Nickel-catalyzed Enantioselective α-Heteroarylation of Ketones via Siteselective C–F bond Activation to Construct All-Carbon Quaternary Stereocenters

Xiaodong Gu,[a] Kexin Liu,[a] Limin Yang,[c] Mingliang Li[b*] and Jun (Joelle) Wang[a,b*]

[a] *Department of Chemistry, Hong Kong Baptist University, Kowloon, Hong Kong*

[b] *Department of Chemistry, Southern University of Science and Technology, Shenzhen 518055, China*

[c] *College of Materials, Chemistry and Chemical Engineering, Hangzhou Normal University, Hangzhou 311121, China*

Supporting Information Placeholder

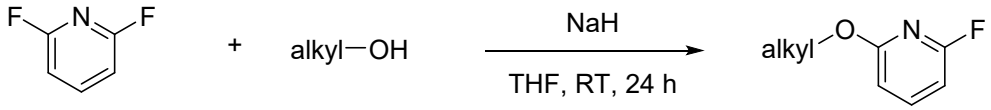
Table of Contents

1. General information

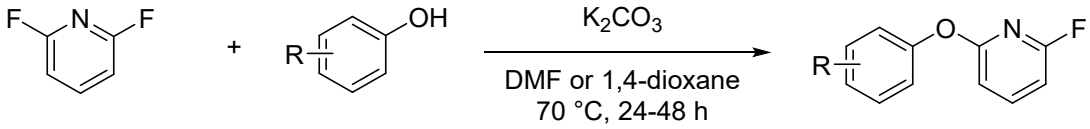
NMR Spectra were recorded on a Bruker DPX-500 (400) spectrometer at 500 MHz or 400 MHz for ^{1}H NMR, 376 MHz for ^{19}F NMR and 100 MHz or 125 MHz for ^{13}C NMR in $CDCl_3$ with tetramethylsilane (TMS) or the residual deuterated solvent peaks as internal standard. Chemical shifts (δ) are reported in ppm, and coupling constants (*J*) are in Hertz (Hz). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. Flash column chromatograph was carried out using 200-300 mesh silica gel at medium pressure. High resolution mass spectra (HRMS) were recorded on a LC-TOF spectrometer. ESI-HRMS data were acquired using a Thermo LTQ Orbitrap XL Instrument equipped with an ESI source. Optical rotation was obtained on a Rudolph Research Analytical (Atopol I). HPLC analysis was performed on Agilent 1260 series, UV detection monitored at 254 nm, using a Chiralcel AS-H, OJ-3, IA, IB, IC, ID , OD-H or AD-H column with hexane and *i*-PrOH as the eluent. Related HPLC analysis of **3as to 3az, 3nj** and other materials that needs improvement are were performed on Waters e2695. Unless otherwise noted, all reagents were purchased from commercial suppliers and used without purification. All air- and moisture-sensitive manipulations were carried out with standard Schlenk techniques under nitrogen or in a glove box under argon. Anhydrous toluene and dioxane were distilled from sodium benzophenone prior to use.

2. Procedure for the synthesis of fluoropyridine derivatives

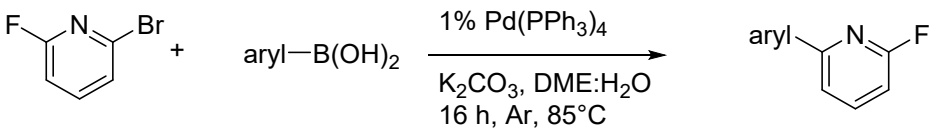
The fluoropyridine derivatives **2b'**[1], **2s**[2], **2c**[3], **2k'**[3], **2a'**[4], **2d'**[5], **2c'**[6], **2h'**[6] were prepared according to the reported procedure. Other non-specified fluoropyridines were bought from manufacturers.



Sodium hydride (60% NaH, 696 mg, 17.4 mmol) was slowly added to a mixture of aliphatic alcohols (17.4 mmol) in dry tetrahydrofuran (25 ml THF) at 0 ℃ and stirred for 30 mins. Then 2,6-difluoropyridine (2 g, 17.4 mmol) was added dropwise to the mixture and stirred for 24 h at room temperature, the reaction was quenched with water (20 ml). Then the mixture was evaporated under vacuum and the crude product was extracted with ethyl acetate (×2) and washed with saturated brine. The combined organic phase was dried over anhydrous sodium sulfate (Na_2SO_4) and evaporated to dryness. The crude product was purified by silica gel chromatography (eluent: Petroleum ether (PE), Rf: about 0.2 to 0.4) to afford product **2b, 2c, 2b', 2e'**.[7]

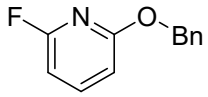


The mixture of 2,6-difluoropyridine (2 g, 17.4 mmol), potassium carbonate (2.88 g, 20.88 mmol, 1.2 equiv.) and phenol derivatives (19.1 mmol, 1.1 equiv) were added to DMF or 1,4-dioxane (25 ml) and stirred at 70 ℃ for 24 or 48 h. Then the mixture was evaporated under vacuum and the crude product was extracted with ethyl acetate (×2) and washed with saturated brine. The combined organic phase was dried over anhydrous Na_2SO_4 and evaporated to dryness. The crude product was purified by silica gel chromatography (eluent: PE, Rf: about 0.2 to 0.4) to afford product **2d, 2e, 2f, 2g, 2g', 2t', 2u', 2v'**.[8]



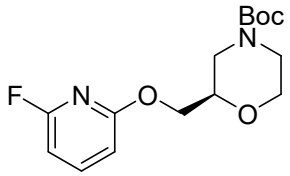
A round bottom flask was charged with K_2CO_3 (3.0 equiv) and water (1 mL) at room temperature. The mixture was stirred until a clear solution was obtained (about 2 minutes). Dimethoxyethane (DME) (15 mL) was added and the mixture was sparged with argon for 15 minutes. Phenylboronic acid (1.05 equiv) and 2-bromo-6-fluoropyridine (1 g, 5.72 mmol) were added to the mixture, followed by Pd $(PPh_3)_4$ (1 mol%). The reaction mixture was sparged again with argon for 5 minutes. Then the reaction mixture was heated to 85° C under an atmosphere of argon for 16 hours. The reaction mixture was cooled and directly concentrated. Water was added to the residue and the mixture was extracted with ethyl acetate (EA). The combined organic phase was dried with anhydrous Na_2SO_4 and concentrated. The crude product was purified by silica gel chromatography to afford product **2j, 2p, 2q, 2k, 2l, 2m, 2n, 2o, 2y** (PE, Rf: about 0.2 to 0.4)**.**[9]

2-(Benzyloxy)-6-fluoropyridine (2b)



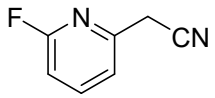
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.53 (q, *J* = 8.1 Hz, 1H), 7.45 – 7.39 (m, 2H), 7.32 (dd, *J* = 8.3, 6.4 Hz, 2H), 7.29 – 7.24 (m, 1H), 6.60 (dd, *J* = 8.1, 1.7 Hz, 1H), 6.40 (dd, *J* = 7.8, 2.5 Hz, 1H), 5.30 (s, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.7 (d, *J* = 13.6 Hz), 162.2 (d, *J* = 240.5 Hz), 142.7 (d, *J* = 8.0 Hz), 136.6, 128.5, 128.1, 128.0, 107.4 (d, *J* = 5.1 Hz), 100.1 (d, *J* = 35.4 Hz), 68.2. ^{19}F NMR (376 MHz, $CDCl_3$) δ -70.27.

***t*-Butyl (*R*)-2-(((6-fluoropyridin-2-yl)oxy)methyl)morpholine-4-carboxylate (2c)**



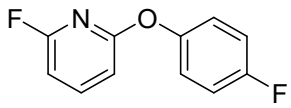
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.65 (q, *J* = 8.1 Hz, 1H), 6.72 – 6.61 (m, 1H), 6.48 (dd, *J* = 7.7, 2.4 Hz, 1H), 4.41 – 4.25 (m, 2H), 4.06 – 3.71 (m, 4H), 3.58 (td, *J* = 11.7, 2.8 Hz, 1H), 3.07 – 2.70 (m, 2H), 1.47 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.44 (d, *J* = 13.4 Hz), 154.76, 142.73 (d, *J* = 7.9 Hz), 107.46 (d, *J* = 5.2 Hz), 100.41 (d, *J* = 35.1 Hz), 80.23, 77.24, 73.61, 66.72, 66.58, 28.38. ^{19}F NMR (376 MHz, $CDCl_3$) δ -70.27.

2-(6-Fluoropyridin-2-yl)acetonitrile (2b')



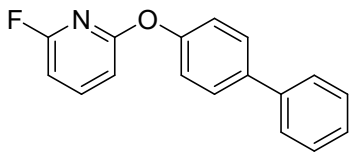
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.90 (q, *J* = 8.0 Hz, 1H), 7.41 – 7.29 (m, 1H), 6.95 (dd, *J* = 8.3, 2.8 Hz, 1H), 3.94 (s, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.01 (d, *J* = 241.5 Hz), 149.18 (d, *J* = 13.6 Hz), 142.63 (d, *J* = 7.8 Hz), 119.85 (d, *J* = 4.2 Hz), 116.54, 109.09 (d, *J* = 36.1 Hz), 25.85. ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.05.

2-Fluoro-6-(4-fluorophenoxy) pyridine (2e)



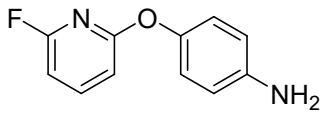
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 (q, *J* = 8.0 Hz, 1H), 7.13 – 7.03 (m, 4H), 6.71 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.58 (dd, *J* = 8.0, 2.7 Hz, 1H). ^{13}C NMR: (125 MHz, $CDCl_3$) δ 162.4 (d, *J* = 13.6 Hz), 162.1 (d, *J* = 242.8 Hz), 159.8 (d, *J* = 243.4 Hz), 149.2 (d, *J* = 2.7 Hz), 143.6 (d, *J* = 7.9 Hz), 122.8 (d, *J* = 8.4 Hz), 116.3 (d, *J* = 23.3 Hz), 107.3 (d, *J* = 5.1 Hz), 102.6 (d, *J* = 35.4 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.07, -117.79.

2-([1,1'-Biphenyl]-4-yloxy)-6-fluoropyridine (2f)



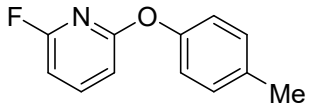
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.77 (q, *J* = 8.0 Hz, 1H), 7.64 – 7.57 (m, 4H), 7.47 – 7.43 (m, 2H), 7.38 – 7.33 (m, 1H), 7.24 – 7.20 (m, 2H), 6.77 (dd, *J* = 7.9, 1.5 Hz, 1H), 6.63 (dd, *J* = 7.9, 2.7 Hz, 1H). ^{13}C NMR: (125 MHz, $CDCl_3$) δ 162.4 (d, *J* = 13.6 Hz), 162.1 (d, *J* = 242.8 Hz), 159.8 (d, *J* = 243.4 Hz), 149.2 (d, *J* = 2.7 Hz), 143.6 (d, *J* = 7.9 Hz), 122.8 (d, *J* = 8.4 Hz), 116.3 (d, *J* = 23.3 Hz), 107.3 (d, *J* = 5.1 Hz), 102.6 (d, *J* = 35.4 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.83.

4-((6-Fluoropyridin-2-yl)oxy)aniline (2g)



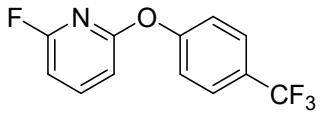
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.69 (q, *J* = 8.0 Hz, 1H), 7.00 – 6.89 (m, 2H), 6.74 – 6.66 (m, 2H), 6.62 (dd, *J* = 8.0, 1.7 Hz, 1H), 6.55 (dd, *J* = 7.9, 2.7 Hz, 1H), 3.47 (br, 2H). ^{13}C NMR: (125 MHz, $CDCl_3$) δ. 163.5 (d, *J* = 13.8 Hz), 162.3 (d, *J* = 241.9 Hz), 145.6, 144.0, 143.4 (d, *J* = 7.9 Hz), 122.31 116.2, 106.6 (d, *J* = 5.1 Hz), 102.0 (d, *J* = 35.5 Hz).

2-Fluoro-6-(p-tolyloxy)pyridine (2g')



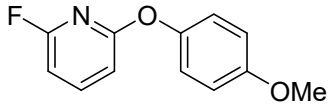
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 (q, *J* = 8.0 Hz, 1H), 7.26 – 7.20 (m, 2H), 7.08 – 7.04 (m, 2H), 6.69 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.61 (dd, *J* = 8.0, 2.5 Hz, 1H), 2.39 (s, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.20.

2-Fluoro-6-(4-(trifluoromethyl)phenoxy)pyridine (2n')



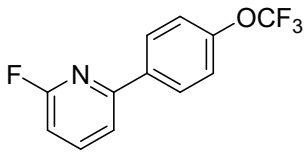
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.81 (q, *J* = 7.9 Hz, 1H), 7.69 – 7.63 (m, 2H), 7.26 – 7.22 (m, 2H), 6.83 (dd, *J* = 7.9, 1.6 Hz, 1H), 6.67 (dd, *J* = 7.9, 2.6 Hz, 1H).

