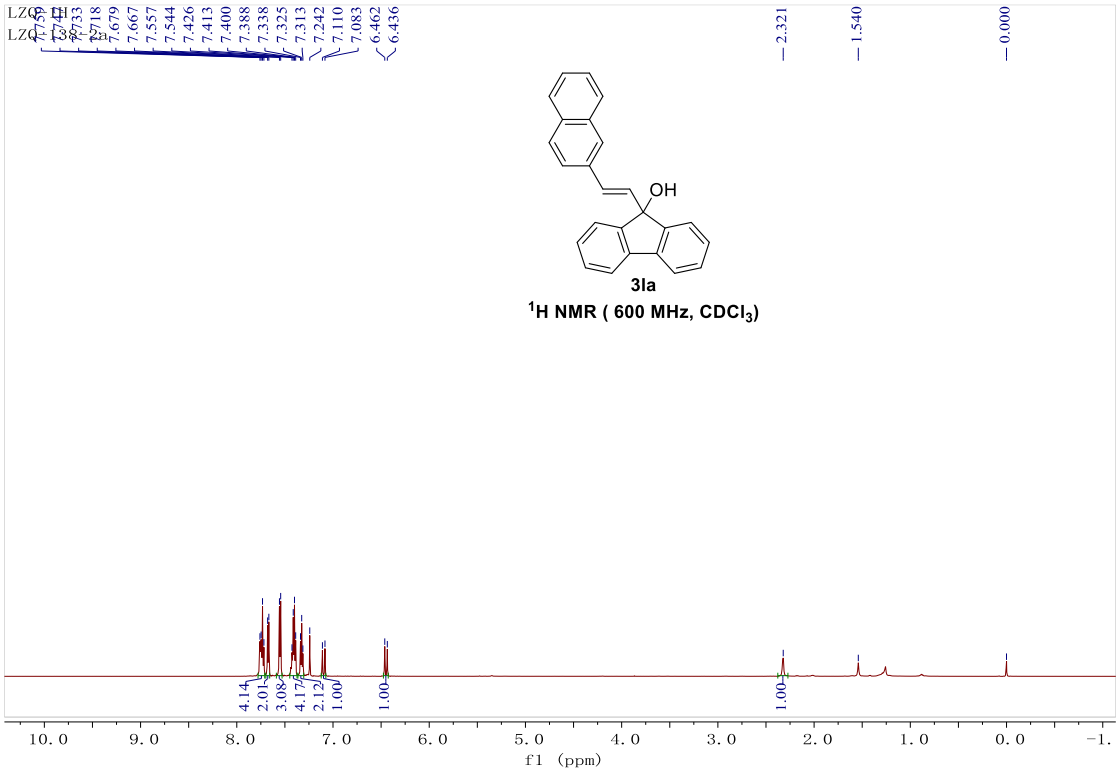
3ka

^{1}H NMR (600 MHz, $CDCl_3$)



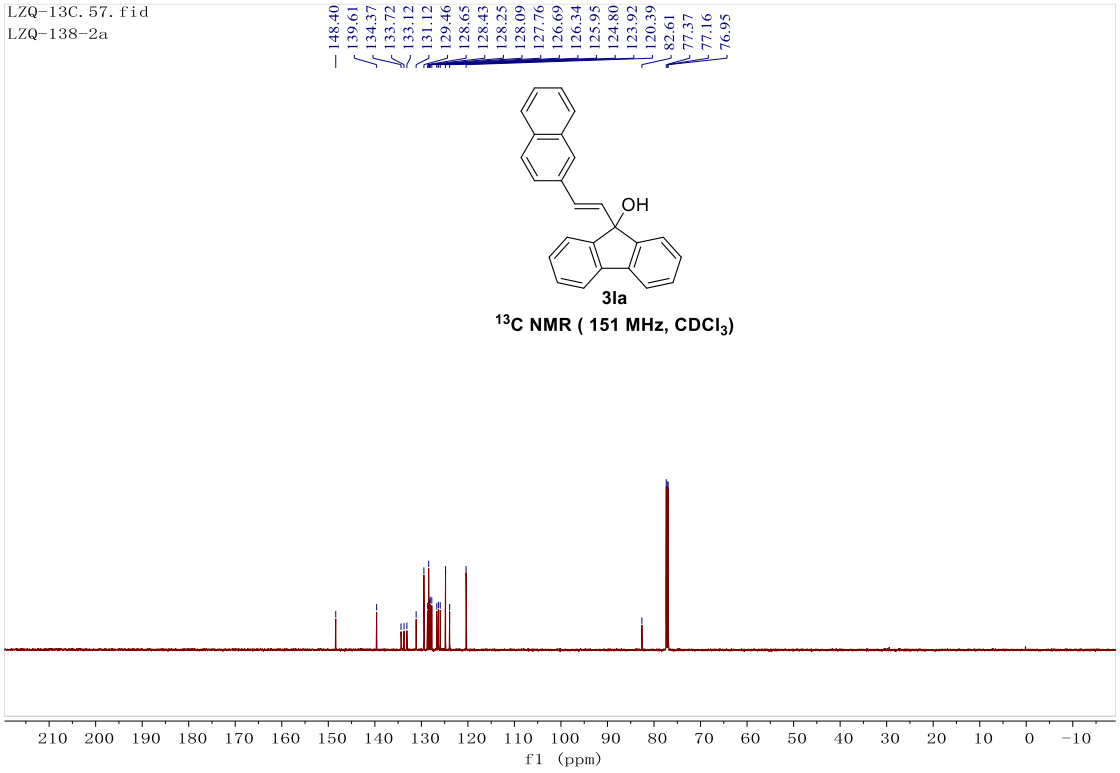
3ka

^{13}C NMR (151 MHz, $CDCl_3$)



3la

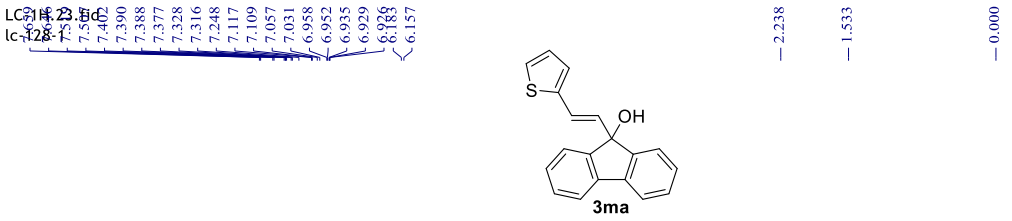
^{1}H NMR (600 MHz, $CDCl_3$)



3la

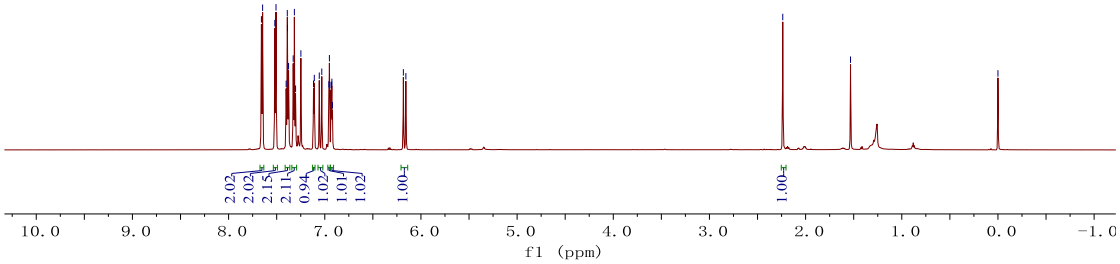
^{13}C NMR (151 MHz, $CDCl_3$)

LC-1H-23.fid
lc-128-1

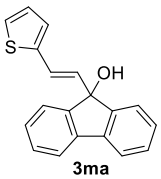


3ma

^{1}H NMR (600 MHz, $CDCl_3$)

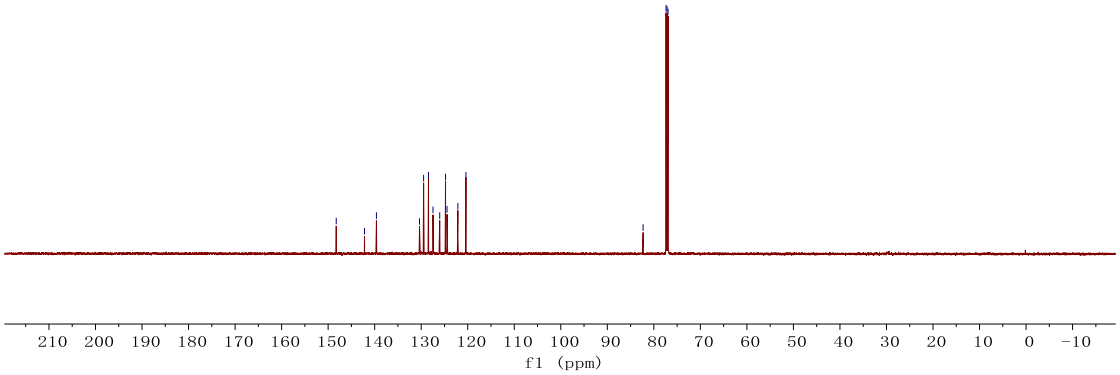


LZ-13C.25.fid
LZ-128-1

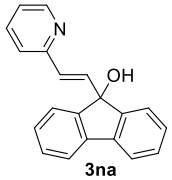


3ma

^{13}C NMR (151 MHz, $CDCl_3$)

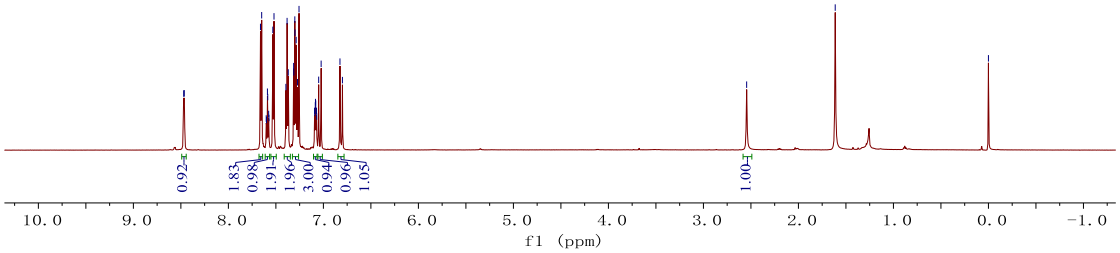


LZQ-1H.35.fid
LZQ-161-4

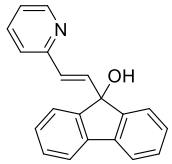


3na

^{1}H NMR (600 MHz, $CDCl_3$)