2-Fluoro-6-(4-methoxyphenoxy)pyridine (2o')



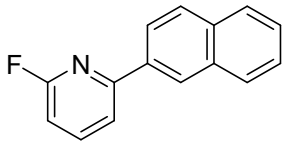
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.71 (q, *J* = 7.9 Hz, 1H), 7.10 – 7.03 (m, 2H), 6.97 – 6.86 (m, 2H), 6.66 (dd, *J* = 7.9, 1.6 Hz, 1H), 6.57 (dd, *J* = 7.9, 2.6 Hz, 1H), 3.82 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.1(d, *J* = 13.8 Hz), 162.2 (d, *J* = 242.4 Hz), 156.9, 146.9, 143.3 (d, *J* = 8.0 Hz), 122.3, 114.8, 106.8 (d, *J* = 5.1 Hz), 102.1 (d, *J* = 35.6 Hz) , 55.6. ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.96.

2-Fluoro-6-thiophen-2-ylpyridine (2m)



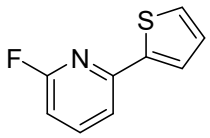
^{1}H NMR (500 MHz, $CDCl_3$): δ 8.03 – 7.94 (m, 2H), 7.78 (q, *J* = 8.0 Hz, 1H), 7.53 (dd, *J* = 7.6, 2.5 Hz, 1H), 7.29 – 7.22 (m, 2H), 6.83 (dd, *J* = 8.2, 3.0 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.44 (d, *J* = 238.8 Hz), 154.68 (d, *J* = 13.4 Hz), 150.27 (d, *J* = 1.9 Hz), 141.91 (d, *J* = 7.7 Hz), 136.12, 128.45, 121.00, 120.56 (q, *J* = 257.5 Hz), 117.25 (d, *J* = 3.9 Hz), 108.12 (d, *J* = 37.5 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -57.88, -66.54.

2-Fluoro-6-(naphthalen-2-yl)pyridine (2p)



^{1}H NMR (500 MHz, $CDCl_3$): δ 8.52 (d, *J* = 2.2 Hz, 1H), 8.11 (dd, *J* = 8.6, 1.9 Hz, 1H), 7.98 – 7.83 (m, 4H), 7.76 (dd, *J* = 7.6, 2.6 Hz, 1H), 7.52 (dt, *J* = 6.4, 3.6 Hz, 2H), 6.89 (dd, *J* = 7.9, 3.1 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.6 (d, *J* = 238.4 Hz), 156.3 (d, *J* = 13.5 Hz), 141.9 (d, *J* = 7.7 Hz), 134.9, 134.0, 133.5, 129.0, 128.7, 127.8, 127.0, 126.8, 126.6, 124.3, 117.7 (d, *J* = 4.1 Hz), 107.9 (d, *J* = 37.7 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -66.51.

2-Fluoro-6-thiophen-2-ylpyridine (2q)

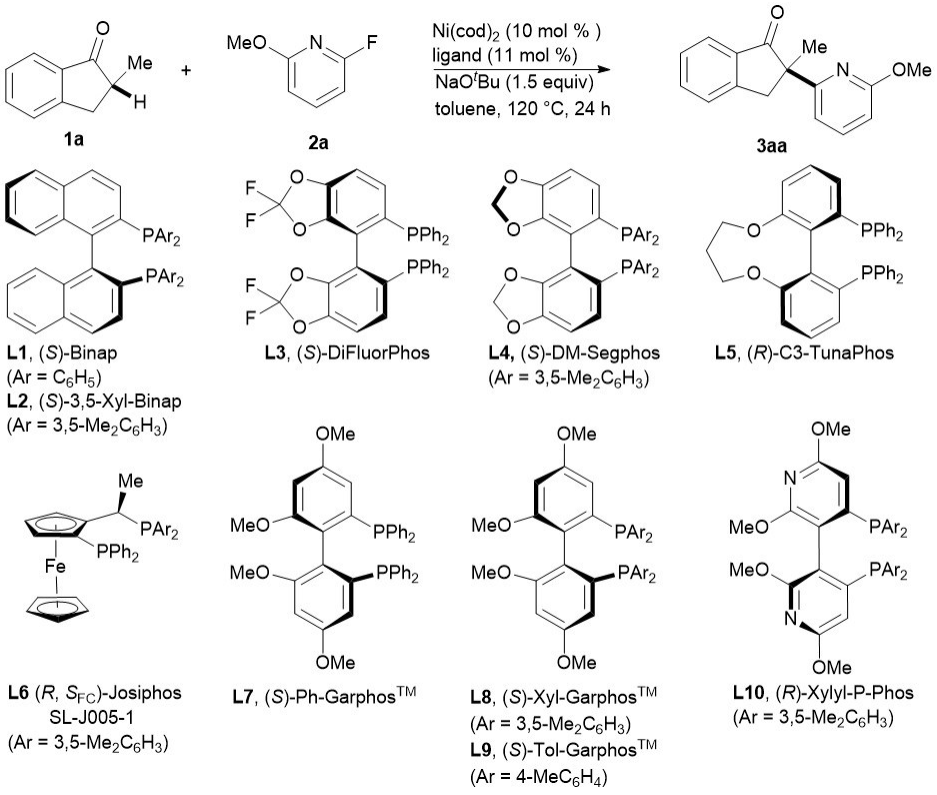


^{1}H NMR (500 MHz, $CDCl_3$): δ 7.78 – 7.66 (m, 1H), 7.66 – 7.56 (m, 1H), 7.50 – 7.41 (m, 1H), 7.41 – 7.36 (m, 1H), 7.12 – 7.03 (m, 1H), 6.73 (dt, *J* = 8.3, 2.4 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.06 (d, *J* = 239.3 Hz), 151.41 (d, *J* = 14.1 Hz), 142.88, 141.69 (d, *J* = 8.0 Hz), 128.24, 128.22, 125.79, 115.92 (d, *J* = 4.1 Hz), 107.20 (d, *J* = 37.2 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -66.92.

3. Optimization of reaction conditions and general procedural for the asymmetric heteroarylation

Optimization of reaction conditions

Table S1. Exploring the influence of chiral ligands [a]

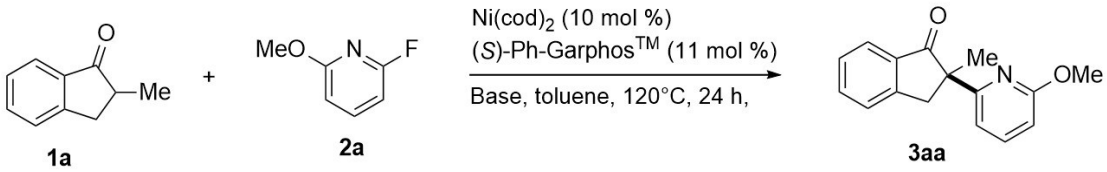


Entry	ligand	Yield (%) [b]	ee (%) [c]
1	**L1**	39	68
2	**L2**	21	65
3	**L3**	NR	–
4	**L4**	12	75
5	**L5**	17	-74
6	**L6**	67	-84
7	**L7**	42	92
8	**L8**	11	62

9	**L9**	21	86
10	**L10**	7	-47

[a] Reaction conditions: **1a** (0.1 mmol), **2a** (0.15 mmol), $Ni(cod)_2$ (10 mol %), ligand (11 mol %), NaO^{t}Bu (0.15 mmol), toluene (1.0 mL), 120℃, 24 h. [b] Yield of **3** determined by ^{1}H NMR using dibromomethane as internal standard. [c] Determined by chiral HPLC

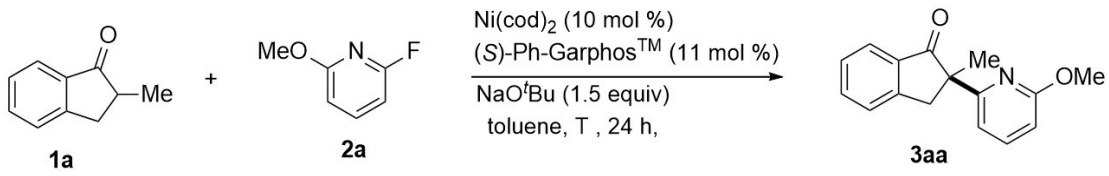
Table S2. Exploring the influence of base [a]



Entry	Base	Yield (%) [b]	*ee* (%) [c]
1	NaHMDS	trace	25
2	LiO^{t}Bu	17	86
3	KO^{t}Bu	34	63
4	NaOMe	trace	91
5	LiOMe	trace	90
6	KOMe	trace	89
7	NaOEt	trace	60
8	K_3PO_4	trace	94
9	DABCO	NR	-
10	NaOH	trace	67

[a] Reaction conditions: **1a** (0.1 mmol), **2a** (0.15 mmol), $Ni(cod)_2$ (10 mol %), (S)-Ph-Garphos™ (11 mol %), Base (0.15 mmol), toluene (1.0 mL), 120℃, 24 h. [b] Yield of **3aa** determined by ^{1}H NMR using dibromomethane internal standard. [c] Determined by chiral HPLC.

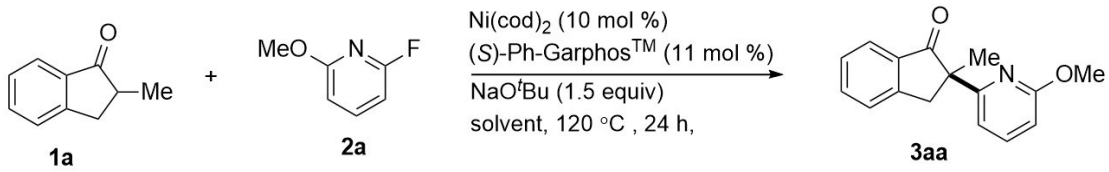
Table S3. The influence of temperature [a]



Entry	T (°C)	Yield (%) [b]	*ee* (%) [c]
1	110	trace	-
2	120	42	92

[a] Reaction conditions: **1a** (0.1 mmol), **2a** (0.15 mmol), $Ni(cod)_2$ (10 mol %), (S)-Ph-Garphos™ (11 mol %), NaO^tBu (0.15 mmol), toluene (1.0 mL), T, 24 h. [b] Yield of **3aa** determined by ^1H NMR using dibromomethane as internal standard. [c] Determined by chiral HPLC.

Table S4. Exploring the influence of solvent and concentration ratio of substrates[a]

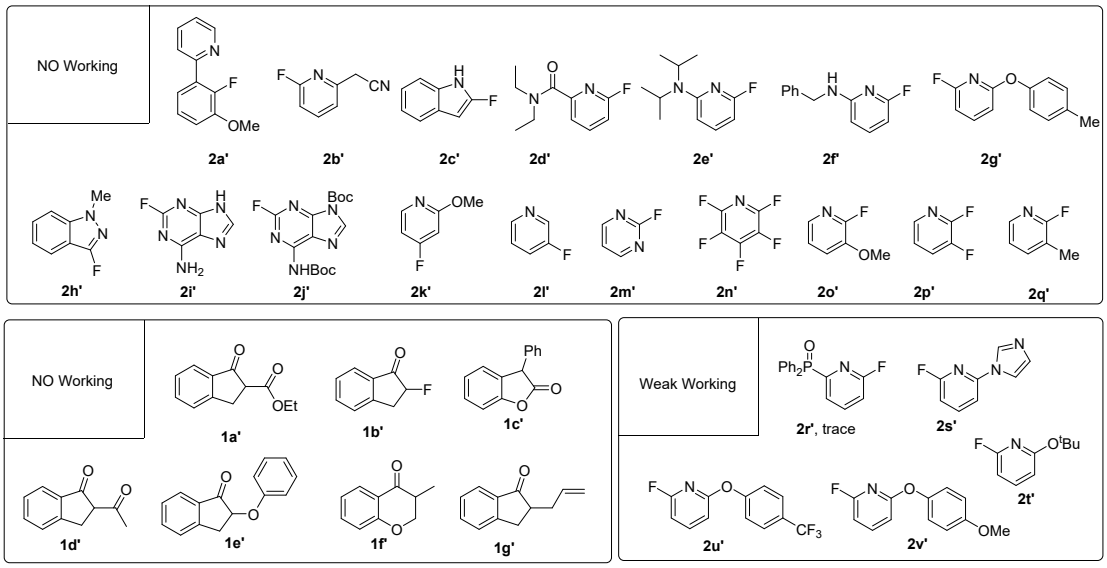


Entry	solvent	Yield (%) [b]	*ee* (%) [c]
1	toluene	42	92
2	m-Xylene	27	93
3	DMF	25	10
4	Benzotrifluoride	7	racemic
5	anisole	44	97
6	ethylbenzene	NR	-
7	mesitylene	NR	-
8	*p*-difluorobenzene	NR	-
9	*p*-xylene	NR	-
10	1,4-dioxane	84	90
11[d]	anisole	78(77 [e])	97
12[d]	1,4-dioxane	85	91

[a] Reaction conditions: **1a** (0.1 mmol), **2a** (0.15 mmol), $Ni(cod)_2$ (10 mol %), (S)-Ph-Garphos^{TM} (11 mol %), NaO^{t}Bu (1.5 equiv), solvent (1.0 mL), 120℃, 24 h. [b] Yield of **3aa** determined by ^{1}H NMR using dibromomethane internal standard. [c] Determined by chiral HPLC. [d] **1a** (0.2 mmol), **2a** (0.1 mmol), NaO^{t}Bu (0.11 mmol). [d] Isolated yield.

General procedural for the asymmetric heteroarylation

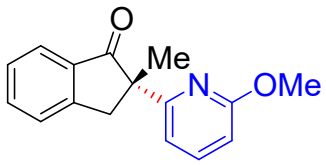
A flame-dried sealed pressure-resistant tube (10 mL) equipped with a magnetic stir bar (10 mm × 5 mm, egg shaped) was evacuated and filled Ar for three times before being transferred into a glovebox. $Ni(cod)_2$ (0.01 mmol, 10 mol %), (*S*)-Ph-GarPhos (0.011 mmol, 11 mol%) and dry 1,4-dioxane (1 mL) was added to the tube stiring for 10 min. NaO^{t}Bu (0.15 mmol, 1.5 equiv), indanone derivatives (0.1 mmol, 1 equiv) and heteroaryl fluorides (0.15 mmol, 1.5 equiv) were added in succession. The reaction tube was capped and taken out of the glovebox. The reaction was stirred at 120℃ for 24 h. After cooling the reaction mixture to ambient temperature, the mixture was concentrated and directly purified by purified by silica gel chromatography using PE/EA (silica gel, 100:1 to 30:1) to afford the product.



Scheme S1. Weak or non-reactive substrate. Reaction conditions: **1** (0.2 mmol), **2** (0.1 mmol), $Ni(cod)_2$ (10 mol %), (S)-Ph-Garphos^{TM}, NaO^{t}Bu (0.11 mmol) (0.11 mmol), anisole (1.0 mL), 120 °C, 24 h, Isolated yield, ee was determined by chiral HPLC.

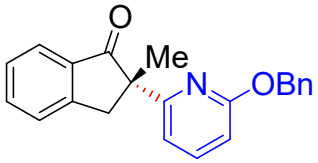
4. Characterization of products

***(S)*-2-(6-Methoxypyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3aa)**



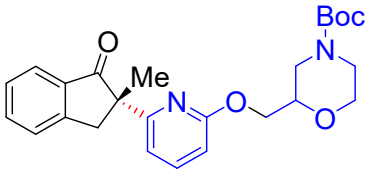
Light yellow oil (19.5 mg, 77% yield, 97% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.78 (d, *J* = 7.7 Hz, 1H), 7.64 – 7.56 (m, 1H), 7.56 – 7.45 (m, 2H), 7.42 – 7.34 (m, 1H), 7.06 – 6.98 (m, 1H), 6.60 – 6.51 (m, 1H), 4.01 (d, *J* = 17.1 Hz, 1H), 3.70 (s, 3H), 3.14 (d, *J* = 17.1 Hz, 1H), 1.66 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) 208.5, 163.2, 160.0, 153.8, 139.2, 135.7, 135.0, 127.5, 126.4, 124.7, 113.4, 108.7, 55.9, 53.1, 42.7, 23.5. $[\alpha]^{29}_{D}$ = -32.2 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (minor) = 4.9 min, t_r (major) = 5.6 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{16}H_{16}NO_2$, 254.1181; found 254.1172.

***(S)*-2-(6-(Benzyloxy) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ab)**



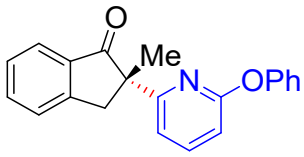
Colorless oil (16.5 mg, 50% yield, 71% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 – 7.75 (m, 1H), 7.67 – 7.60 (m, 1H), 7.56 – 7.47 (m, 2H), 7.43 – 7.38 (m, 1H), 7.31 – 7.21 (m, 5H), 7.05 – 7.00 (m, 1H), 6.65 – 6.59 (m, 1H), 5.24 – 5.03 (m, 2H), 3.88 (d, *J* = 17.1 Hz, 1H), 3.11 (d, *J* = 17.1 Hz, 1H), 1.65 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) 208.5, 162.6, 160.0, 153.9, 139.3, 137.8, 135.7, 135.0, 128.4, 128.2, 127.7, 127.5, 126.4, 124.8, 113.5, 109.3, 67.2, 55.8, 42.9, 23.3. $[\alpha]^{29}_{D}$ = -11.4 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ID (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 10.0 min, t_r (major) = 12.4 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO_2$, 330.1494; found 330.1485.

***t*-butyl (*R*)-2-(((6-((*S*)-2-Methyl-1-oxo-2,3-dihydro-1*H*-inden-2-yl) pyridin-2-yl) oxy) methyl) morpholine-4-carboxylate (3ac)**



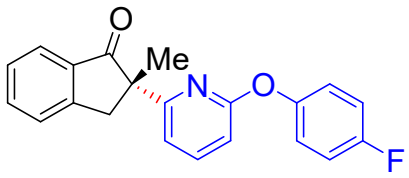
Colorless oil (21.0 mg, 48% yield, 92% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.82 – 7.73 (m, 1H), 7.65 – 7.58 (m, 1H), 7.55 – 7.47 (m, 2H), 7.43 – 7.34 (m, 1H), 7.08 – 6.98 (m, 1H), 6.61 (d, *J* = 8.2 Hz, 1H), 4.20 – 3.87 (m, 6H), 3.68 – 3.59 (m, 1H), 3.54 – 3.45 (m, 1H), 3.14 (d, *J* = 17.0 Hz, 1H), 2.94 (s, 1H), 2.66 (s, 1H), 1.65 (s, 3H), 1.46 (d, *J* = 2.6 Hz, 9H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.4, 162.4, 159.9, 159.8, 154.9, 139.4, 135.7, 135.1, 135.1, 127.6, 126.4, 126.4, 124.8, 113.8, 109.3, 80.2, 73.8, 66.7, 65.8, 55.9, 42.8, 28.5, 23.4. $[\alpha]^{27}_{D}$ = -85.9 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IC (0.46 cm x 25 cm), Hexanes / IPA = 80 / 20, 1.0 mL/min, λ = 254 nm, t_r (minor) = 14.1 min, t_r (major) = 16.2 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{25}H_{31}N_2O_5$, 439.2233; found 439.2223.

***(S)*-2-Methyl-2-(6-phenoxypyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ad)**



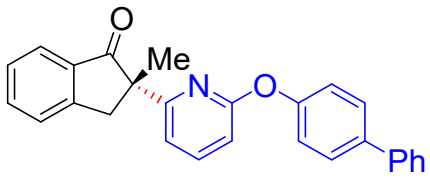
Colorless oil (22.1 mg, 70% yield, 98% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.79 – 7.68 (m, 1H), 7.68 – 7.51 (m, 2H), 7.43 – 7.32 (m, 2H), 7.31 – 7.16 (m, 3H), 7.16 – 7.07 (m, 1H), 7.07 – 6.96 (m, 2H), 6.69 – 6.61 (m, 1H), 3.91 (d, *J* = 17.2 Hz, 1H), 3.05 (d, *J* = 17.2 Hz, 1H), 1.63 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) 208.2, 162.8, 160.7, 154.1, 153.7, 140.0, 135.4, 135.1, 129.4, 127.4, 126.5, 124.7, 124.3, 121.2, 115.6, 108.9, 55.8, 42.1, 24.1. $[\alpha]^{29}_{D}$ = 0.2 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.3 min, t_r (major) = 7.4 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{18}NO_2$, 316.1338; found 316.1229.

***(S)*-2-(6-(4-Fluorophenoxy) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ae)**



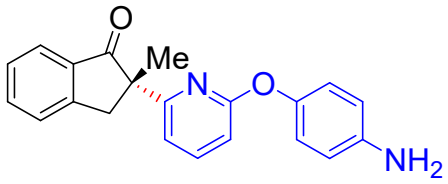
Light yellow oil (18.3 mg, 55% yield, 94% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.73 – 7.68 (m, 1H), 7.62 (t, *J* = 7.9 Hz, 1H), 7.60 – 7.55 (m, 1H), 7.39 – 7.33 (m, 2H), 7.18 (d, *J* = 7.5 Hz, 1H), 6.95 – 6.83 (m, 4H), 6.67 (d, *J* = 8.2 Hz, 1H), 3.78 (d, *J* = 17.0 Hz, 1H), 3.02 (d, *J* = 17.0 Hz, 1H), 1.61 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.2, 162.7, 160.7, 159.4 (d, *J* = 242.1 Hz), 153.8, 149.7 (d, *J* = 2.9 Hz), 140.1, 135.4, 135.1, 127.4, 126.4, 124.7, 122.8 (d, *J* = 8.4 Hz), 115.8 (d, *J* = 23.2 Hz), 115.3, 108.8, 55.7, 42.3, 23.4. ^{19}F NMR (376 MHz, $CDCl_3$) δ -119.25. $[\alpha]^{29}_{D}$ = 19.7 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.4 min, t_r (major) = 7.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{17}NFO_2$, 334.1243; found 334.1235.

***(S)*-2-(6-([1,1'-Biphenyl]-4-yloxy) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3af)**



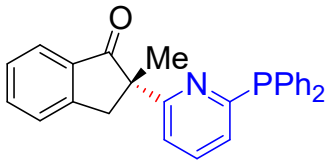
Colorless oil (27.8 mg, 71% yield, 98% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.77 – 7.69 (m, 1H), 7.67 – 7.61 (m, 1H), 7.59 – 7.55 (m, 2H), 7.54 – 7.49 (m,1H), 7.49 – 7.43 (m, 4H), 7.38 – 7.30 (m, 3H), 7.22 (d, *J* = 7.5 Hz, 1H), 7.11 – 7.03 (m, 2H), 6.72 (d, *J* = 8.1 Hz, 1H), 3.91 (d, *J* = 17.1 Hz, 1H), 3.06 (d, *J* = 17.1 Hz, 1H), 1.64 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.2, 162.7, 160.8, 153.8, 153.6, 140.7, 140.1, 137.2, 135.4, 135.0, 128.9, 1280, 127.4, 127.2, 127.1, 126.5, 124.7, 121.5, 115.6, 109.0, 55.8, 42.3, 23.8. $[\alpha]^{29}_{D}$ = -29.4 (c 2.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (minor) = 7.8 min, t_r (major) = 9.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{27}H_{22}NO_2$, 392.1651; found 392.1639.

***(S)*-2-(6-(4-Aminophenoxy) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ag)**



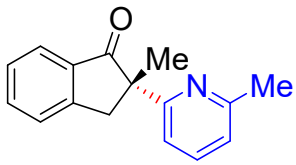
Light yellow oil (7.6 mg, 23% yield, 91% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.75 (d, *J* = 7.5 Hz, 1H), 7.63 – 7.53 (m, 2H), 7.44 – 7.39 (m, 1H), 7.39 – 7.34 (m, 1H), 7.15 (d, *J* = 7.5 Hz, 1H), 6.89 – 6.77 (m, 2H), 6.65 – 6.57 (m, 2H), 6.55 (d, *J* = 8.2 Hz, 1H), 3.97 (d, *J* = 17.2 Hz, 1H), 3.07 (d, *J* = 17.2 Hz, 1H), 1.63 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.4, 163.7, 160.7, 153.7, 146.3, 143.1, 139.9, 135.4, 135.0, 127.4, 126.6, 124.7, 122.4, 116.0, 115.1, 108.0, 55.8, 42.2, 24.3. $[\alpha]^{27}_{D}$ = -44.6 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ID (0.46 cm x 25 cm), Hexanes / IPA = 60 / 40, 0.8 mL/min, λ = 210 nm, t_r (minor) = 8.0 min, t_r (major) = 10.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{19}N_2O_2$, 331.1447; found 331.1435.

***(S)*-2-(6-(Diphenylphosphaneyl) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ah)**



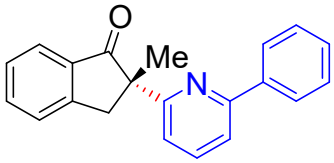
Yellow oil (19.1 mg, 47% yield, 90% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.76 – 7.70 (m, 1H), 7.61 – 7.56 (m, 1H), 7.55 – 7.49 (m, 1H), 7.46 – 7.41 (m, 1H), 7.41 – 7.19 (m, 12H), 7.09 – 7.00 (m, 1H), 4.06 (d, *J* = 17.1 Hz, 1H), 3.03 (d, *J* = 17.1 Hz, 1H), 1.65 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) δ 208.4, 162.2, 162.1, 154.0, 136.3, 136.3, 135.3, 135.1, 134.5, 134.4, 134.3, 134.2, 134.1, 129.0, 128.8, 128.5, 128.4, 128.4, 128.3, 127.4, 126.7, 126.6, 126.5, 124.7, 119.8, 56.3, 41.8, 24.5. ^{31}P NMR (202 MHz, $CDCl_3$) δ -3.75. $[\alpha]^{29}_{D}$ = 102.9 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IC (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 9.4 min, t_r (major) = 12.3 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{27}H_{23}NOP$, 408.1517; found 408.1509.