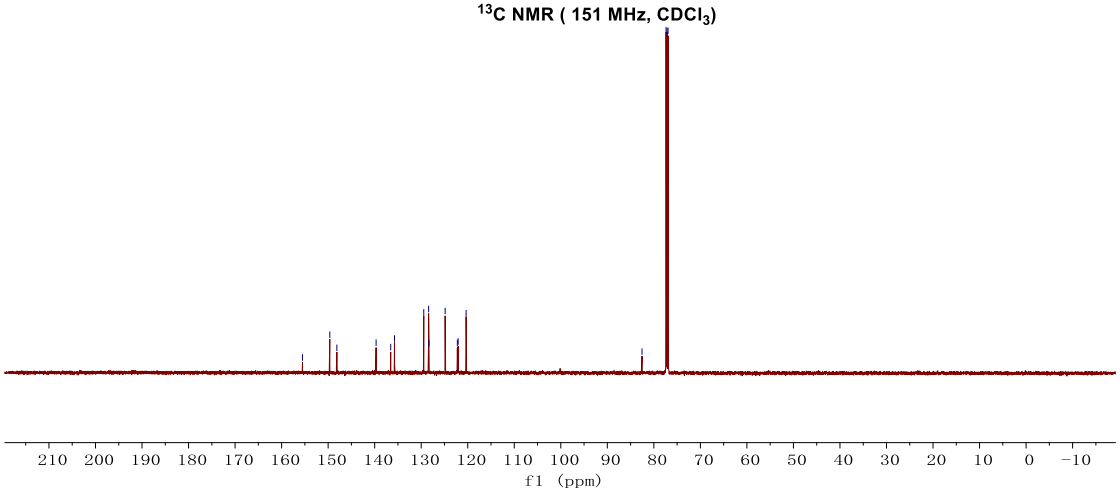


LZQ-13C.69.fid
LZQ-160-4

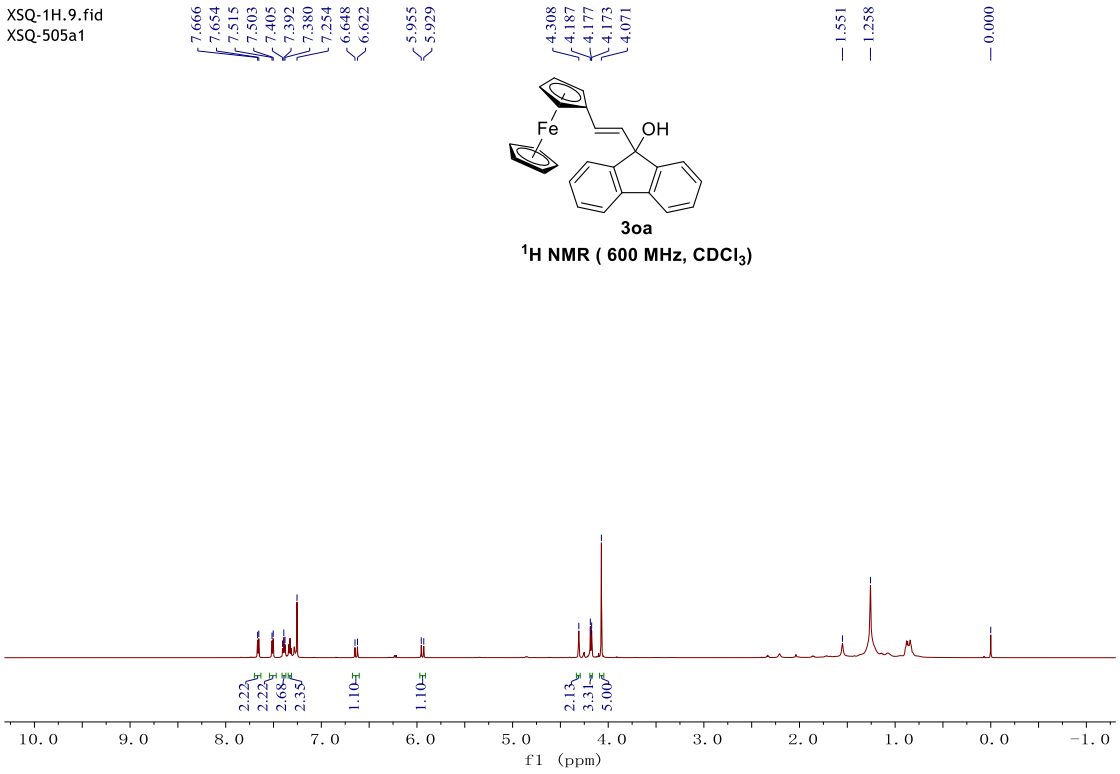


3na

^{13}C NMR (151 MHz, $CDCl_3$)



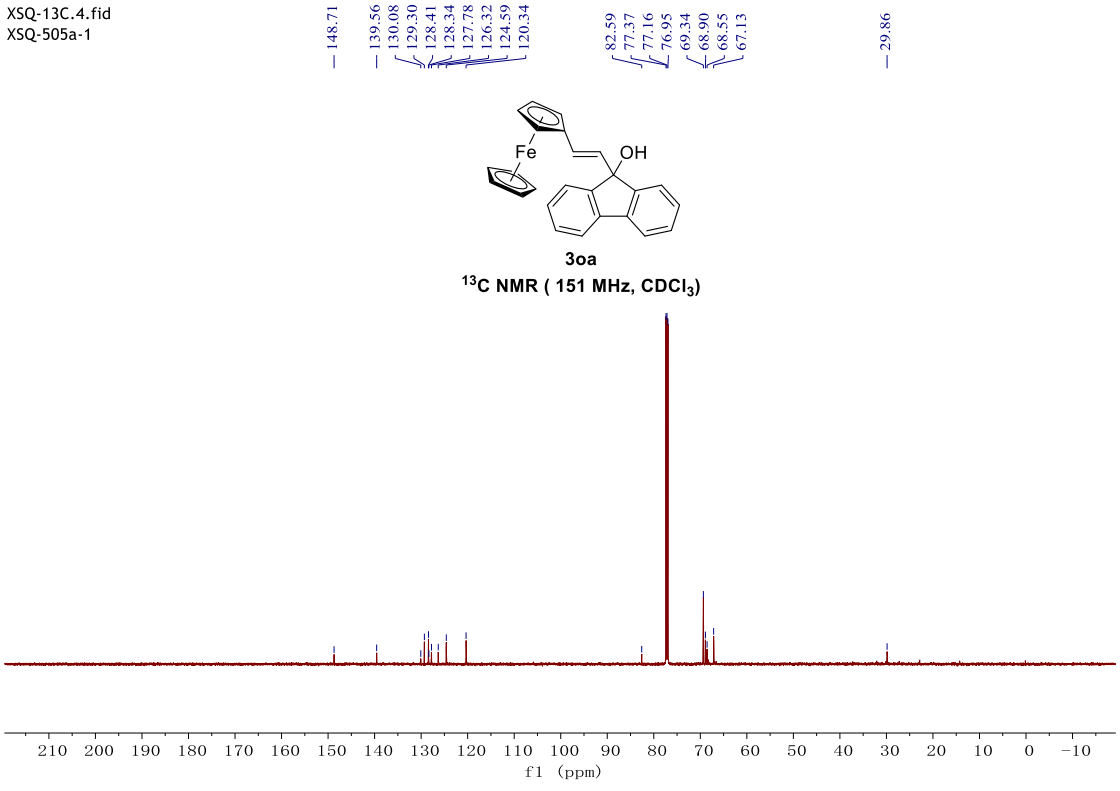
XSQ-1H.9.fid
XSQ-505a1



3oa

^{1}H NMR (600 MHz, $CDCl_3$)

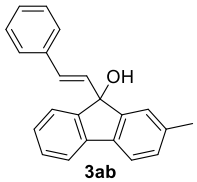
XSQ-13C.4.fid
XSQ-505a-1



3oa

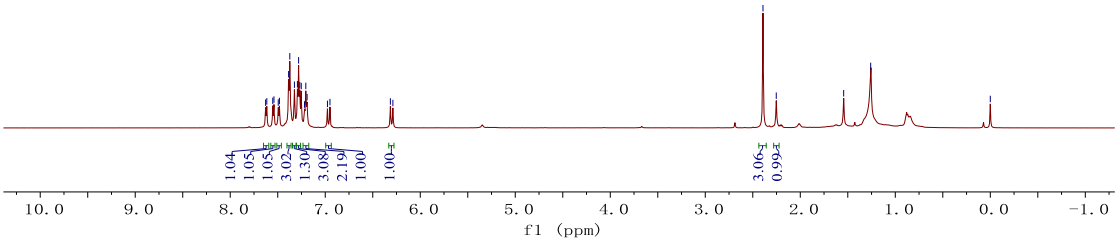
^{13}C NMR (151 MHz, $CDCl_3$)

XSQ-1H-54.fid
XSQ-522A-2

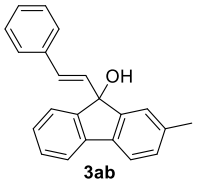


3ab

^{1}H NMR (600 MHz, $CDCl_3$)