***(S)*-2-Methyl-2-(6-methylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ai)**



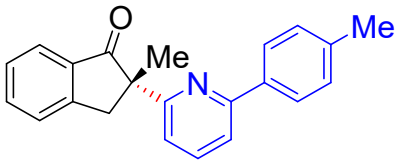
Colorless oil (12.8 mg, 54% yield, 83% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.79 (d, *J* = 7.6 Hz, 1H), 7.61 (td, *J* = 7.5, 1.3 Hz, 1H), 7.58 – 7.45 (m, 2H), 7.38 (t, *J* = 7.5 Hz, 1H), 7.30 (d, *J* = 7.9 Hz, 1H), 6.97 (d, *J* = 7.6 Hz, 1H), 4.18 (d, *J* = 17.2 Hz, 1H), 3.16 (d, *J* = 17.2 Hz, 1H), 2.45 (s, 3H), 1.66 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) δ 208.9, 161.4, 157. 8, 153.7, 136.7, 135.5, 135.1, 127.5, 126.6, 124.7, 121.3, 118.0, 56.0, 42.2, 24.9, 24.7. $[\alpha]^{29}_D$ = 12.9 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (minor) = 4.9 min, t_r (major) = 5.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{16}H_{16}NO$, 238.1232; found 238.1224.

***(S)*-2-Methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3aj)**



Yellow oil (27.2 mg, 91% yield, 98% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.97 – 7.89 (m, 2H), 7.83 – 7.78 (m, 1H), 7.71 (t, *J* = 7.8 Hz, 1H), 7.67 – 7.51 (m, 3H), 7.47 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.44 – 7.31 (m, 4H), 4.32 (d, *J* = 17.2 Hz, 1H), 3.21 (d, *J* = 17.2 Hz, 1H), 1.75 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) 208.6, 161.7, 156.0, 153.8, 139.4, 137.4, 135.6, 135.1, 129.0, 128.7, 127.5, 126.9, 126.6, 124.8, 119.6, 118.2, 56.4, 42.1, 24.7. $[\alpha]^{29}_D$ = -65.0 (c 2.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.7 min, t_r (major) = 7.5 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{18}NO$, 300.1388; found 300.1379.

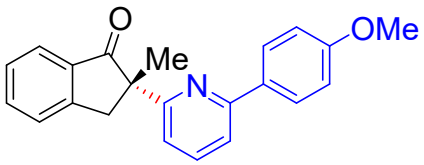
***(S)*-2-Methyl-2-(6-(*p*-tolyl) pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ak)**



Light yellow oil (31.0 mg, 99% yield, 97% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 – 7.75 (m, 3H), 7.68 (t, *J* = 7.8 Hz, 1H), 7.66 – 7.60 (m, 1H), 7.59 – 7.51 (m, 2H), 7.47 – 7.42 (m, 1H), 7.42 – 7.37 (m, 1H), 7.21 (d,

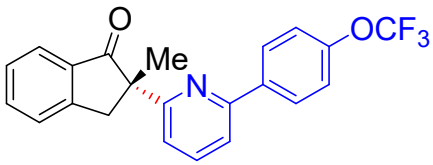
J = 8.0 Hz, 2H), 4.32 (d, *J* = 17.1 Hz, 1H), 3.21 (d, *J* = 17.1 Hz, 1H), 2.37 (s, 3H), 1.75 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.7, 161.6, 156.0, 153.9, 138.9, 137.3, 136.7, 135.6, 135.1, 129.4, 127.5, 126.8, 126.6, 124.8, 119.2, 117.9, 56.4, 42.1, 24.6, 21.4. $[\alpha]^{29}_D$ = -75.5 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.2 min, t_r (major) = 6.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO$, 314.1545; found 314.1536.

***(S)*-2-(6-(4-Methoxyphenyl) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3al)**



Light yellow oil (28.6 mg, 87% yield, 96% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.93 – 7.83 (m, 2H), 7.80 (d, *J* = 7.7 Hz, 1H), 7.70 – 7.59 (m, 2H), 7.53 (t, *J* = 7.6 Hz, 2H), 7.40 (d, *J* = 7.6 Hz, 2H), 6.98 – 6.87 (m, 2H), 4.30 (d, *J* = 17.1 Hz, 1H), 3.83 (s, 3H), 3.20 (d, *J* = 17.1 Hz, 1H), 1.74 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.7, 161.6, 160.5, 155.7, 153.9, 137.3, 135.6, 135.1, 132.1, 128.2, 127.5, 126.6, 124.8, 118.8, 117.4, 114.0, 56.3, 55.5, 42.2, 24.6. $[\alpha]^{29}_D$ = -84.0 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 8.8 min, t_r (major) = 10.4 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO_2$, 330.1494; found 330.1485.

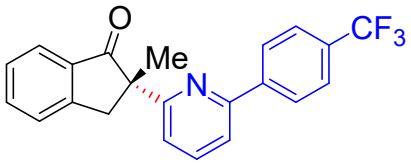
***(S)*-2-Methyl-2-(6-(4-(trifluoromethoxy)phenyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3am)**



Light yellow oil (24.9 mg, 65% yield, 94% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.97 – 7.92 (m, 2H), 7.83 – 7.78 (m, 1H), 7.76 – 7.70 (m, 1H), 7.69 – 7.62 (m, 1H), 7.60 – 7.52 (m, 2H), 7.52 – 7.46 (m, 1H), 7.44 – 7.37 (m, 1H), 7.26 – 7.21 (m, 2H), 4.26 (d, *J* = 17.1 Hz, 1H), 3.22 (d, *J* = 17.1 Hz, 1H), 1.75 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.5, 162.0, 154.6, 153.7, 149.9, 138.0, 137.6, 135.5, 135.2, 128.4, 127.6, 126.6, 124.8, 121.0, 120.6 (q, *J* = 257.2 Hz), 119.9, 118.2, 56.3, 42.2, 24.5. ^{19}F NMR (376 MHz, $CDCl_3$) δ -57.54. $[\alpha]^{29}_D$ = -166.9 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm),

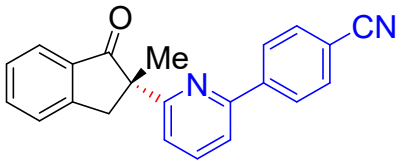
Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 270 nm, t_r (minor) = 6.0 min, t_r (major) = 6.4 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO_2$, 384.1211; found 384.1203.

(*S*)-2-Methyl-2-(6-(4-(trifluoromethyl)phenyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3an)



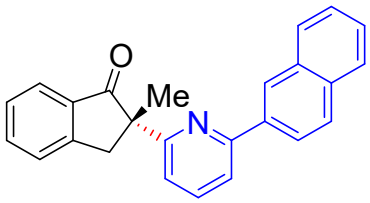
Yellow oil (34.1 mg, 93% yield, 98% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.07 – 7.98 (m, 2H), 7.81 (d, *J* = 7.7 Hz, 1H), 7.75 (t, *J* = 7.9 Hz, 1H), 7.68 – 7.59 (m, 4H), 7.59 – 7.51 (m, 2H), 7.41 (t, *J* = 7.4 Hz, 1H), 4.26 (d, *J* = 17.1 Hz, 1H), 3.23 (d, *J* = 17.1 Hz, 1H), 1.76 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 208.4, 162.2, 154.4, 153.7, 142.6, 137.7, 135.5, 135.3, 130.7 (q, *J* = 32.5 Hz), 127.6, 127.2, 126.6, 125.6 (q, *J* = 3.8 Hz), 124.8, 124.3 (q, *J* = 272.0 Hz), 120.5, 118.6, 77.4, 77.2, 76.9, 56.3, 42.2, 24.5. ^{19}F NMR (376 MHz, $CDCl_3$): δ -62.57. $[\alpha]^{29}_D$ = -44.6 (c 2.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 12.3 min, t_r (major) = 12.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{17}F_3NO$, 368.1262; found 368.1255.

(*S*)-4-(6-(2-Methyl-1-oxo-2,3-dihydro-1*H*-inden-2-yl)pyridin-2-yl)benzonitrile (3ao)



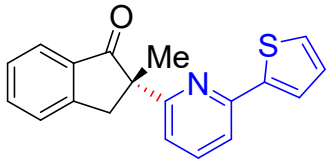
Colorless oil (19.8 mg, 82% yield, 91% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.07 – 7.97 (m, 2H), 7.83 – 7.73 (m, 2H), 7.71 – 7.59 (m, 4H), 7.58 – 7.51 (m, 2H), 7.45 – 7.38 (m, 1H), 4.23 (d, *J* = 17.2 Hz, 1H), 3.23 (d, *J* = 17.2 Hz, 1H), 1.75 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$): 208.2, 162.4, 153.7, 153.6, 143.4, 137.8, 135.4, 135.3, 132.5, 127.7, 127.4, 126.6, 124.9, 120. 9, 119.0, 118.8, 112.3, 56.3, 42.2, 24.5. $[\alpha]^{29}_D$ = -87.4 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ID (0.46 cm x 25 cm), Hexanes / IPA = 60 /40, 1.0 mL/min, λ = 270 nm, t_r (minor) = 8.0 min, t_r (major) = 10.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{17}N_2O$, 325.1341; found 325.1332.

(*S*)-2-Methyl-2-(6-(naphthalen-2-yl) pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ap)



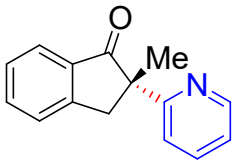
Yellow transparent crystal (32.5 mg, 93% yield, 98% *ee*). M.p. 122.3-123.5°C. ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.42 – 8.30 (m, 1H), 8.12 – 8.05 (m, 1H), 7.91 – 7.81 (m, 4H), 7.79 – 7.72 (m, 2H), 7.71 – 7.63 (m, 1H), 7.57 (d, *J* = 7.7 Hz, 1H), 7.54 – 7.46 (m, 3H), 7.42 (t, *J* = 7.4 Hz, 1H), 4.35 (d, *J* = 17.2 Hz, 1H), 3.26 (d, *J* = 17.1 Hz, 1H), 1.80 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.7, 161.8, 155.8, 153.9, 137.5, 136.7, 135.6, 135.1, 133.7, 133.5, 128.8, 128.3, 127.7, 127.5, 126.6, 126.5, 126.3, 126.2, 124.8, 124.7, 119.5, 118.5, 56.4, 42.3, 24.5. $[\alpha]^{29}_{D}$ = -44.6 (c 2.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 8.1 min, t_r (major) = 10.0 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{25}H_{20}NO$, 350.1545; found 350.1537.

***(S)*-2-Methyl-2-(6-(thiophen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3aq)**



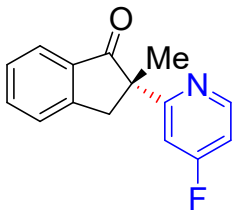
Light yellow oil (19.8 mg, 65% yield, 87% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.82 – 7.76 (m, 1H), 7.68 – 7.59 (m, 2H), 7.57 – 7.52 (m, 1H), 7.52 – 7.45 (m, 2H), 7.42 – 7.36 (m, 2H), 7.30 (dd, *J* = 5.1, 1.2 Hz, 1H), 7.04 (dd, *J* = 5.1, 3.7 Hz, 1H), 4.29 (d, *J* = 17.1 Hz, 1H), 3.18 (d, *J* = 17.1 Hz, 1H), 1.72 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) 208.4, 161.6, 153.9, 151.5, 145.5, 137.4, 135.5, 135.2, 128.0, 127.6, 127.5, 126.6, 124.8, 124.4, 119.3, 116.6, 56.2, 41.9, 24.6. $[\alpha]^{29}_{D}$ = -105.03 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 7.3 min, t_r (major) = 9.6 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{19}H_{16}NOS$, 306.0953; found 306.0945.

***(S)*-2-Methyl-2-(pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ar)**



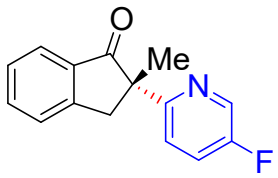
Light yellow oil (17.6 mg, 79% yield, 81% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.55 – 8.46 (m, 1H), 7.80 (d, *J* = 7.7 Hz, 1H), 7.70 – 7.59 (m, 2H), 7.55 – 7.48 (m, 2H), 7.43 – 7.36 (m, 1H), 7.16 – 7.10 (m, 1H), 4.10 (d, *J* = 17.2 Hz, 1H), 3.20 (d, *J* = 17.2 Hz, 1H), 1.69 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 208.6, 162.4, 153.5, 149.3, 136.7, 135.4, 135.3, 127.7, 126.7, 124.9, 121.9, 121.2, 55.9, 42.5, 24.6. $[\alpha]^{29}_{D}$ = -111.0 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.4 min, t_r (major) = 7.5 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{15}H_{14}NO$, 224.1075; found 224.1066.

***(S)*-2-(4-Fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3as)**



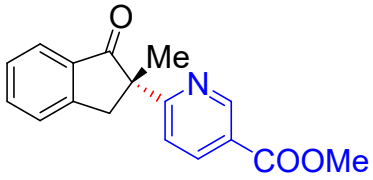
Colorless oil (10. 1 mg, 42% yield, 90% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.51 – 8.42 (m, 1H), 7.80 (d, *J* = 7.7 Hz, 1H), 7.68 – 7.60 (m, 1H), 7.51 (d, *J* = 7.7 Hz, 1H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.34 – 7.28 (m, 1H), 6.92 – 6.86 (m, 1H), 4.08 (d, *J* = 17.2 Hz, 1H), 3.20 (d, *J* = 17.2 Hz, 1H), 1.67 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$) δ 207.8, 169.2 (d, *J* = 262.0 Hz), 165.9 (d, *J* = 6.5 Hz), 153.4, 151.5 (d, *J* = 7.2 Hz), 135.5, 135.1, 127.8, 126.7, 125.0, 109.9 (d, *J* = 16.4 Hz), 109.4 (d, *J* = 17.6 Hz), 55.8 (d, *J* = 2.8 Hz), 42.3, 24.6. ^{19}F NMR (376 MHz, $CDCl_3$) δ -102.01. $[\alpha]^{29}_{D}$ = 31.0 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.1 min, t_r (major) = 7.1 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{15}H_{13}FNO$, 242.0981; found 242.0973.

***(S)*-2-(5-fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3at)**



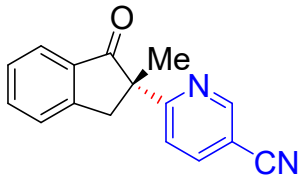
Colorless oil (15.9 mg, 66% yield, 94% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.34 (d, *J* = 2.9 Hz, 1H), 7.86 – 7.72 (m, 1H), 7.70 – 7.68 (m, 1H), 7.59 – 7.47 (m, 2H), 7.46 – 7.32 (m, 2H), 4.07 (d, *J* = 17.2 Hz, 1H), 3.19 (d, *J* = 17.3 Hz, 1H), 1.67 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 208.2, 159.7, 158.1, 157.2, 153.3, 137.3, 137.1, 135.4, 135.1, 127.8, 126.7, 124.9, 123.4, 123.2, 122.1, 122.1, 55.4, 42.3, 25.0. $[\alpha]^{25}_{D}$ = -0.26 (c 0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ASH (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (major) = 5.7 min, t_r (minor) = 6.5 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{15}H_{12}FNO$, 242.0981; found 242.0976.

Methyl *(S)*-6-(2-methyl-1-oxo-2,3-dihydro-1H-inden-2-yl)nicotinate (3au)



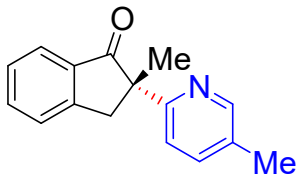
Colorless oil (18.3 mg, 65% yield, 78% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.09 (dd, *J* = 2.2, 0.9 Hz, 1H), 8.25 (dd, *J* = 8.3, 2.3 Hz, 1H), 7.84 – 7.76 (m, 1H), 7.69 – 7.58 (m, 2H), 7.56 – 7.48 (m, 1H), 7.48 – 7.36 (m, 1H), 4.11 (d, *J* = 17.3 Hz, 1H), 3.92 (s, 3H), 3.21 (d, *J* = 17.3 Hz, 1H), 1.71 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 207.7, 166.7, 165.9, 153.3, 150.4, 137.8, 135.4, 135.1, 127.8, 126.7, 125.0, 124.2, 120.8, 56.2, 52.5, 42.3, 24.6. $[\alpha]^{25}_{D}$ = -0.13 (c 0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ASH (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (major) = 11.2 min, t_r (minor) = 16.9 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{17}H_{16}NO_3$, 282.1130; found 282.1124.

***(S)*-6-(2-methyl-1-oxo-2,3-dihydro-1H-inden-2-yl)nicotinonitrile (3av)**



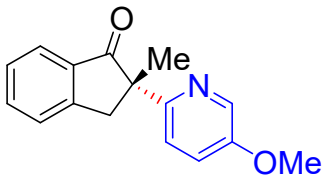
Colorless oil (8.6 mg, 35% yield, 37% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.79 – 8.69 (m, 1H), 7.96 – 7.88 (m, 1H), 7.82 – 7.74 (m, 1H), 7.73 – 7.61 (m, 2H), 7.56 – 7.49 (m, 1H), 7.42 (t, *J* = 7.5 Hz, 1H), 4.10 (d, *J* = 17.3 Hz, 1H), 3.21 (d, *J* = 17.3 Hz, 1H), 1.70 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 206.9, 166.6, 153.1, 151.8, 139. 8, 135.7, 134.8, 123.0, 126.7, 125.2, 121.4, 116.8, 108.0, 56.4, 41.9, 24.7. $[\alpha]^{25}_D$ = -0.09 (c 0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ASH (0.46 cm x 25 cm), Hexanes / IPA = 80 / 20, 1.0 mL/min, λ = 254 nm, t_r (major) = 10.7 min, t_r (minor) = 15.4 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{16}H_{13}N_2O$, 249.1028; found 249.1022.

***(S)* 2-methyl-2-(5-methylpyridin-2-yl)-2,3-dihydro-1H-inden-1-one (3aw)**



Colorless oil (5.7 mg, 24% yield, 81% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.41 – 8.27 (m, 1H), 7.81 – 7.76 (m, 1H), 7.65 – 7.57 (m, 1H), 7.53 – 7.34 (m, 4H), 4.07 (d, *J* = 17.2 Hz, 1H), 3.18 (d, *J* = 17.5 Hz, 1H), 2.28 (s, 3H), 1.66 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 208.8, 159.5, 153.5, 149.7, 137.2, 135.4, 135.2, 131.2, 127.6, 126.7, 124.9, 120.6, 55.6, 42.5, 24.6, 18.1. $[\alpha]^{25}_D$ = -0.09 (c 0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ASH (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (major) = 5.8 min, t_r (minor) = 6.8 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{16}H_{16}NO$, 238.1232; found 238.1226.

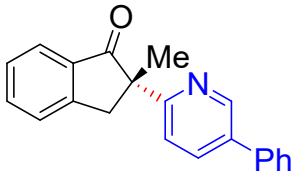
***(S)*- 2-(5-methoxypyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3ax)**



Colorless oil (14.9 mg, 59% yield, 86% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.20 (dd, *J* = 3.1, 0.7 Hz, 1H), 7.83 – 7.73 (m, 1H), 7.66 – 7.56 (m, 1H), 7.53 – 7.34 (m, 3H), 7.20 – 7.12 (m, 1H), 4.06 (d, *J* = 17.2 Hz, 1H), 3.81 (s, 3H), 3.17 (d, *J* = 17.2 Hz, 1H), 1.66 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 208.8, 154.4, 154.2, 153.5, 136.7, 135.3, 135.2, 127.6, 126.7, 124.8, 121.3, 121.1, 55.7, 55.2, 42.5, 24.7. $[\alpha]^{25}_D$ = -0.23 (c

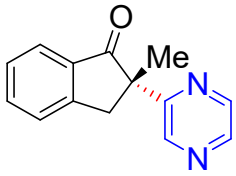
0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ASH (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (major) = 8.7 min, t_r (minor) = 11.0 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{16}H_{16}NO_2$, 254.1181; found 254.1176.

(*S*)-2-methyl-2-(5-phenylpyridin-2-yl)-2,3-dihydro-1H-inden-1-one (3ay)



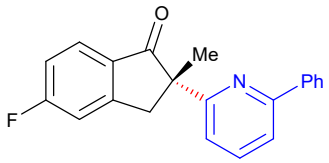
Colorless oil (23.0 mg, 77% yield, 90% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.79 – 8.67 (m, 1H), 7.90 – 7.78 (m, 2H), 7.66 – 7.58 (m, 2H), 7.57 – 7.50 (m, 3H), 7.49 – 7.33 (m, 4H), 4.15 (d, *J* = 17.3 Hz, 1H), 3.24 (d, *J* = 17.3 Hz, 1H), 1.74 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 208.5, 161.2, 153.5, 147.7, 137.8, 135.4, 135.3, 135.1, 134.8, 129.2, 128.0, 127.7, 127.2, 126.7, 124.9, 121.0, 55.7, 42.5, 24.6. $[\alpha]^{25}_D$ = -0.34 (c 0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ASH (0.46 cm x 25 cm), Hexanes / IPA = 92 / 8, 1.0 mL/min, λ = 254 nm, t_r (major) = 7.6 min, t_r (minor) = 9.6 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{18}NO$, 300.1388; found 300.1383.

(*S*)-2-Methyl-2-(pyrazin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3az)



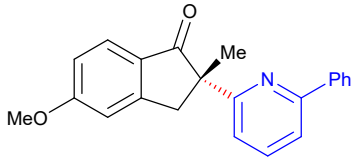
Light yellow solid (11.6 mg, 52% yield, 79% *ee*). M.p. 90.3-93.1°C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.83 (s, 1H), 8.53 – 8.38 (m, 2H), 7.80 (d, *J* = 7.7 Hz, 1H), 7.70 – 7.60 (m, 1H), 7.58 – 7.47 (m, 1H), 7.46 – 7.38 (m, 1H), 4.04 (d, *J* = 17.3 Hz, 1H), 3.22 (d, *J* = 17.3 Hz, 1H), 1.74 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 207.3, 157.9, 153.1, 143.8, 143.3, 142.9, 135.6, 134.9, 128.0, 126.7, 125.1, 54.8, 41.9, 24.2. $[\alpha]^{29}_D$ = 153.7 (c 1.0, $CHCl_3$). ^{19}F NMR (376 MHz, $CDCl_3$) δ -130.19.The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 90 / 10, 1.0 mL/min, λ = 254 nm, t_r (major) = 7.9 min, t_r (minor) = 8.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{14}H_{13}N_2O$, 225.1028; found 225.1020.

(*S*)-5-Fluoro-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3bj)



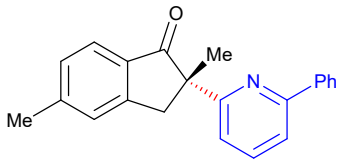
Light yellow solid (21.9 mg, 69% yield, 94% *ee*). M.p. 98.0-98.5°C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.97 – 7.88 (m, 2H), 7.83 – 7.76 (m, 1H), 7.72 (t, *J* = 7.8 Hz, 1H), 7.60 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.49 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.45 – 7.34 (m, 3H), 7.23 – 7.17 (m, 1H), 7.14 – 7.06 (m, 1H), 4.36 (d, *J* = 17.4 Hz, 1H), 3.17 (d, *J* = 17.4 Hz, 1H), 1.74 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$): 206.7, 167.6 (d, *J* = 256.3 Hz), 161.3, 156.8 (d, *J* = 9.9 Hz), 156.0, 139.3, 137.5, 131.9 (d, *J* = 1.9 Hz), 129.0, 128.7, 127.1 (d, *J* = 10.5 Hz),126.9, 119.5, 118.4, 115.9 (d, *J* = 23.8 Hz), 113.2 (d, *J* = 22.2 Hz), 56.7, 41.8, 41.8, 24.6. ^{19}F NMR (376 MHz, $CDCl_3$) δ -102.64. $[\alpha]^{29}_D$ = -184.2 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 97 / 3, 1.0 mL/min, λ = 254 nm, t_r (minor) = 8.2 min, t_r (major) = 9.2 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{17}FNO$, 318.1294; found 318.1286.

***(S)*-5-Methoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3cj)**



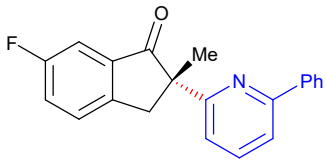
Colorless oil (32.6 mg, 99% yield, 96% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.99 – 7.92 (m, 2H), 7.77 – 7.67 (m, 2H), 7.62 – 7.55 (m, 1H), 7.52 – 7.47 (m, 1H), 7.46 – 7.39 (m, 2H), 7.39 – 7.33 (m, 1H), 6.97 (d, *J* = 2.2 Hz, 1H), 6.94 – 6.90 (m, 1H), 4.29 (d, *J* = 17.2 Hz, 1H), 3.90 (s, 3H), 3.16 (d, *J* = 17.2 Hz, 1H), 1.74 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 206.8, 165.8, 161.9, 156.8, 155.9, 139.4, 137.4, 128.9, 128.7, 128.7, 126.9, 126.5, 119.6, 118.2, 115.7, 109.6, 56.5, 55.8, 42.0, 24.9. $[\alpha]^{29}_D$ = 4.7 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 90 / 10, 1.0 mL/min, λ = 254 nm, t_r (minor) = 7.6 min, t_r (major) = 8.3 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO_2$, 330.1494; found 330.1484.