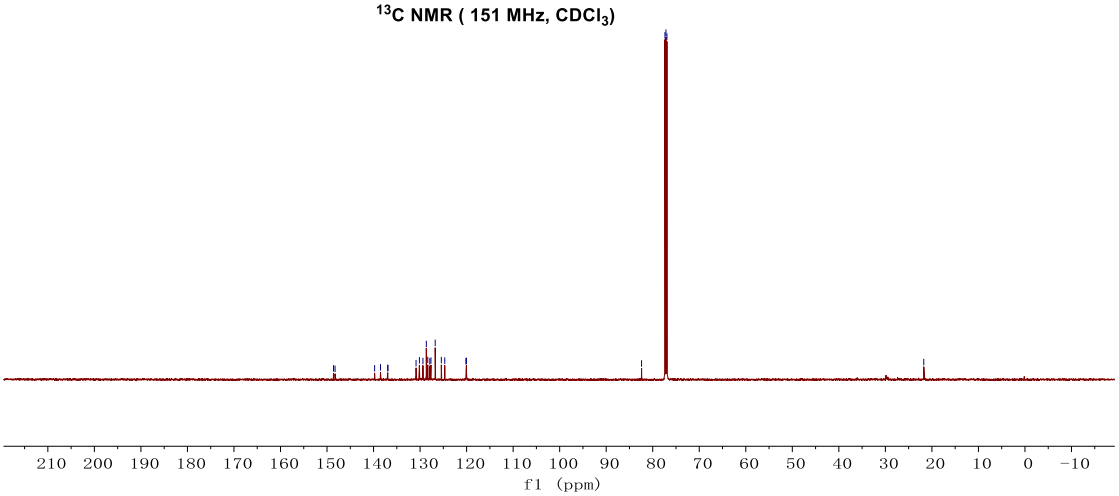


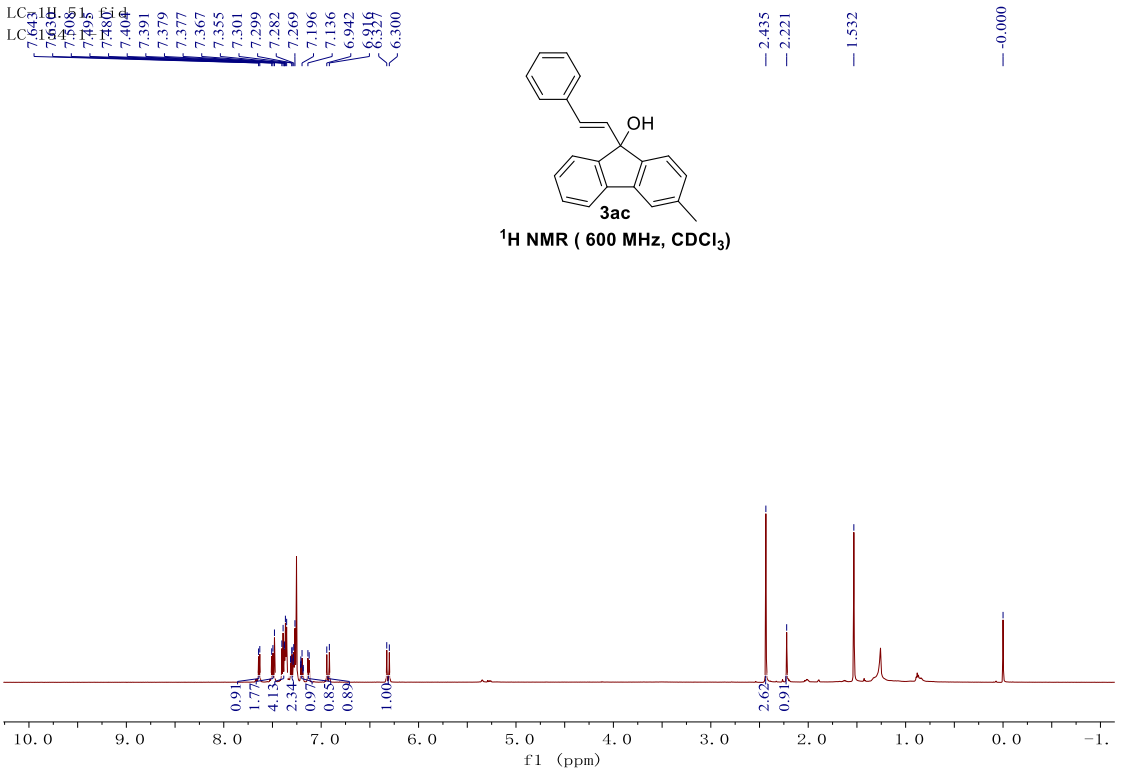
XSQ-13C.11.fid
XSQ-522A-2



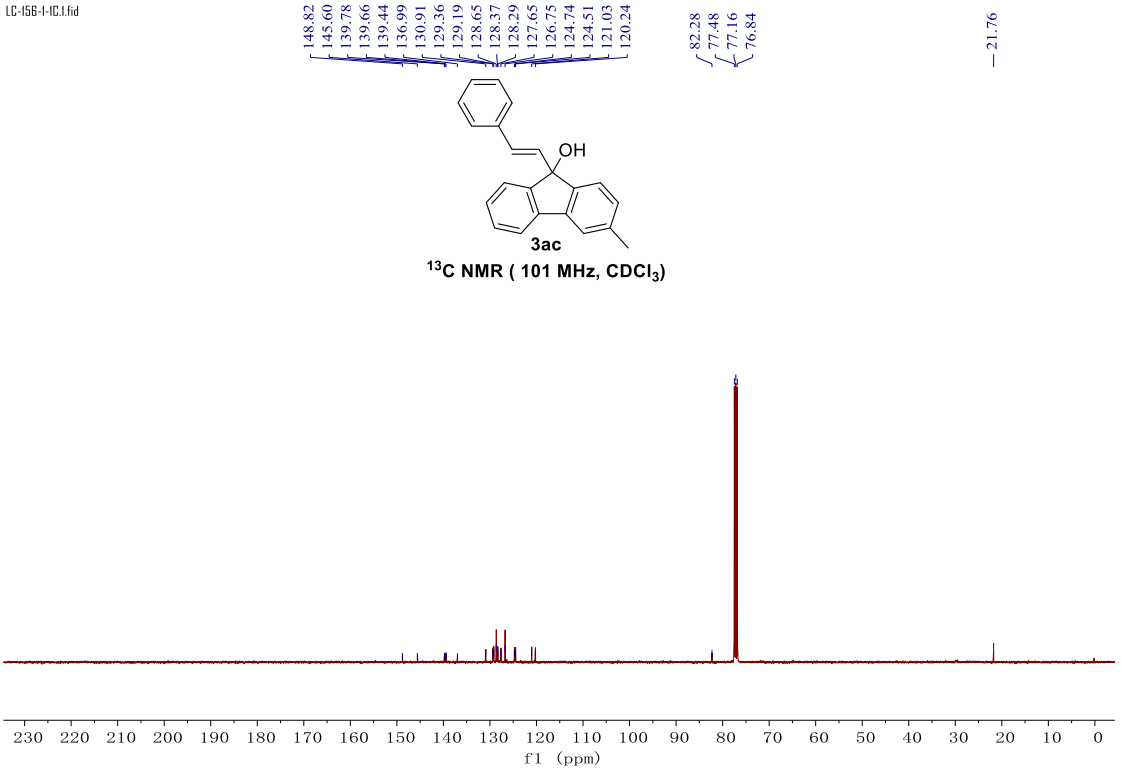
3ab

^{13}C NMR (151 MHz, $CDCl_3$)

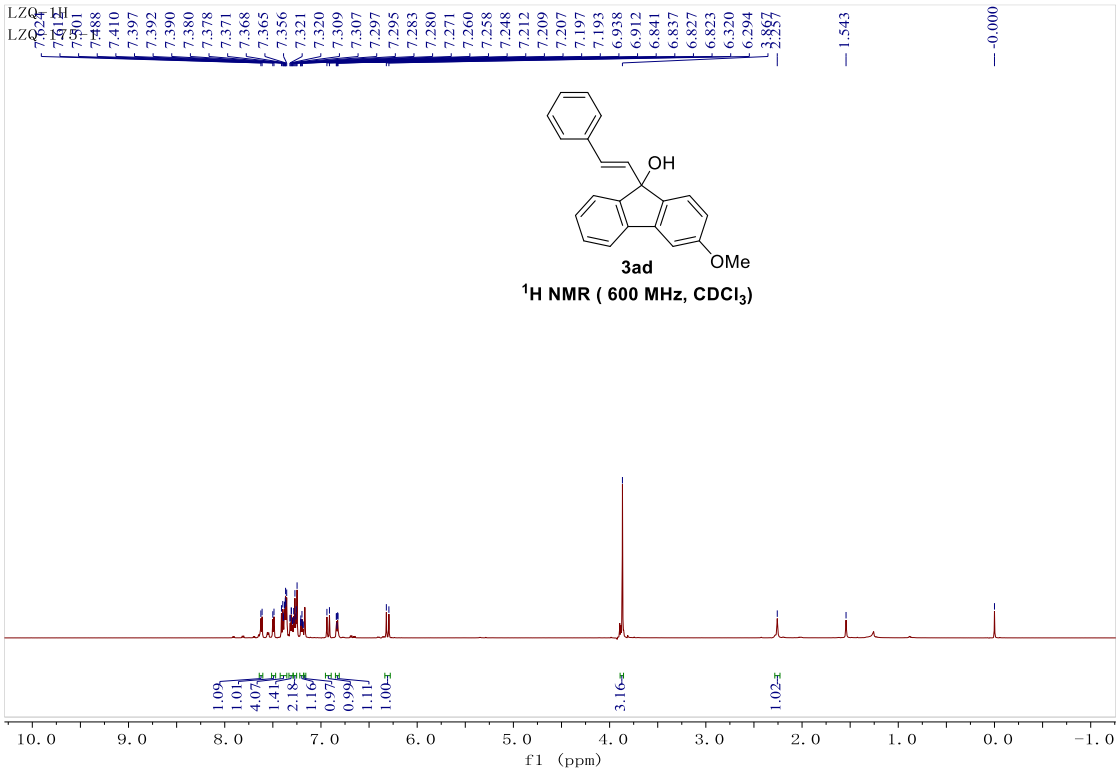




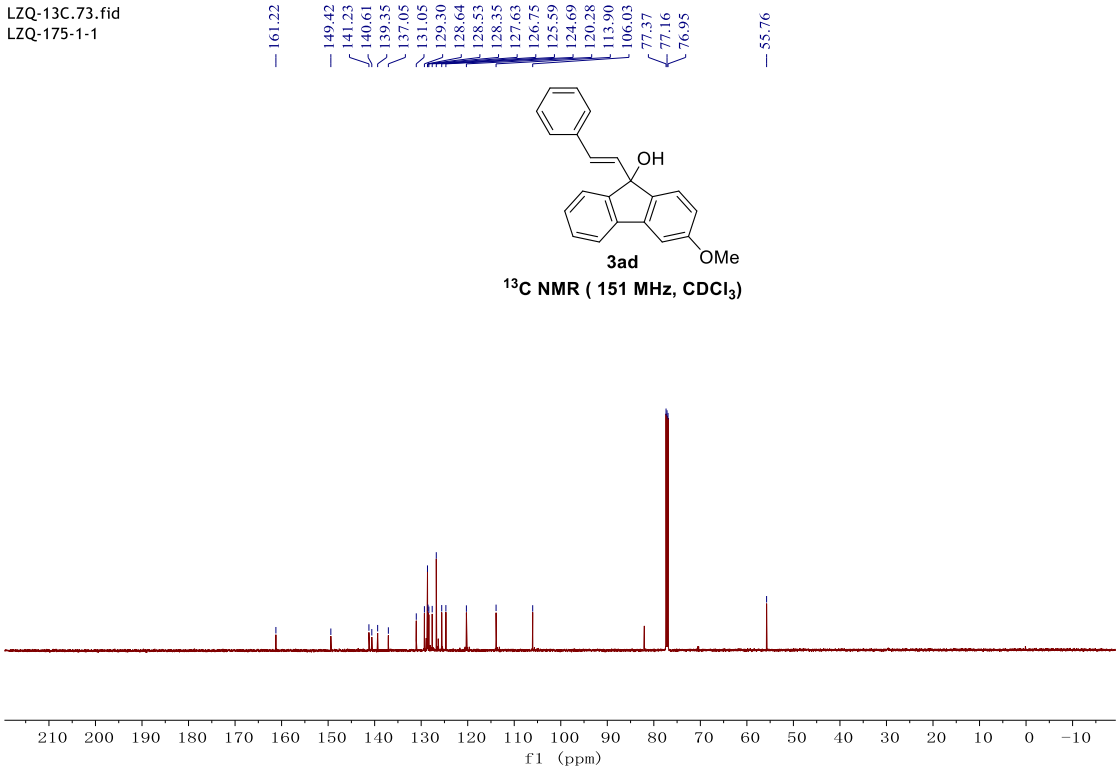
^{1}H NMR (600 MHz, $CDCl_3$)



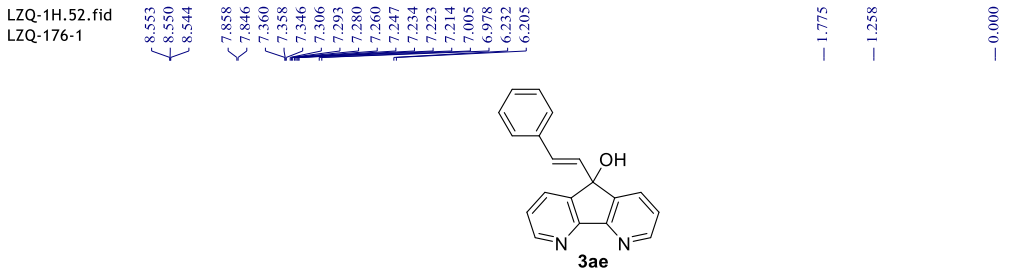
^{13}C NMR (101 MHz, $CDCl_3$)



^{1}H NMR (600 MHz, $CDCl_3$)

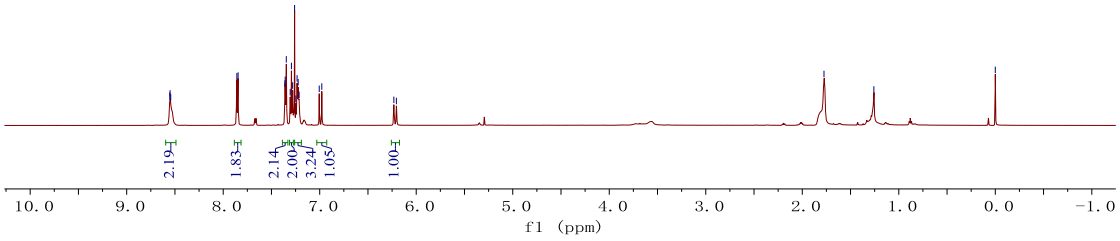


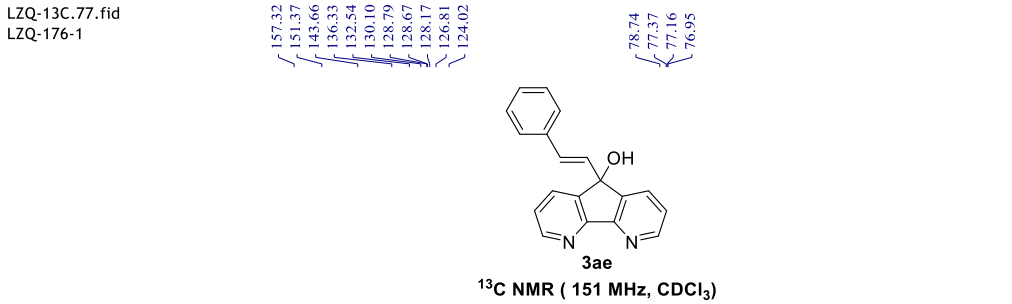
^{13}C NMR (151 MHz, $CDCl_3$)



3ae

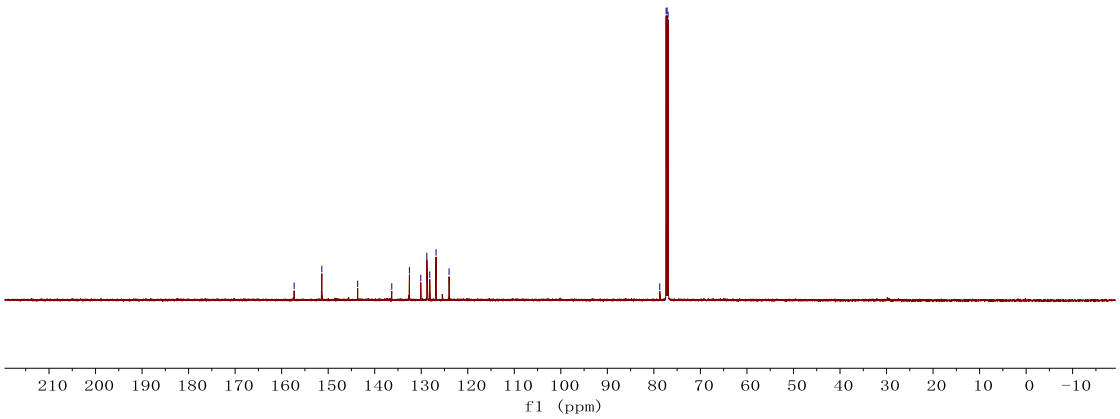
^{1}H NMR (600 MHz, $CDCl_3$)