***(S)*-2,5-Dimethyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3dj)**



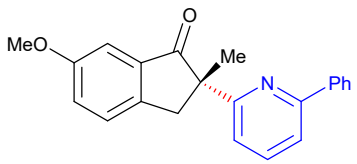
Colorless oil (31.0 mg, 99% yield, 97% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.98 – 7.93 (m, 2H), 7.70 (dt, *J* = 7.8, 3.9 Hz, 2H), 7.59 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.47 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.45 – 7.39 (m, 2H), 7.39 – 7.32 (m, 2H), 7.21 (d, *J* = 7.8 Hz, 1H), 4.27 (d, *J* = 17.1 Hz, 1H), 3.16 (d, *J* = 17.1 Hz, 1H), 2.47 (s, 3H), 1.74 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 208.2, 161.9, 155.9, 154.3, 146.3, 139.4, 137.4, 133.3, 128.9, 128.8, 128.7, 126.9, 126.9, 124.6, 119.6, 118.2, 56.5, 41.9, 24.8, 22.3. $[\alpha]^{29}_{D}$ = -84.0 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 97 / 3, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.5 min, t_r (major) = 7.0 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{23}H_{21}NO_3$, 314.1545; found 314.1536.

***(S)*-6-Fluoro-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ej)**



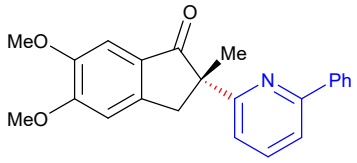
Light yellow oil (21.9 mg, 69% yield, 94% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.97 – 7.87 (m, 2H), 7.72 (t, *J* = 7.8 Hz, 1H), 7.60 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.53 – 7.31 (m, 7H), 4.28 (d, *J* = 16.9 Hz, 1H), 3.16 (d, *J* = 16.9 Hz, 1H), 1.75 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 207.7 (d, *J* = 2.8 Hz), 162.5 (d, *J* = 247.5 Hz), 161.4, 156.1, 149.2 (d, *J* = 2.2 Hz), 139.3, 137.5, 137.3 (d, *J* = 7.2 Hz), 129.0, 128.7, 127.9 (d, *J* = 7.8 Hz), 126.9, 122.8 (d, *J* = 23.6 Hz), 119.4, 118.4, 110.4 (d, *J* = 21.8 Hz), 57.3, 41.5, 24.6. ^{19}F NMR (376 MHz, $CDCl_3$) δ -114.70. $[\alpha]^{29}_{D}$ = -196.8 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 97 / 3, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.6 min, t_r (major) = 6.9 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{21}H_{17}FNO$, 318.1294; found 318.1286.

***(S)*-6-Methoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3fj)**



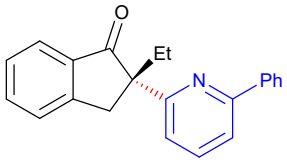
Colorless oil (32.2 mg, 98% yield, 98% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.04 – 7.86 (m, 2H), 7.70 (t, *J* = 7.8 Hz, 1H), 7.64 – 7.55 (m, 1H), 7.48 – 7.33 (m, 5H), 7.26 – 7.20 (m, 2H), 4.19 (d, *J* = 16.9 Hz, 1H), 3.85 (s, 3H), 3.14 (d, *J* = 16.9 Hz, 1H), 1.75 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 208.7, 161.8, 159.6, 156.0, 146.7, 139.4, 137.4, 136.7, 129.0, 128.7, 127.3, 126.9, 124.6, 119.5, 118.2, 105.8, 57.2, 55.7, 41.6, 24.6. $[\alpha]^{29}_D$ = -121.0 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 90 / 10, 1.0 mL/min, λ = 254 nm, t_r (minor) = 6.8 min, t_r (major) = 8.1 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO_2$, 330.1494; found 330.1485.

***(S)*-5,6-Dimethoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3gj)**



White soild (30.5 mg, 85% yield, 96% *ee*). M.p. 127.9-128.9°C.^{1}H NMR (500 MHz, $CDCl_3$): δ 7.99 – 7.92 (m, 2H), 7.70 (t, *J* = 7.8 Hz, 1H), 7.61 – 7.56 (m, 1H), 7.46 (d, *J* = 7.8 Hz, 1H), 7.44 – 7.39 (m, 2H), 7.39 – 7.34 (m, 1H), 7.22 (s, 1H), 6.95 (s, 1H), 4.20 (d, *J* = 16.9 Hz, 1H), 4.00 (s, 3H), 3.92 (s, 3H), 3.12 (d, *J* = 16.9 Hz, 1H), 1.74 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 207.3, 162.0, 156.0, 155.9, 149.6, 149.2, 139.5, 137.4, 128.9, 128.7, 128.1, 126.9, 119.5, 118.2, 107.5, 105.1, 56.6, 56.4, 56.2, 42.0, 24.8. $[\alpha]^{29}_D$ = -112.1 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 80 / 20, 1.0 mL/min, λ = 254 nm, t_r (minor) = 10.2 min, t_r (major) = 11.4 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{23}H_{21}NO_3$, 360.1600; found 360.1589.

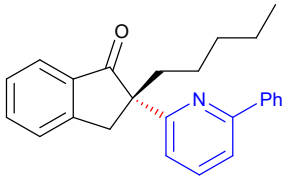
***(S)*-2-Ethyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3hj)**



Light yellow oil (26.3 mg, 84% yield, 96% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.03 – 7.93 (m, 2H), 7.76 (d, *J* = 7.8 Hz, 1H), 7.71 (t, *J* = 7.8 Hz, 1H), 7.66 – 7.54 (m, 4H), 7.46 – 7.40 (m, 2H), 7.40 – 7.34 (m, 2H), 4.51 (d, *J* = 17.4 Hz, 1H), 3.28 (d, *J* = 17.4 Hz, 1H), 2.36 – 2.23 (m, 1H), 2.23 – 2.07 (m, 1H), 0.87 (t, *J* = 7.4 Hz, 3H) ^{13}C NMR: (125 MHz, $CDCl_3$): 208.3, 160.1, 155.7, 154.4, 139.5, 137.3, 136.3, 135.1, 128.9, 128.7,

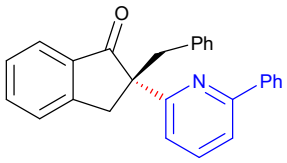
127.4, 126.9, 126.5, 124.4, 120.3, 118.2, 61.0, 37.4, 31.8, 9.5. $[\alpha]^{29}_{D}$ = -78.7 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 5.5 min, t_r (major) = 6.2 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO$, 314.1545; found 314.1535.

***(S)*-2-Pentyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ij)**



Light yellow oil (20.6 mg, 58% yield, 96% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.01 – 7.93 (m, 2H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.71 (t, *J* = 7.8 Hz, 1H), 7.66 – 7.53 (m, 4H), 7.45 – 7.32 (m, 4H), 4.54 (d, *J* = 17.4 Hz, 1H), 3.28 (d, *J* = 17.4 Hz, 1H), 2.29 – 2.18 (m, 1H), 2.12 – 1.99 (m, 1H), 1.30 – 1.15 (m, 6H), 0.88 – 0.76 (m, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 208.3, 160.2, 155.7, 154.4, 139.5, 137.3, 136.2, 135.1, 128.9, 128.7, 127.4, 126.9, 126.5, 124.5, 120.2, 118.2, 60.7, 39.0, 37.8, 32.4, 24.8, 22.6, 14.2. $[\alpha]^{29}_{D}$ = -39.8 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 98 / 2, 1.0 mL/min, λ = 210 nm, t_r (minor) = 5.5 min, t_r (major) = 6.0 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{25}H_{26}NO$, 356.2014; found 356.2003.

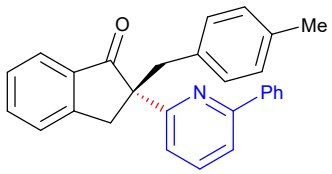
***(S)*-2-Benzyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3jj)**



Yellow oil (15.0 mg, 40% yield, 86% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.98 – 7.90 (m, 2H), 7.76 – 7.69 (m, 2H), 7.69 – 7.65 (m, 1H), 7.63 – 7.58 (m, 1H), 7.54 – 7.50 (m, 1H), 7.47 – 7.35 (m, 4H), 7.33 – 7.27 (m, 1H), 7.18 – 7.04 (m, 5H), 4.37 (d, *J* = 17.3 Hz, 1H), 3.62 (d, *J* = 13.8 Hz, 1H), 3.50 (d, *J* = 13.8 Hz, 1H), 3.39 (d, *J* = 17.3 Hz, 1H). ^{13}C NMR: (125 MHz, $CDCl_3$): 207.6, 159.9, 155.9, 154.2, 139.4, 137.5, 137.4, 136.1, 135.1, 130.3, 129.0, 128.7, 128.2, 127.3, 126.9, 126.6, 126.3, 124.4, 120.4, 118.4, 61.6, 43.9, 36.8. $[\alpha]^{29}_{D}$ = -19.2 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel OD-H (0.46 cm

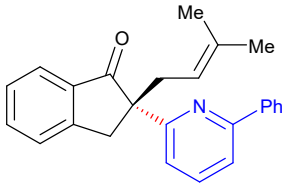
x 25 cm), Hexanes / IPA = 95/ 5, 1.0 mL/min, λ = 210 nm, t_r (major) = 9.2 min, t_r (minor) = 12.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{27}H_{22}NO$, 376.1701; found 376.1692.

***(S)*-2-(4-Methylbenzyl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3kj)**



Light yellow oil (22.6 mg, 58% yield, 89% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.97 – 7.89 (m, 2H), 7.75 – 7.65 (m, 3H), 7.63 – 7.57 (m, 1H), 7.55 – 7.50 (m, 1H), 7.46 – 7.35 (m, 4H), 7.33 – 7.27 (m, 1H), 6.94 (d, *J* = 1.5 Hz, 4H), 4.37 (d, *J* = 17.3 Hz, 1H), 3.58 (d, *J* = 13.9 Hz, 1H), 3.45 (d, *J* = 13.9 Hz, 1H), 3.38 (d, *J* = 17.3 Hz, 1H), 2.22 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 207.7, 160.0, 155.9, 154.3, 139.5, 137.4, 136.1, 136.0, 135.1, 134.4, 130.2, 129.0, 128.9, 128.7, 127.3, 126.9, 126.4, 124.4, 120.4, 118.4, 61.7, 43.5, 36.7, 21.1. $[\alpha]^{29}_D$ = -18.8 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel OD-H (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 210 nm, t_r (major) = 8.0 min, t_r (minor) = 8.9 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{28}H_{24}NO$, 390.1858; found 390.1848.

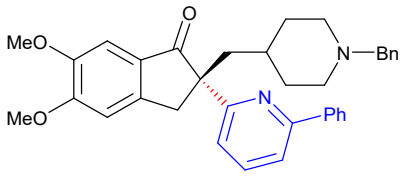
***(S)*-2-(3-Methylbut-2-en-1-yl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3lj)**



Light yellow oil (24.0 mg, 68% yield, 94% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.00 – 7.94 (m, 2H), 7.76 (d, *J* = 7.7 Hz, 1H), 7.74 – 7.67 (m, 1H), 7.64 – 7.57 (m, 3H), 7.54 (d, *J* = 7.7 Hz, 1H), 7.45 – 7.40 (m, 2H), 7.40 – 7.33 (m, 2H), 5.08 – 4.94 (m, 1H), 4.43 (d, *J* = 17.3 Hz, 1H), 3.28 (d, *J* = 17.3 Hz, 1H), 3.02 – 2.90 (m, 1H), 2.87 – 2.76 (m, 1H), 1.61 (d, *J* = 1.3 Hz, 3H), 1.60 (d, *J* = 1.5 Hz, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 208.0, 160.1, 155.7, 154.5, 139.5, 137.3, 136.1, 135.1, 135.1, 128.9, 128.7, 127.3, 126.9, 126.5, 124.5, 120.3, 119.5, 118.2, 60.7, 37.5, 37.0, 26.0, 18.2. $[\alpha]^{29}_D$ = -4.2 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel AS-H (0.46 cm x 25 cm), Hexanes / IPA = 98/ 2, 1.0 mL/min, λ = 254

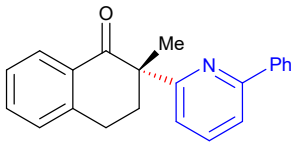
nm, t_r (minor) = 6.5 min, t_r (major) = 8.1 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{25}H_{24}NO$, 354.1858; found 354.1848.

***(S)*-2-(3-Methylbut-2-en-1-yl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3mj)**



Light yellow oil (34.6 mg, 65% yield, 93% *ee*). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.00 – 7.94 (m, 2H), 7.70 – 7.65 (m, 2H), 7.58 – 7.54 (m, 1H), 7.48 – 7.33 (m, 4H), 7.30 – 7.20 (m, 4H), 7.14 (s, 1H), 6.96 (s, 1H), 4.59 (d, *J* = 17.0 Hz, 1H), 3.98 (s, 3H), 3.87 (s, 3H), 3.48 – 3.41 (m, 2H), 3.18 (d, *J* = 17.0 Hz, 1H), 2.84 – 2.74 (m, 2H), 2.37 – 2.31 (m, 1H), 2.01 – 1.94 (m, 1H), 1.88 – 1.77 (m, 2H), 1.66 – 1.60 (m, 1H), 1.40 – 1.32 (m, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 206.3, 159.9, 155.9, 155.4, 149.5, 149.5, 139.5, 137.4, 137.2, 129.5, 128.9, 128.7, 128.2, 128.1, 127.2, 126.8, 120.6, 118.2, 107.3, 104.9, 63.1, 60.6, 56.3, 56.1, 53.5, 45.2, 37.7, 33.3, 32.9. $[\alpha]^{29}_D$ = -35.7 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IA (0.46 cm x 25 cm), Hexanes / IPA = 80 / 20, 1.0 mL/min, λ = 254 nm, t_r (minor) = 9.7 min, t_r (major) = 19.1 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{35}H_{37}N_2O_3$, 533.2804; found 533.2796.

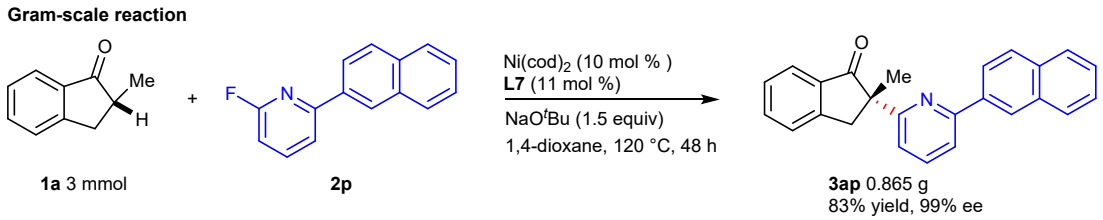
***(S)*-2-methyl-2-(6-phenylpyridin-2-yl)-3,4-dihydronaphthalen-1(2H)-one (3nj)**



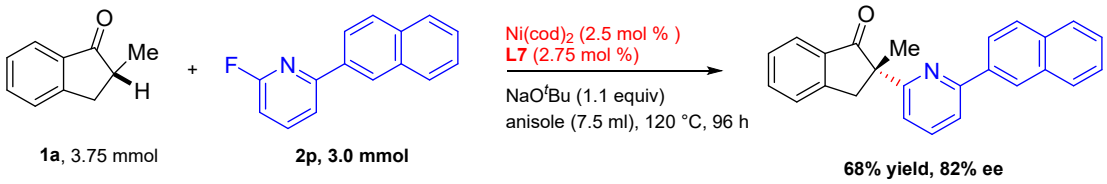
Colorless oil (27.5 mg, 88% yield, 97% *ee*). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.21 – 8.13 (m, 1H), 7.99 – 7.91 (m, 2H), 7.66 – 7.54 (m, 2H), 7.49 – 7.28 (m, 5H), 7.17 – 7.04 (m, 2H), 3.09 – 2.78 (m, 3H), 2.35 – 2.19 (m, 1H), 1.63 (s, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$): 201.2, 161.6, 156.0, 144.1, 139.2, 137.4, 133.1, 133.1, 129.0, 128.8, 128.7, 127.9, 126.8, 126.5, 119.8, 118.0, 53.2, 35.8, 26.5, 25.7. $[\alpha]^{25}_D$ = 0.64 (c 0.5, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IC (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 8.6 min, t_r (major) = 14.7 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{22}H_{20}NO$, 314.1545; found 314.1540.

5. Gram-scale reaction and synthetic applications

Gram-scale reaction



A flame-dried sealed pressure-resistant tube (50 mL) equipped with a magnetic stir bar (10 mm × 5 mm, egg shaped) was evacuated and filled Ar for three times before being transferred into a glovebox. $Ni(cod)_2$ (0.3 mmol, 10 mol %), (*S*)-Ph-GarPhos (0.33 mmol, 11 mol%) and dry 1,4-dioxane (20 mL) was added to the tube and stirred for 10 min. NaO^{t}Bu (4.5 mmol, 1.5 equiv), indanone derivatives (3.0 mmol, 1 equiv) and heteroaryl fluorides (4.5 mmol, 1.5 equiv) were added in succession. The reaction tube was capped and taken out of the glovebox. The reaction was stirred at 120℃ for 48 h. After cooling the reaction mixture to ambient temperature, the mixture was concentrated and directly purified by purified by silica gel chromatography using PE/EA (silica gel, 10:1) to afford the desired product **3ap** with 83% yields (0.865g). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 8.1 min, t_r (major) = 10.0 min.

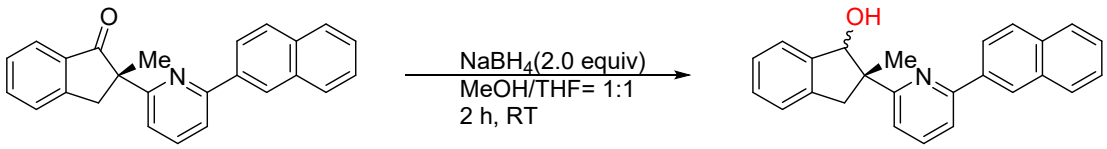


A flame-dried sealed pressure-resistant tube (50 mL) equipped with a magnetic stir bar (10 mm × 5 mm, egg shaped) was evacuated and filled Ar for three times before being transferred into a glovebox. $Ni(cod)_2$ (0.075 mmol, 2.5 mol %), (*S*)-Ph-GarPhos (0.0825 mmol, 2.75 mol%) and anisole (7.5 mL) was added to the tube and stirred for 30 min. NaO^{t}Bu (3.3 mmol, 1.1 equiv), indanone derivatives (3.75 mmol, .1.25 equiv) and heteroaryl fluorides (3.0 mmol, 1.0 equiv) were added in succession. The reaction tube was capped and

taken out of the glovebox. The reaction was stirred at 120℃ for 96 h. After cooling the reaction mixture to ambient temperature, the mixture was concentrated and directly purified by purified by silica gel chromatography using PE/EA (silica gel, 10:1) to afford the desired product **3ap** with 68% yields (0.7120 g). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 95 / 5, 1.0 mL/min, λ = 254 nm, t_r (minor) = 8.1 min, t_r (major) = 10.0 min.

Synthetic applications

(2*S*)-2-Methyl-2-(6-(naphthalen-2-yl) pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-ol (4)



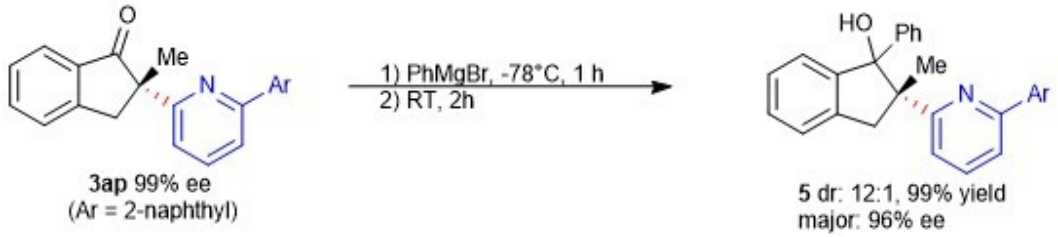
3ao, 99% ee

4, dr: 1.2: 1, 99% yield,
major: 99% ee
minor: 99% ee

The solution of **3ap** (69.8 mg, 0.2 mmol) in THF (0.5 mL) was added MeOH (0.5 mL) and $NaBH_4$ (0.4 mmol) at 0℃ under air. The reaction mixture was then stirred at room temperature for 2 h and quenched with 5 ml water. The reaction mixture was extracted with EA (3 x 2 mL). The combined organic phases were dried over with anhydrous Na_2SO_4, filtered, evaporated in vacuo and purified by flash chromatography (silica gel, PE/EA) to afford product **4** as white solid (69.5 mg, 99% yield, dr: 1.2: 1, major: 99% ee, minor: 99% ee). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.41 – 8.31 (m, 1H), 8.14 – 7.99 (m, 1H), 7.97 – 7.79 (m, 3H), 7.78 – 7.64 (m, 2H), 7.61 – 7.44 (m, 3H), 7.34 – 7.18 (m, 4H), 5.68 – 5.26 (d, 1H), 3.45 (dd, *J* = 15.3, 14.8 Hz, 1H), 3.08 (dd, *J* = 15.3, 14.8 Hz, 1H), 1.40 (d, 3H). ^{13}C NMR: (100 MHz, $CDCl_3$): 167.9, 166.6, 156.4, 155.4, 144.5, 143.4, 141.6, 139.3, 138.3, 137.8, 136.8, 136.2, 133.8, 133.7, 133.5, 133.5, 128.8, 128.8, 128. 7, 128.6, 128.2, 127.8, 127.8, 127.5, 127.0, 126.9, 126.7, 126.7, 126.5, 126.5, 126.4, 126.4, 125.1, 125.1, 125.0, 124.7, 124.5, 123.8, 120.8, 118.8, 118.6, 118.3, 83.6, 81.6, 55.2, 53.1, 44.0, 41.5, 27.4, 22.5. $[\alpha]^{29}_D$ = -74.4 (c 3.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IA (0.46 cm x 25 cm), Hexanes / IPA = 90 / 10, 1.0 mL/min, λ = 254 nm, t_r-major (minor) = 10.5 min, t_r- minor (major) = 14.9 min, t_r-major (major) =

19.4 min, t_r- minor (minor) = 20.5 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{25}H_{22}NO$, 352.1701; found 352.1692.

(*2S*)-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-1-phenyl-2,3-dihydro-1*H*-inden-1-ol (5)

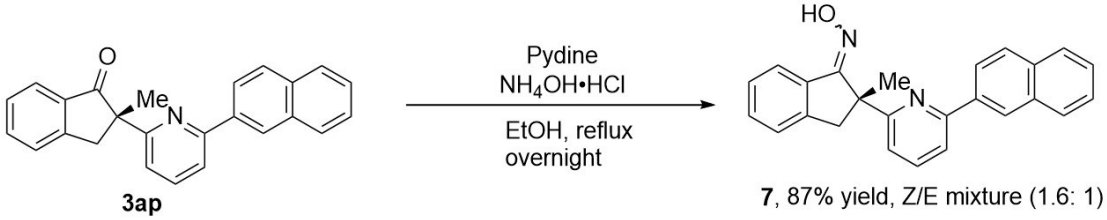


The solution of **3ap** (69.8 mg, 0.2 mmol) in THF (1.0 mL) was added 220 µl phenylmagnesium bromide solution (PhMgBr, 1 M in THF, 0.22 mmol) at -78 ℃. Then the reaction mixture was stirred at room temperature for 2 h and quenched with 1ml Saturated ammonium chloride solution. The reaction mixture was extracted with EA (3 x 2 mL). The combined organic phases were dried over with anhydrous Na_2SO_4, filtered, evaporated in vacuo and purified by flash chromatography (silica gel, PE/EA) to afford product **5** as corlorless oil (84.5 mg, 99% yield, dr: 12: 1, major: 96% ee). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.30 (d, *J* = 1.7 Hz, 1H), 8.03 – 7.90 (m, 4H), 7.59 – 7.50 (m, 5H), 7.45 – 7.42 (m, 1H), 7.37 – 7.34 (m, 2H), 7.02 – 6.91 (m, 6H), 4.10 – 3.90 (m, 2H), 3.18 (d, *J* = 15.2 Hz, 1H), 1.78 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 164.4, 155.2, 147.3, 144.2, 142.0, 136.9, 136.8, 133.7, 133.5, 128.8, 128.4, 128.2, 127.8, 127.4, 127.2, 126.6, 126.4, 126.3, 126.2, 125.0, 124.6, 124.4, 119.2, 118.0, 115.4, 89.2, 59.4, 41.7, 25.6. $[\alpha]^{29}_D$ = 188.9 (c 4.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel IB (0.46 cm x 25 cm), Hexanes / IPA = 90 / 10, 1.0 mL/min, λ = 210 nm, t_r-major (major) = 5.8 min, t_r-major (minor) = 6.5 min, HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{31}H_{26}NO$, 428.2014; found 428.2007.

(*R*)-2-(2-Methyl-1-methylene-2,3-dihydro-1*H*-inden-2-yl)-6-(naphthalen-2-yl)pyridine (6)

Methyltriphenylphosphoniumbromide (PPh_3CH_3Br, 142.8 mg, 0.4 mmol) was dissolved in extra dry THF (1.5 mL) at RT. Then Potassium tert-butoxide (^tBuOK, 44.8 mg, 0.4 mmol) was added and the mixture was stirred at RT for 5 min. Next, **3ap** (69.8 mg, 0.2 mmol) was dissolved with 1.5 mL extra dry THF and added to the mixture at 0°C. The reaction was stirred overnight at room temperature. Then, the reaction was evaporated in vacuo and purified by flash chromatography (silica gel, PE/EA) to afford product **6** as corlorless oil (68.0 mg, 98% yield, 99% ee). ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.50 (d, *J* = 1.8 Hz, 1H), 8.26 (d, *J* = 1.8 Hz, 1H), 7.99 – 7.82 (m, 3H), 7.71 (d, *J* = 7.8 Hz, 1H), 7.69 – 7.60 (m, 2H), 7.59 – 7.47 (m, 2H), 7.41 – 7.27 (m, 4H), 5.66 (s, 1H), 5.01 (s, 1H), 3.84 (d, *J* = 16.6 Hz, 1H), 3.20 (d, *J* = 16.6 Hz, 1H), 1.85 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 166.8, 158.7, 155.5, 144.1, 140.6, 137.2, 137.0, 133.8, 133.7, 129.0, 128.8, 128.4, 127.8, 126.8, 126.4, 126.3, 126.2, 125.4, 124.9, 121.2, 119.2, 117.7, 104.7, 53.5, 47.5, 30.3. $[\alpha]^{29}_D$ = -34.1 (c 1.0, $CHCl_3$). The enantiomeric excess was determined by Daicel Chiralcel ODH (0.46 cm x 25 cm), Hexanes / IPA = 99 / 1, 1.0 mL/min, λ = 254 nm, t_r (minor) = 7.4 min, t_r (major) = 7.8 min. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{26}H_{22}N$, 348.1752; found 348.1748.