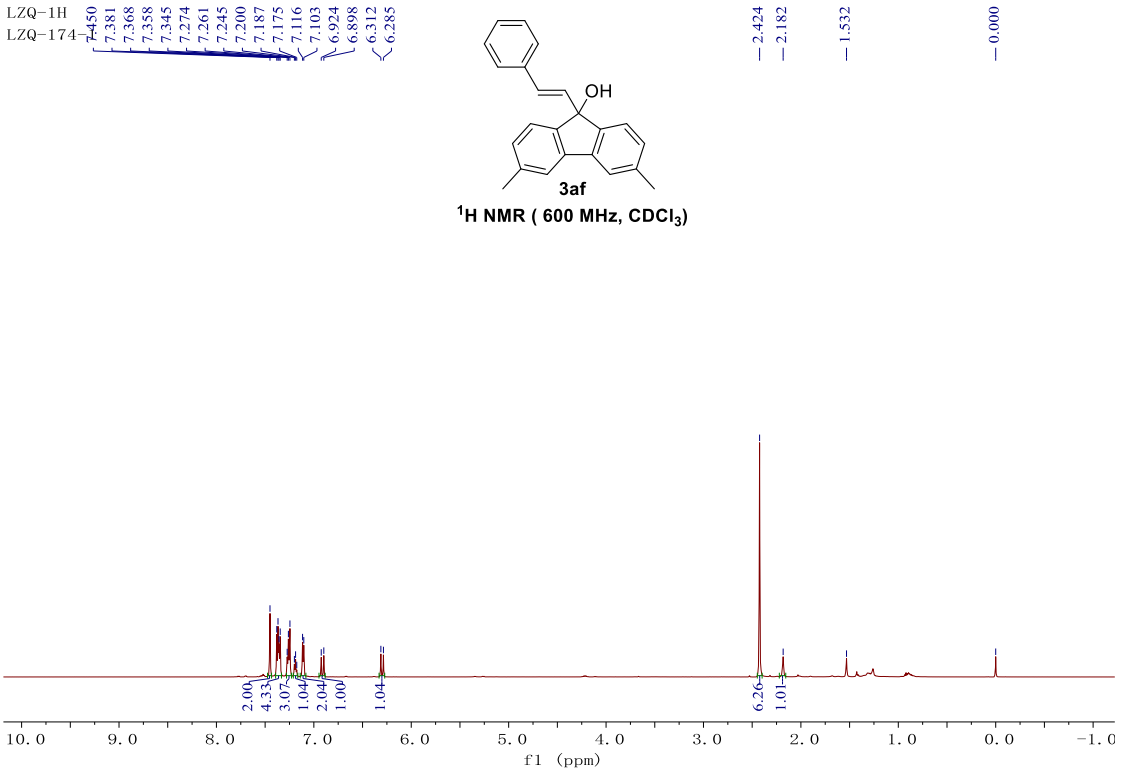




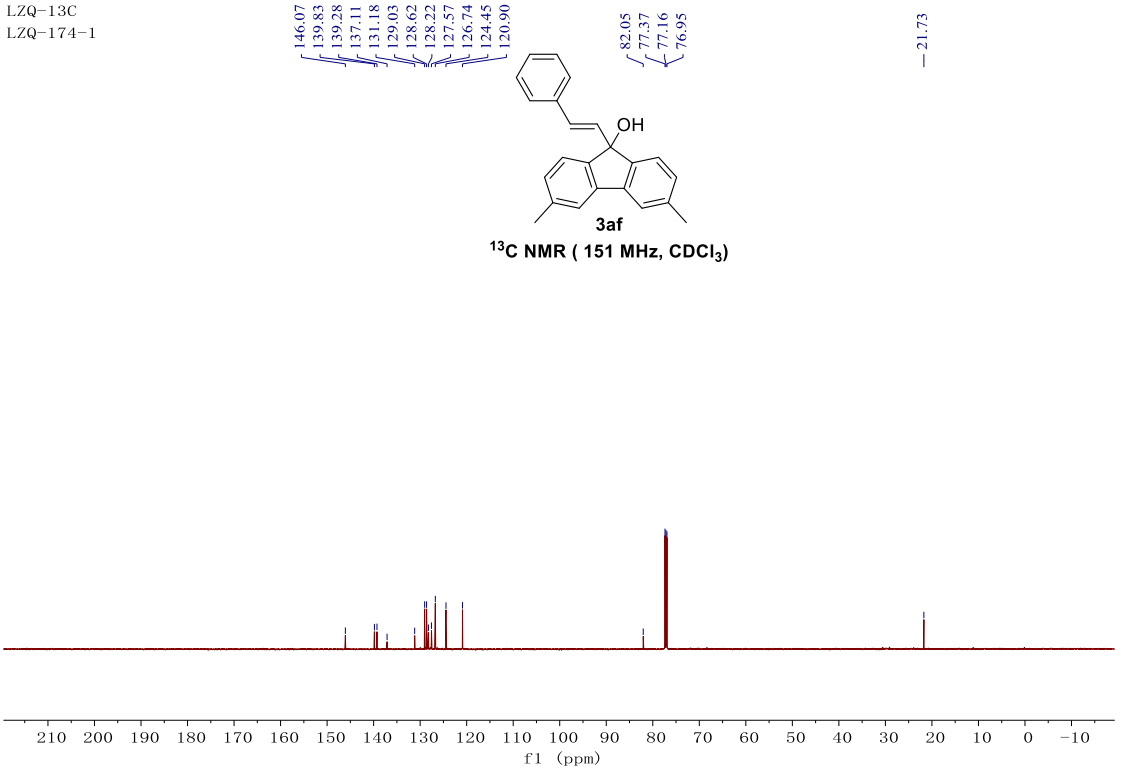
3ae

^{13}C NMR (151 MHz, $CDCl_3$)



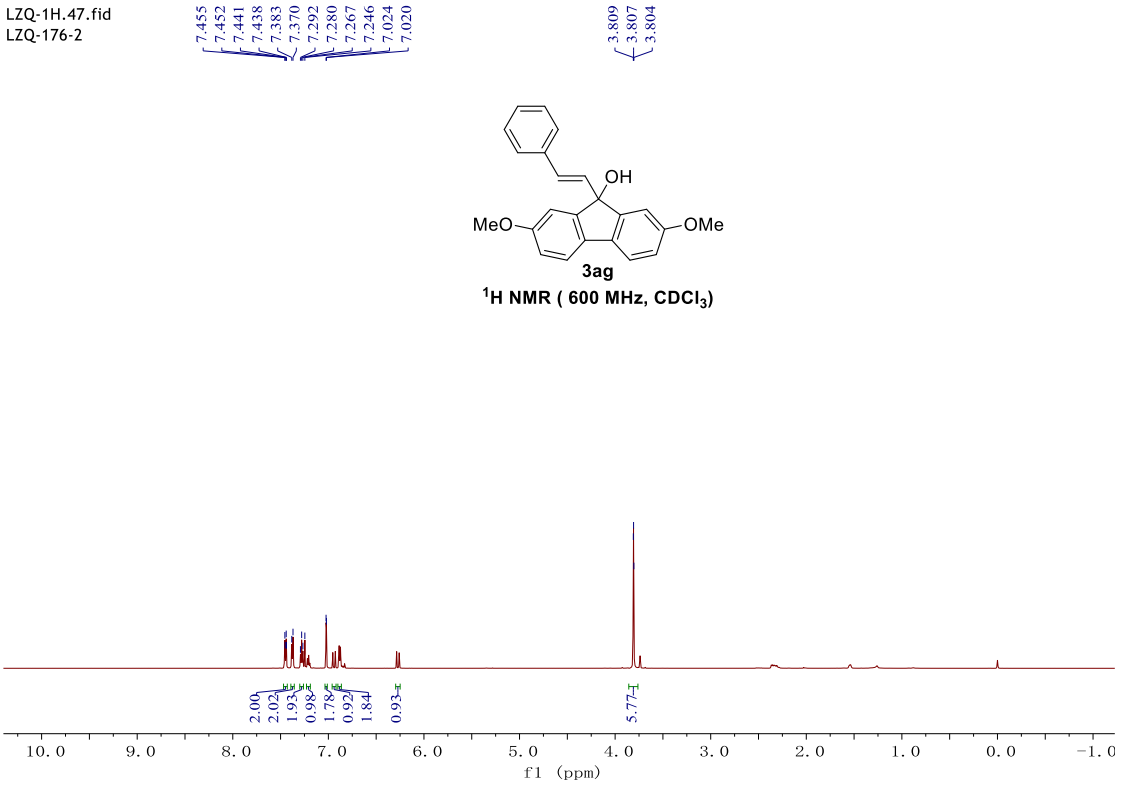


^{1}H NMR (600 MHz, $CDCl_3$)



^{13}C NMR (151 MHz, $CDCl_3$)

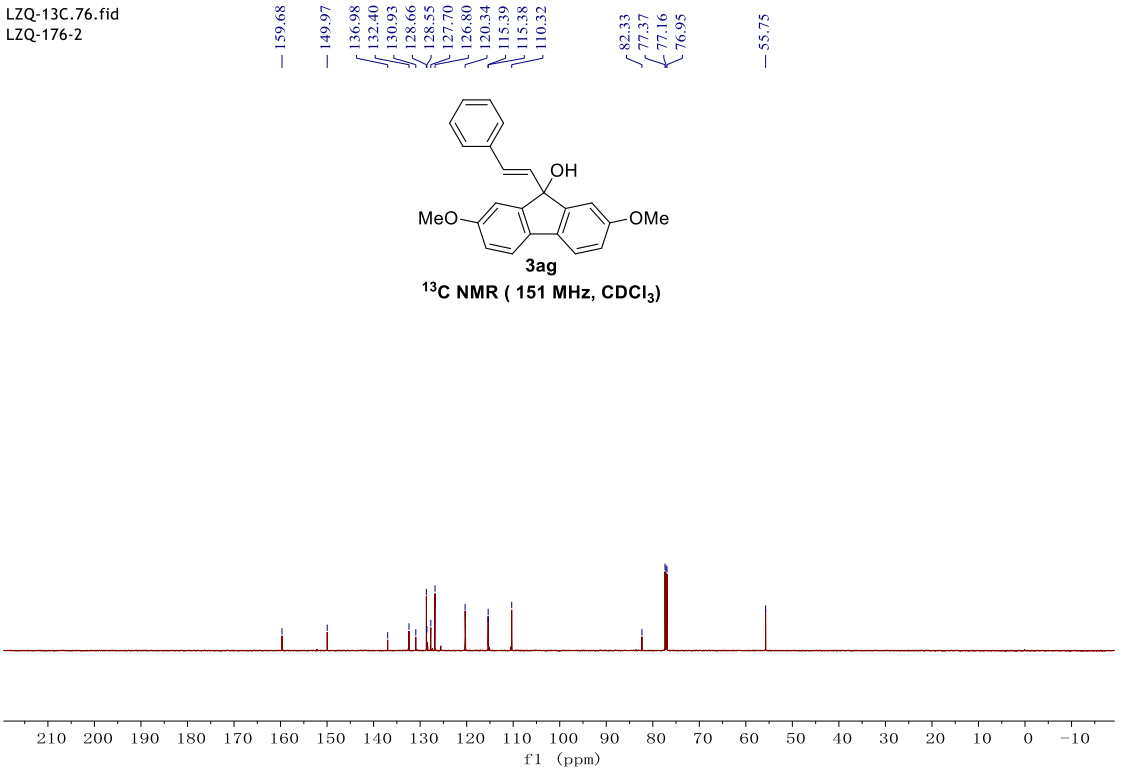
LZQ-1H.47.fid
LZQ-176-2



3ag

^{1}H NMR (600 MHz, $CDCl_3$)

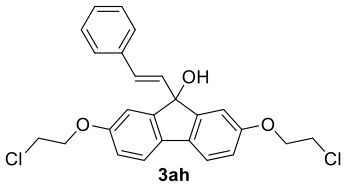
LZQ-13C.76.fid
LZQ-176-2



3ag

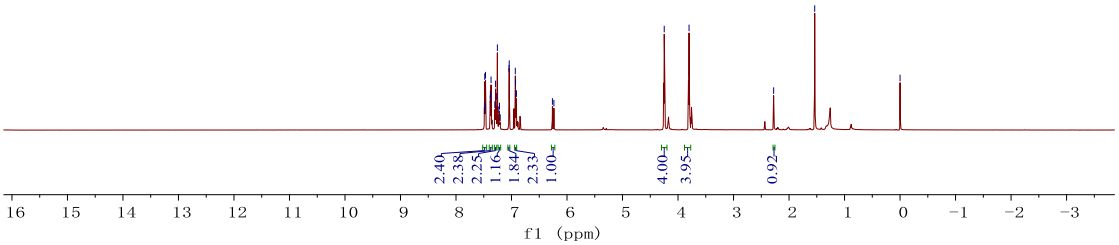
^{13}C NMR (151 MHz, $CDCl_3$)

LC-1H.53.fid
LC-157-3

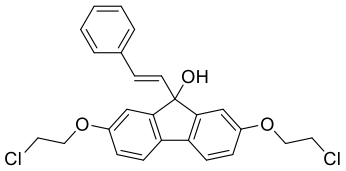


3ah

^{1}H NMR (600 MHz, $CDCl_3$)

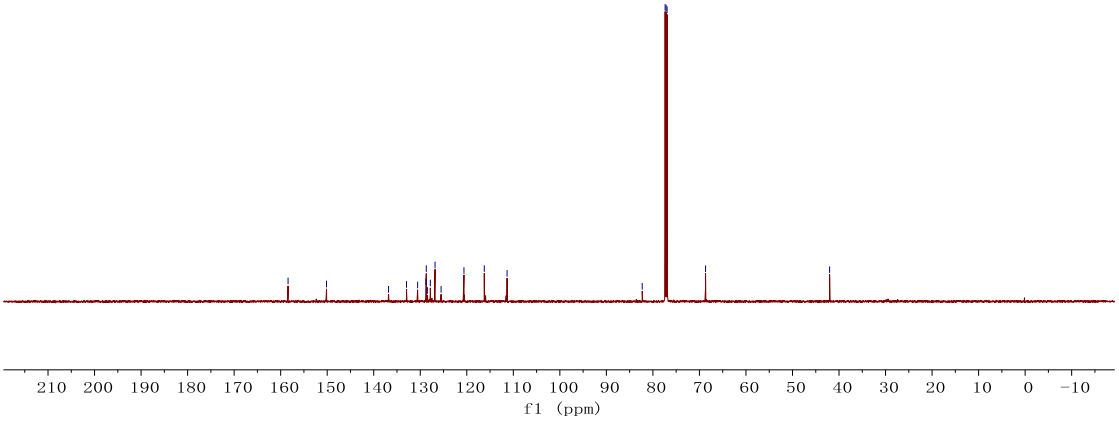


LY-13C.12.fid
LY-57-3



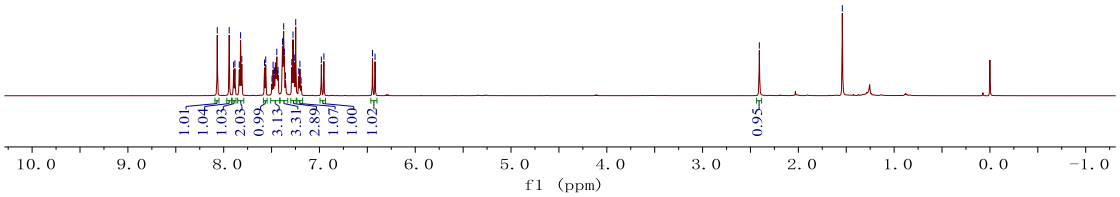
3ah

^{13}C NMR (151 MHz, $CDCl_3$)

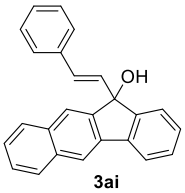


3ai

^{1}H NMR (600 MHz, $CDCl_3$)

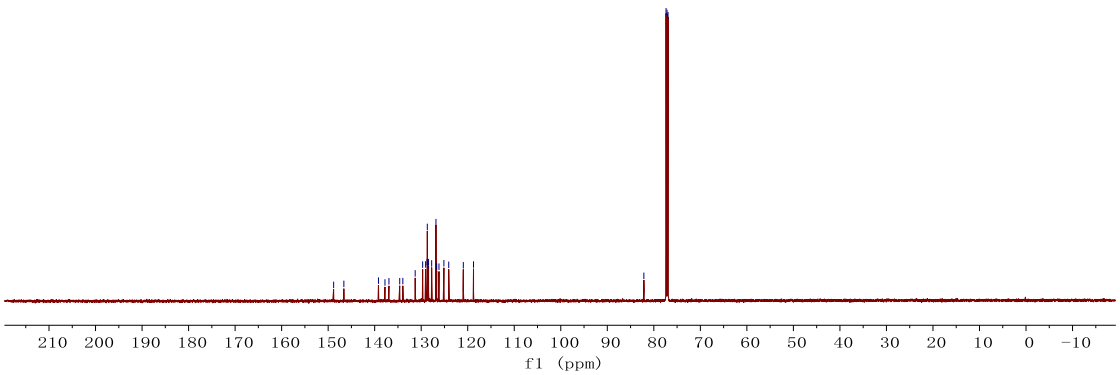


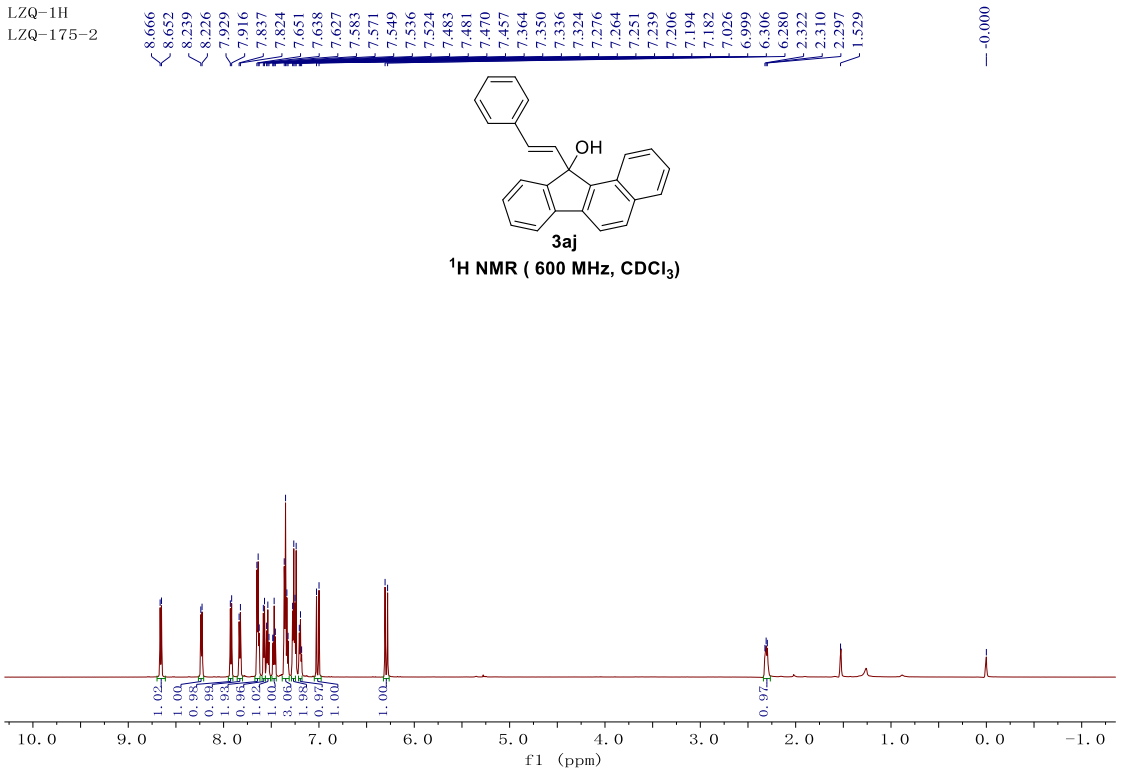
LZQ-13C
LZQ-174-2

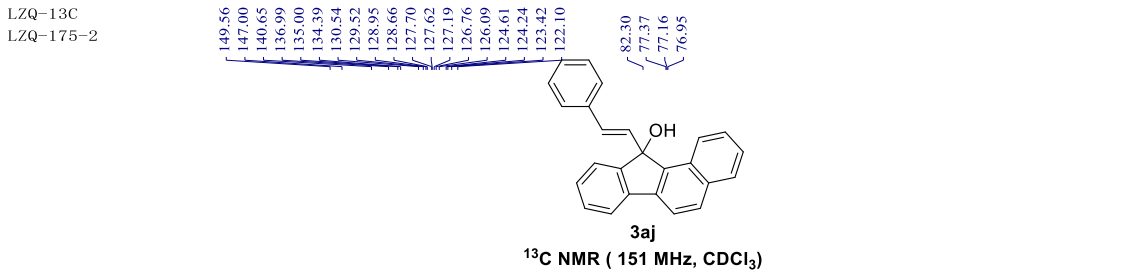


3ai

^{13}C NMR (151 MHz, $CDCl_3$)



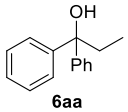

LZQ-1H
LZQ-175-2
8.666
8.652
8.239
8.226
7.929
7.916
7.837
7.824
7.651
7.638
7.627
7.583
7.571
7.549
7.536
7.524
7.483
7.481
7.470
7.457
7.364
7.350
7.336
7.324
7.276
7.264
7.251
7.239
7.206
7.194
7.182
7.026
6.999
6.306
6.280
2.322
2.310
2.297
1.529
-0.000
OH
3aj
1H NMR (600 MHz, CDCl3)
1.02
1.00
0.98
0.99
1.93
0.96
1.02
1.00
3.06
1.98
0.97
1.00
1.00
0.97
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


LZQ-13C
LZQ-175-2
149.56
147.00
140.65
136.99
135.00
134.39
130.54
129.52
128.95
128.66
127.70
127.62
127.19
126.76
126.09
124.61
124.24
123.42
122.10
82.30
77.37
77.16
76.95
OH
3aj
13C NMR (151 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)

XSQ-1H.94.fid
XSQ-360C

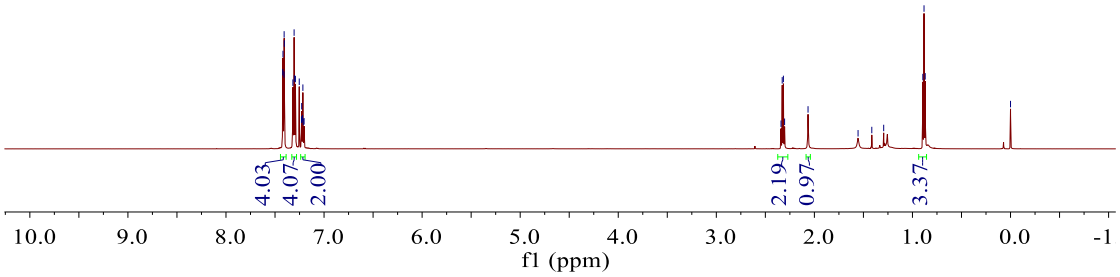
7.421 7.419 7.409 7.407 7.405 7.318 7.305 7.303 7.292 7.253 7.230 7.228 7.226 7.219 7.216 7.213 7.204

2.340 2.328 2.316 2.304 2.065 1.555 1.415 1.293 0.894 0.882 0.870 -0.000



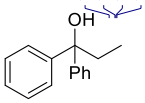
6aa

^{1}H NMR (600 MHz, $CDCl_3$)



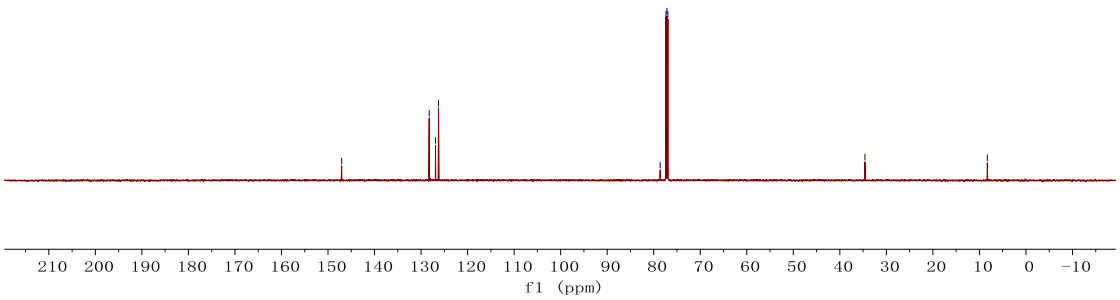
XSQ-13C.5.fid
XSQ-360C

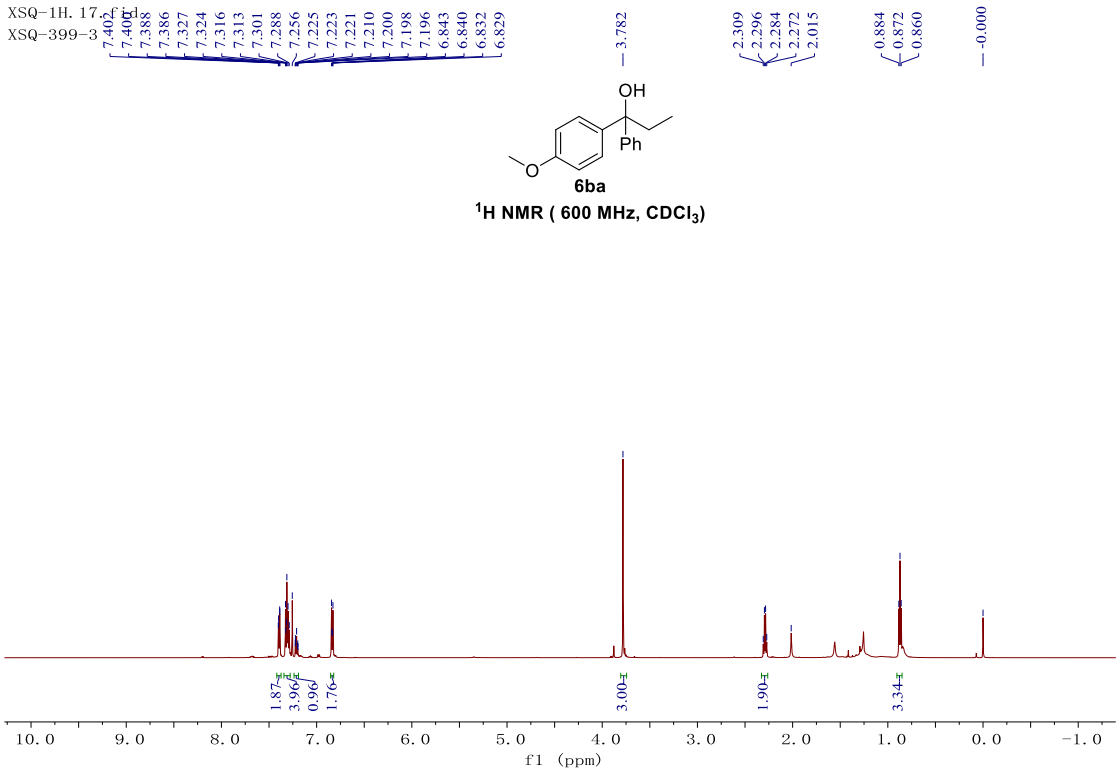
147.06 128.25 126.90 126.25 78.61 77.37 77.16 76.95 34.60 8.29



6aa

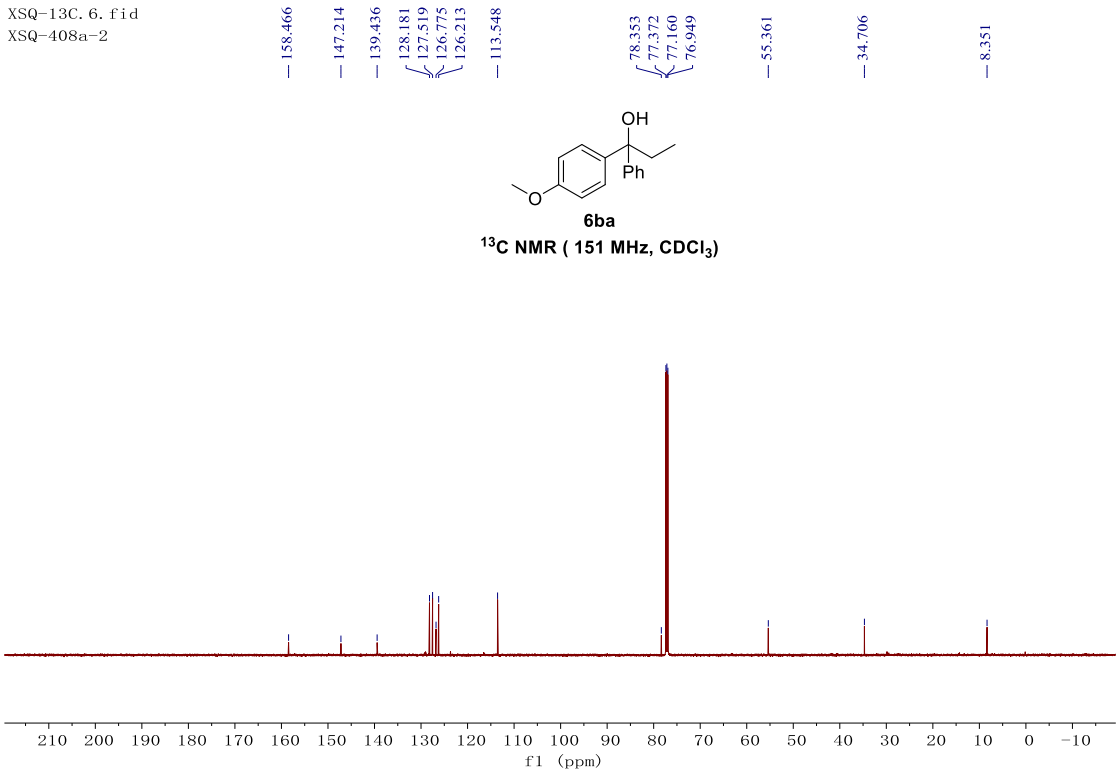
^{13}C NMR (151 MHz, $CDCl_3$)





6ba

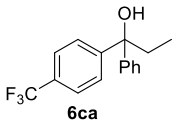
^{1}H NMR (600 MHz, $CDCl_3$)



6ba

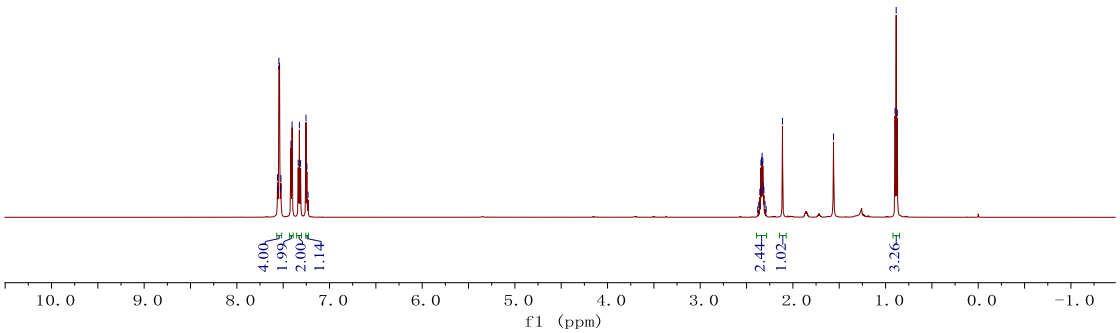
^{13}C NMR (151 MHz, $CDCl_3$)

XSQ-1H.4.fid
XSQ-399d-2

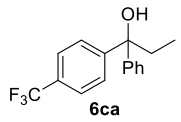


6ca

^{1}H NMR (600 MHz, $CDCl_3$)



XSQ-13C.2.fid
XSQ-399d-2

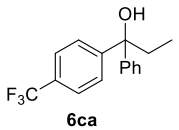


6ca

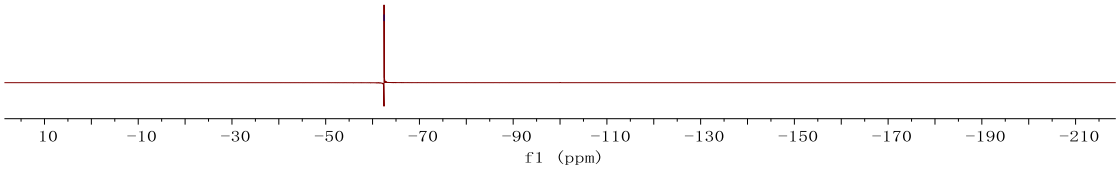
^{13}C NMR (151 MHz, $CDCl_3$)

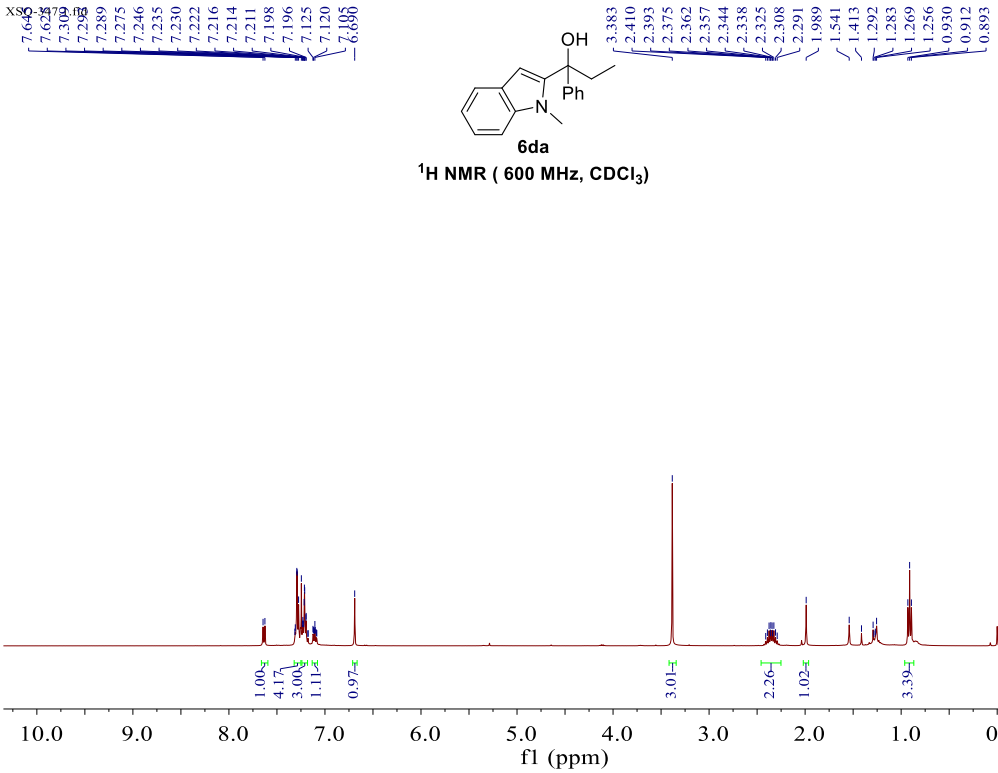
XSQ-19F.3.fid
XSQ-399d-2

−62.456



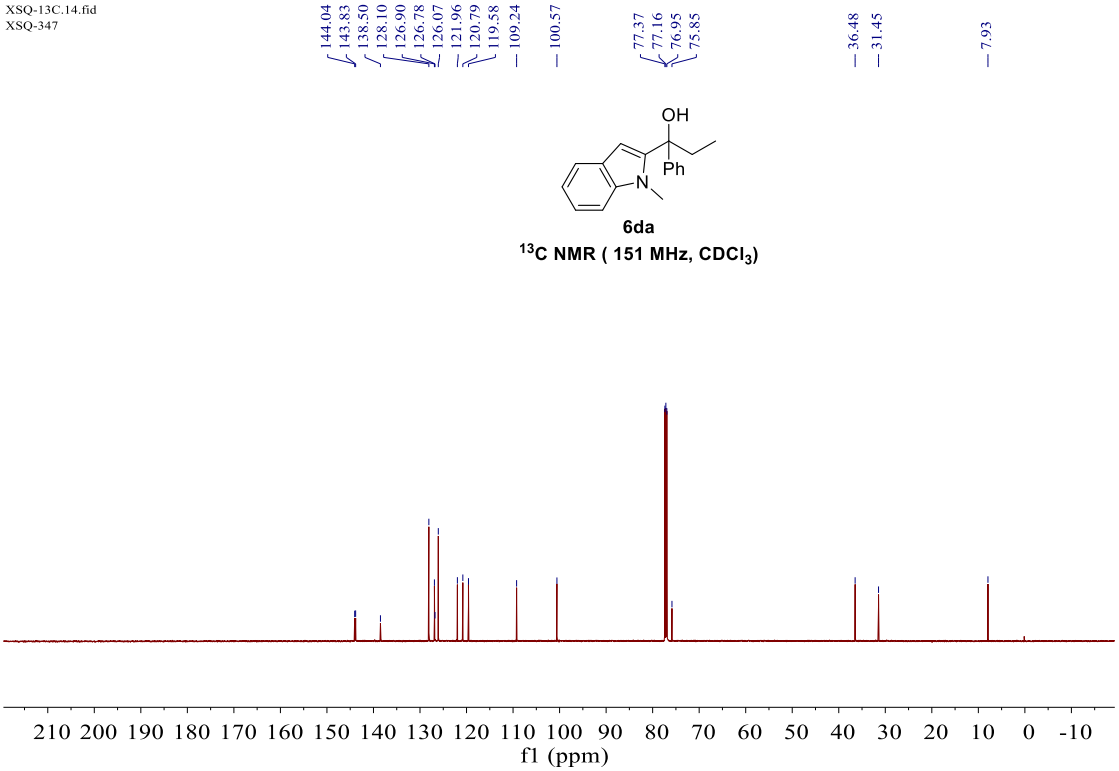
6ca





6da

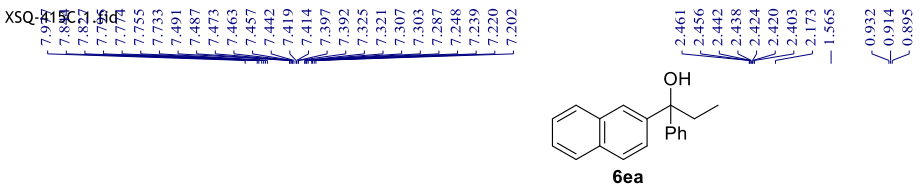
^{1}H NMR (600 MHz, $CDCl_3$)



6da

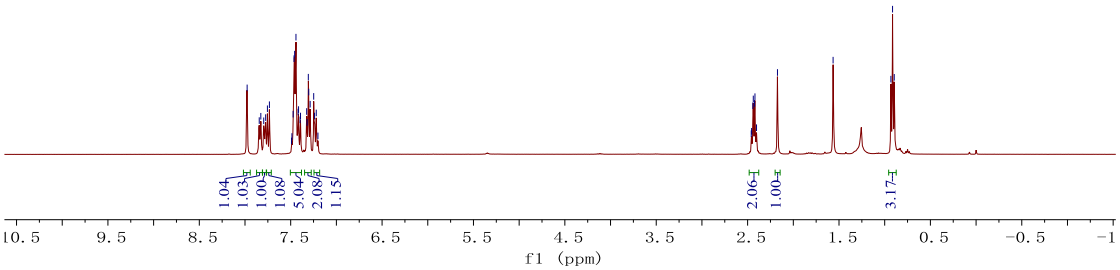
^{13}C NMR (151 MHz, $CDCl_3$)

XSQ-415C.1.fid

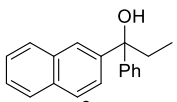


6ea

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

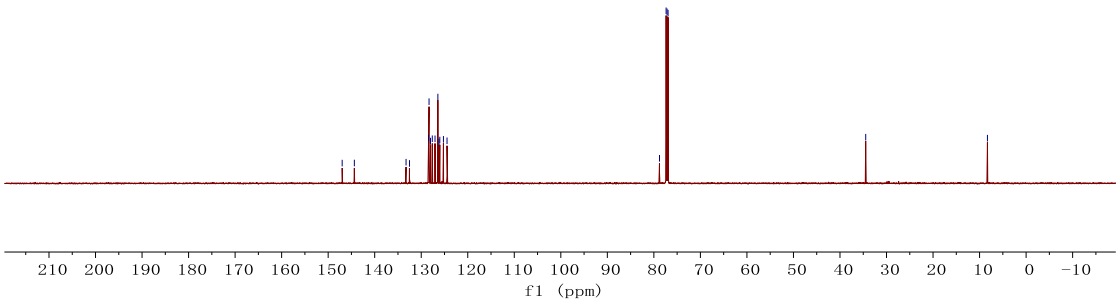


XSQ-13C.1.fid
XSQ-415C

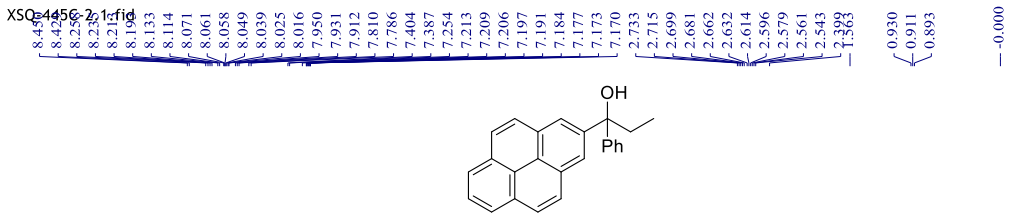


6ea

^{13}C NMR (151 MHz, $CDCl_3$)

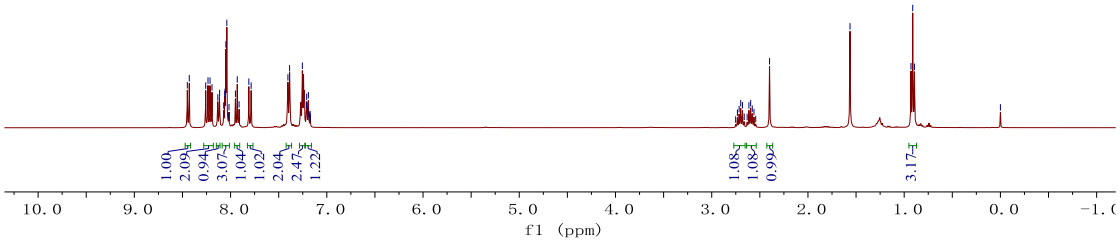


XSQ-445C-2.1.fid

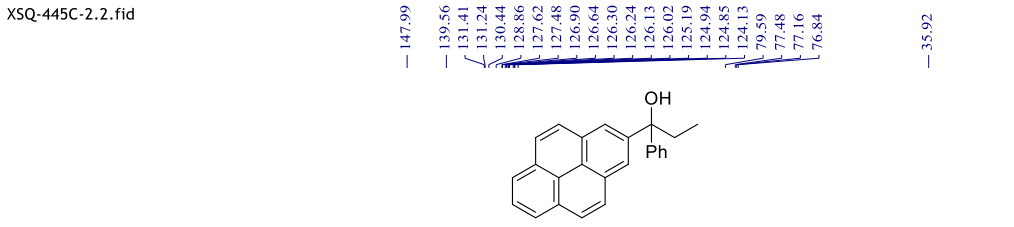


6fa

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

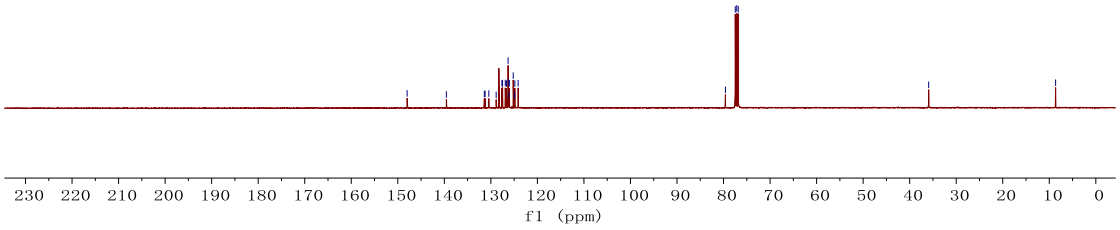


XSQ-445C-2.2.fid

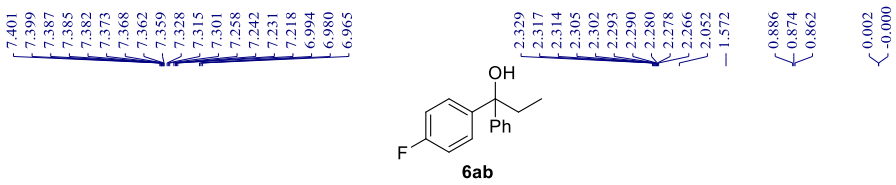


6fa

^{13}C NMR (101 MHz, $CDCl_3$)

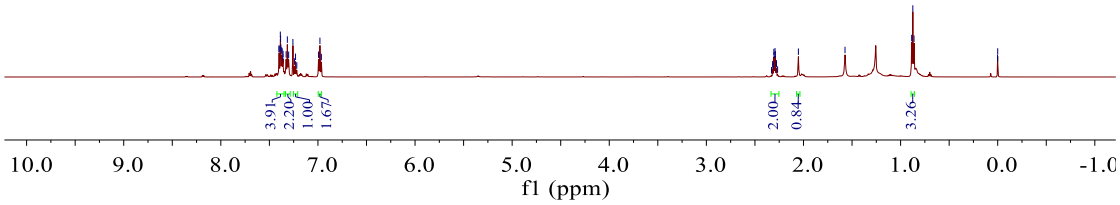


XSQ-1H.40.fid
XSQ-426a

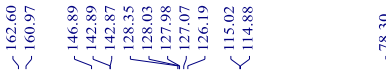


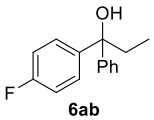
6ab

^{1}H NMR (600 MHz, $CDCl_3$)



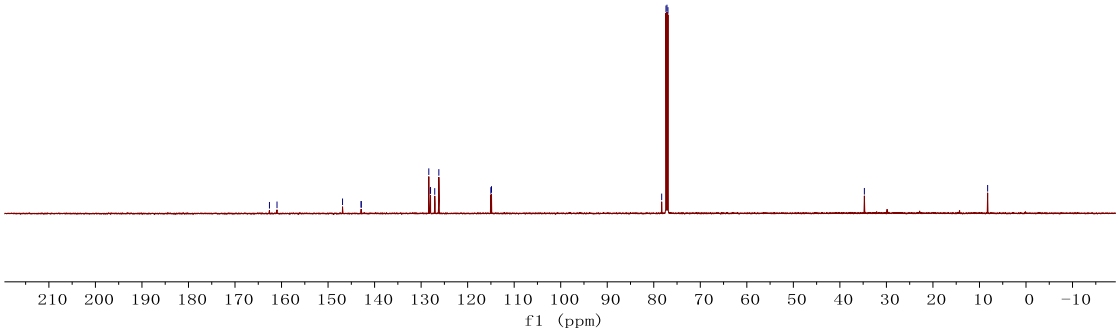
XSQ-13C.13.fid
XSQ-426A-2



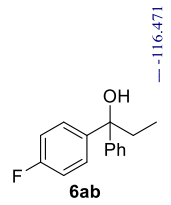


6ab

^{13}C NMR (151 MHz, $CDCl_3$)

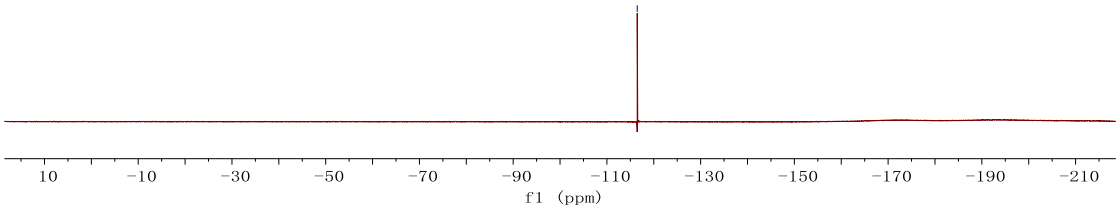


XSQ-19F.2.fid
XSQ-426a

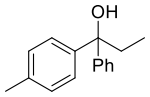


6ab

^{19}F NMR (376 MHz, $CDCl_3$)

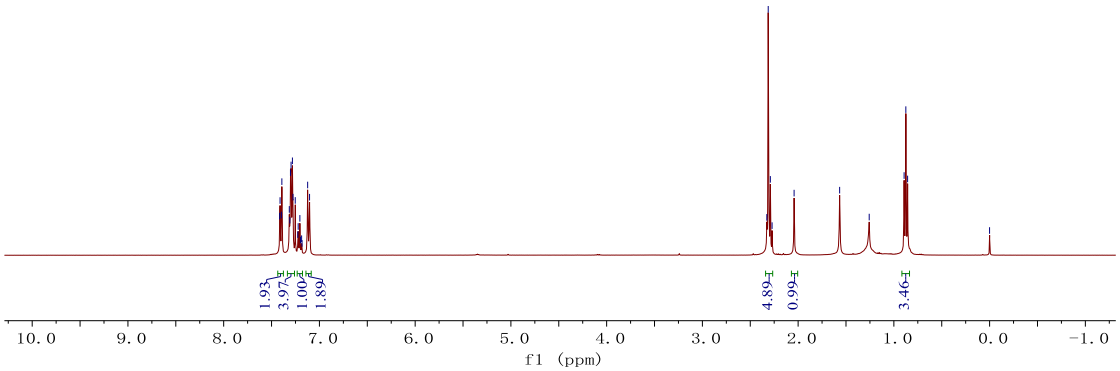


XSQ-438C-2.1.fid

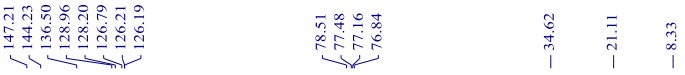


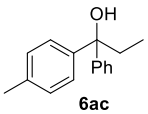
6ac

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



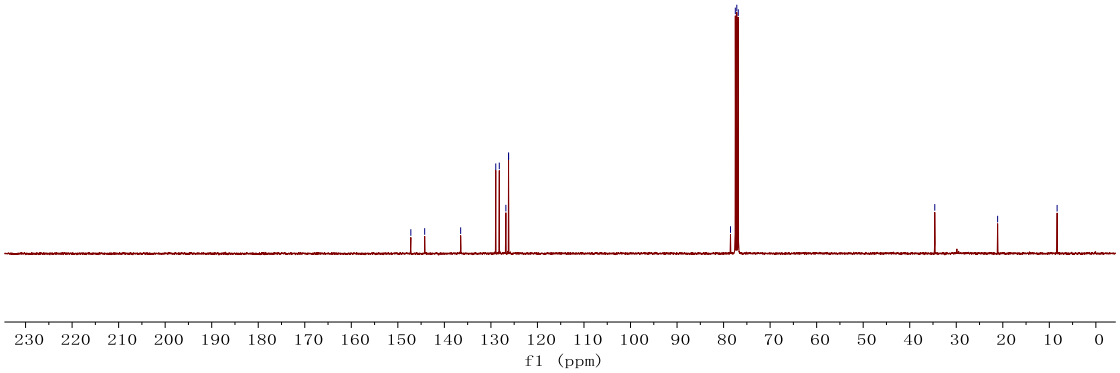
XSQ-438C-2.2.fid



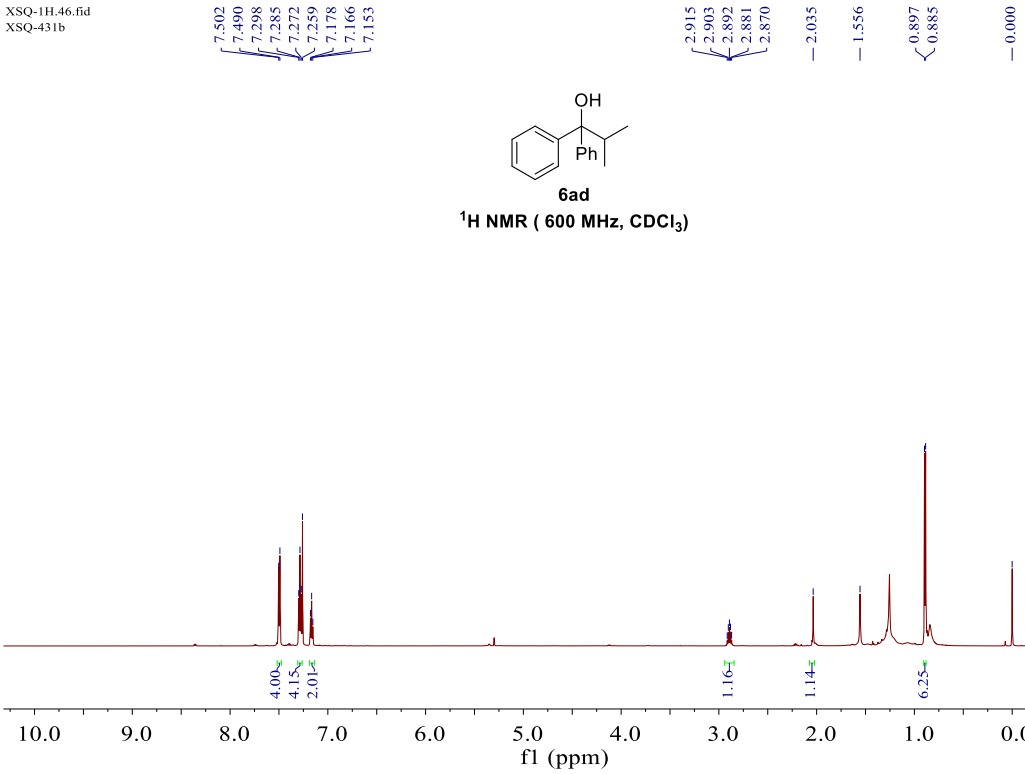


6ac

^{13}C NMR (101 MHz, $CDCl_3$)



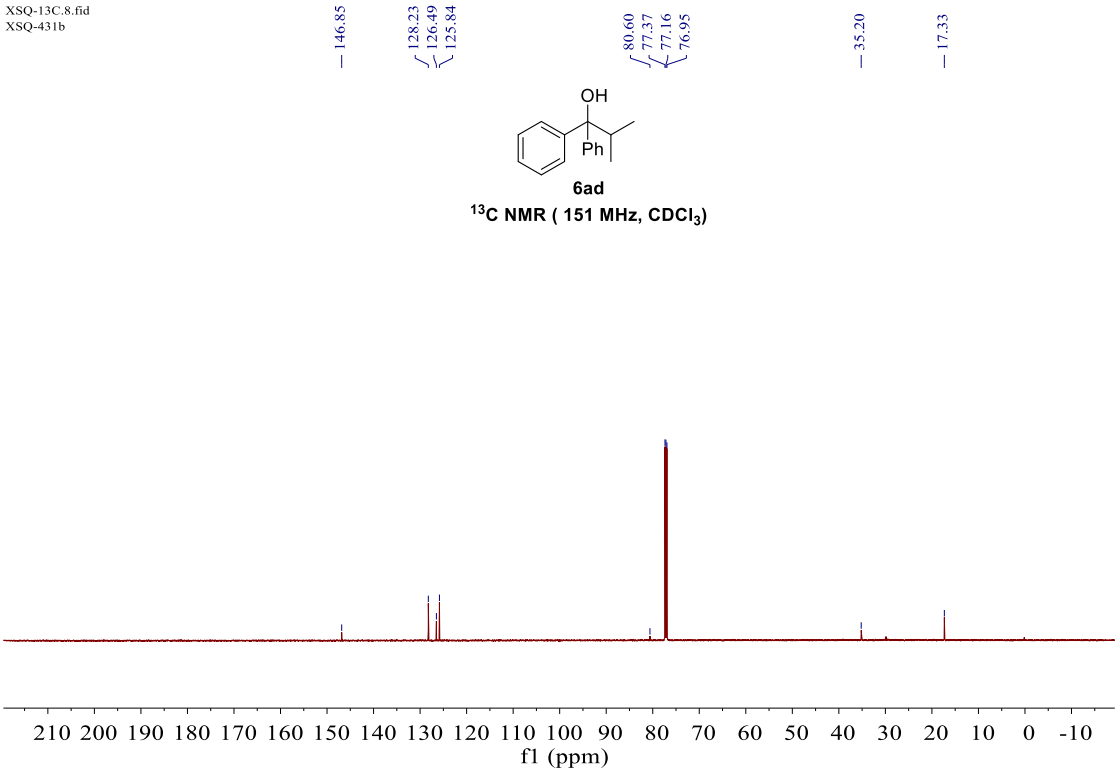
XSQ-1H.46.fid
XSQ-431b



6ad

^{1}H NMR (600 MHz, $CDCl_3$)

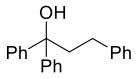
XSQ-13C.8.fid
XSQ-431b



6ad

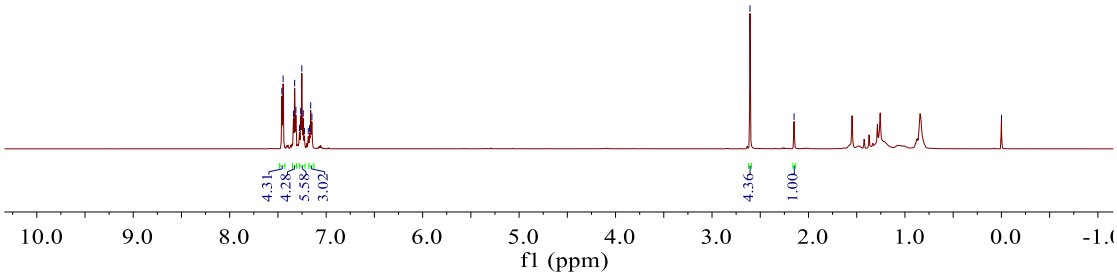
^{13}C NMR (151 MHz, $CDCl_3$)

XSQ-1H.69.fid
XSQ-435b-1

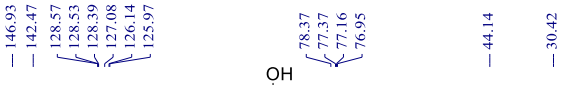


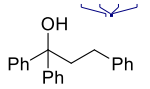
6ae

^{1}H NMR (600 MHz, $CDCl_3$)



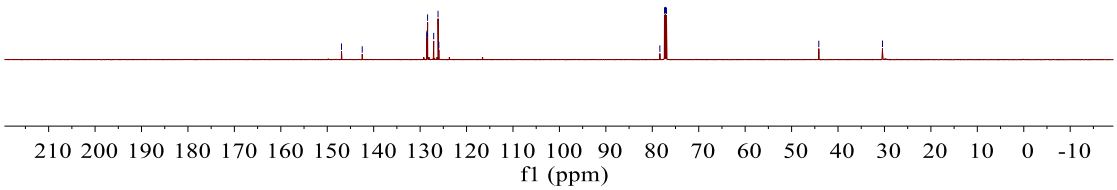
XSQ-13C.10.fid
XSQ-435B



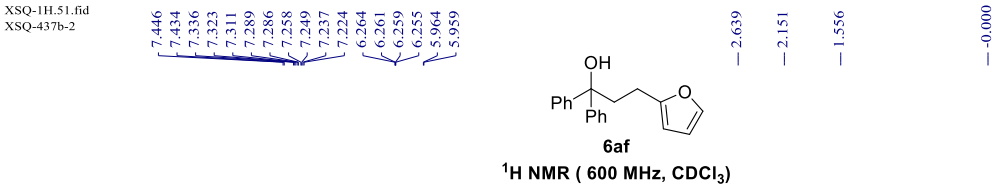


6ae

^{13}C NMR (151 MHz, $CDCl_3$)

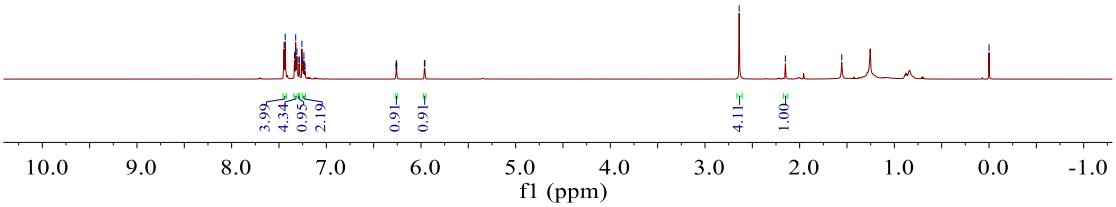


XSQ-1H.51.fid
XSQ-437b-2

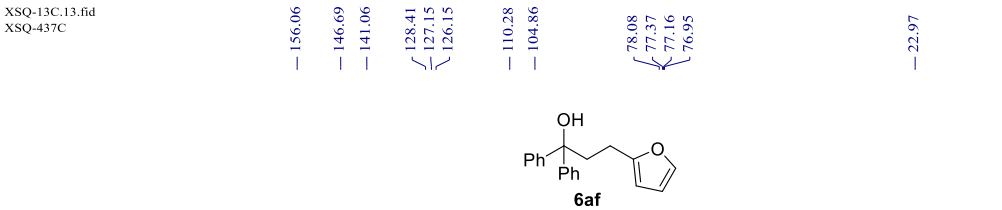


6af

^{1}H NMR (600 MHz, $CDCl_3$)



XSQ-13C.13.fid
XSQ-437C



6af

^{13}C NMR (151 MHz, $CDCl_3$)