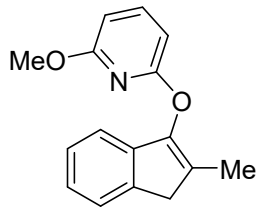
***(S)*-2-Methyl-2-(6-(naphthalen-2-yl) pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one oxime (7)**



The mixture of **3ap** (69.8 mg, 0.2 mmol), hydroxylamine hydrochloride (0.4 mmol) and pyridine (1.0 mmol) in ethanol (10 ml) was refluxed overnight. Then, the reaction was cooled to room temperature, added 2ml H_2O and 150 μL 10% NaOH solution, vigorous stirred and filtered. The residue was washed with water three times and evaporated in vacuo without further purity to give product **7** as light green solid (63.3 mg, 87% yield, Z/E = 1.6: 1). ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.99 – 9.25 (br, 1H), 8.63 – 8.33 (m, 2H), 8.14 (t, *J* = 8.5 Hz, 1H), 7.91 – 7.77 (m, 3H), 7.62 – 7.39 (m, 4H), 7.34 – 7.13 (m, 4H), 4.10 – 3.50 (m, 1H), 3.19 (d, *J* = 16.7 Hz, 1H), 2.02 – 1.77 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 166.0, 164.6, 164.2, 155.8, 155.6, 149.7, 146.8, 146.0, 137.2, 137.2, 136.9, 136.3, 136.2, 133.7, 133.6, 133.2, 131.2, 130.6, 129.8, 128.8, 128.3,

128.2, 127.7, 127.3, 127.0, 126.4, 126.2, 125.4, 125.3, 124. 9, 124.8, 123.9, 122.0, 119.3, 119.0, 118.1, 118.0, 58.4, 52.4, 48.9, 45.8, 26.6, 22.7. $[\alpha]^{29}_{D}$ = -178.9 (c 3.0, $CHCl_3$). HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{25}H_{21}N_2O$, 365.1654; found 365.1644.

2-Methoxy-6-((2-methyl-1*H*-inden-3-yl)oxy)pyridine (8)

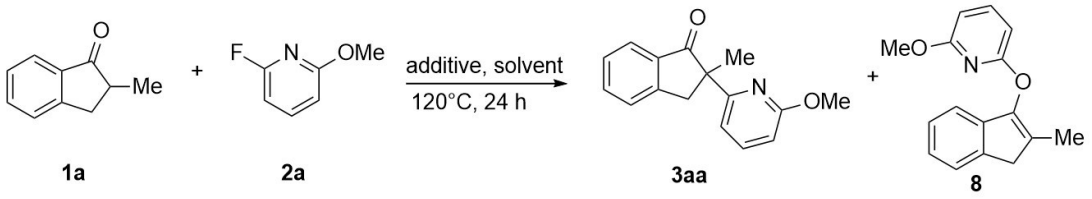


8

Light yellow oil (4.3 mg, 17% yield). ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.49 (t, *J* = 7.9 Hz, 1H), 7.38 (d, *J* = 7.0 Hz, 1H), 7.21 – 7.11 (m, 2H), 7.05 – 6.96 (m, 1H), 6.42 (d, *J* = 7.9 Hz, 1H), 6.31 (d, *J* = 7.8 Hz, 1H), 3.81 (s, 3H), 3.37 (s, 2H), 2.03 (s, 3H). ^{13}C NMR: (125 MHz, $CDCl_3$): 163.6, 161.7, 146.8, 141.4, 140.7, 140.4, 127.7, 126.1, 124.5, 123.8, 118.2, 104.0, 100.0, 53.6, 39.0, 12.3. HRMS (ESI) *m/z*: $[M+H]^+$ calcd for $C_{16}H_{16}NO_2$, 254.1181; found 254.1173.

6. Control experiments

Table S5. Exploring the influence of base [a]

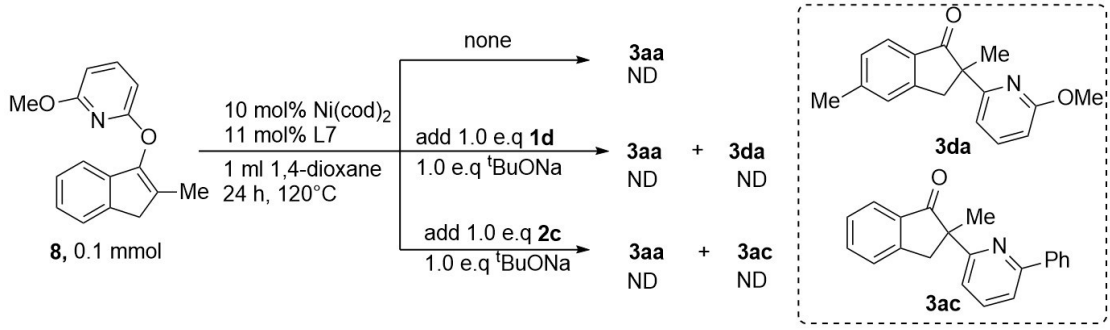


1a **2a** **3aa** **8**

Entry	1a (mmol)	2a (mmol)	Solvent	additive	**3aa**	**8**
1	0.1	0.1	1,4-dioxane	none	ND	ND
2	0.1	0.1	1,4-dioxane	10 mol% $Ni(cod)_2$	ND	ND
3	0.1	0.1	1,4-dioxane	1.0 e.q ^tBuONa	14% yield	17% yield
4	0.2	0.1	anisole	1.1 e.q ^tBuONa	trace	trace
5	0.2	0.1	1,4-dioxane	1.1 e.q ^tBuONa	13% yield	14% yield
6	0.1	0.15	1,4-dioxane	1.5 e.q ^tBuONa	15% yield	19% yield

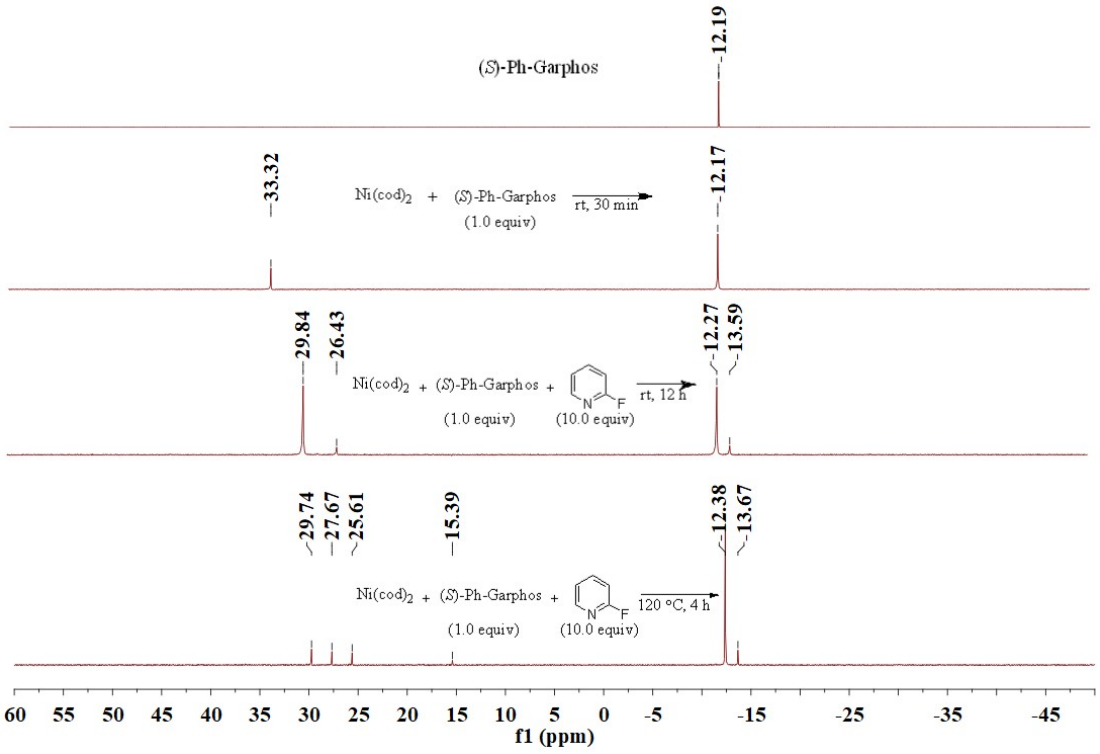
[a] Reaction conditions: **1a, 2a** and additive in 1.0 mL solvent, 120 ℃, 24 h. Yield determined by ^1H NMR using dibromomethane internal standard.

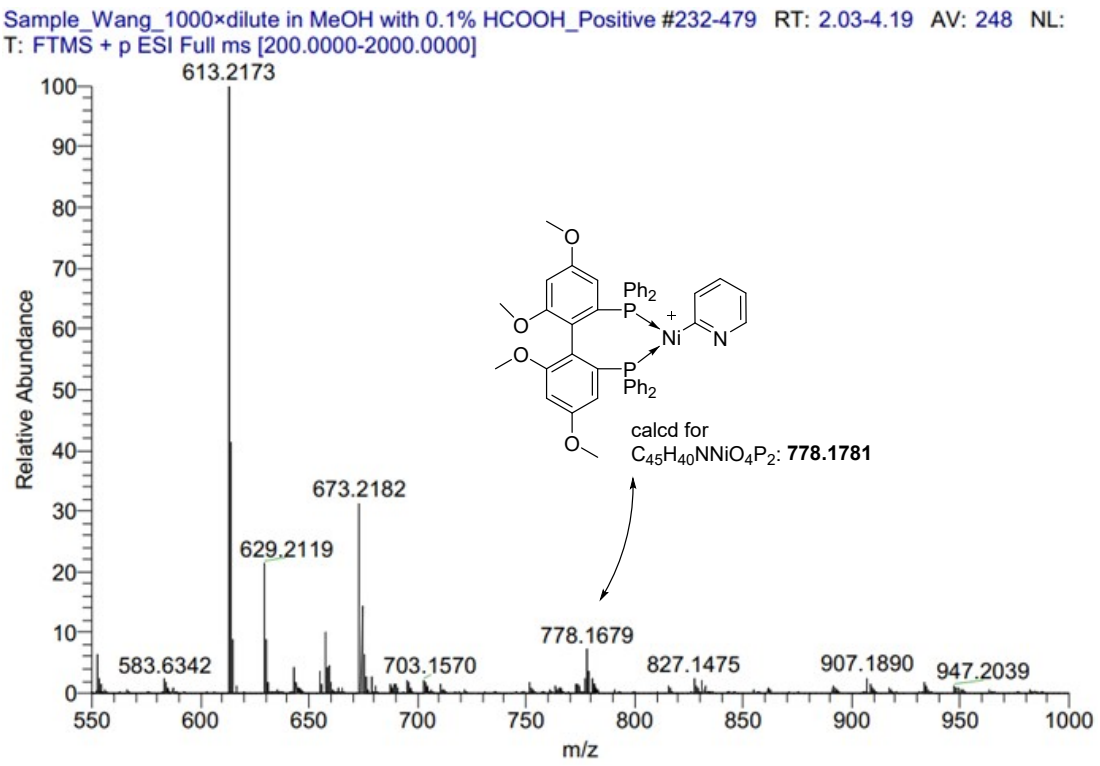
Table S6. Exploring the transformation of *O*-arylation product [a]



[a] Reaction conditions: 0.1 mmol **8** with $Ni(cod)_2$ (10 mol %), **L7** (11 mol %) and different additives in 1.0 mL 1,4-dioxane, 120 ℃, 24 h. Yield determined by ^1H NMR using dibromomethane internal standard.

Table S7. Study on existence of possible intermediates via ^{31}P NMR and HRMS





For study on oxidative addition process was employed 32 mg (S)-Ph-GarPhos (0.05 mmol) in 0.5 ml Toluene-D_8. ^{31}P NMR (202 MHz, Toluene-D_8) δ -12.19. $Ni(cod)_2$ (0.05 mmol) and 32 mg (S)-Ph-GarPhos (0.05

mmol) was stir at rt under glove box for 30 min, then transferred into the NMR tube under N_2 atmosphere. ^{31}P NMR (202 MHz, Toluene-D_8) δ 33.32, -12.17. $Ni(cod)_2$ (0.05 mmol), 32 mg (S)-Ph-GarPhos (0.05 mmol) and 2-Fluoropyridine (0.5 mmol) was stir at rt in glove box for 12 h, then transferred into the NMR tube under N_2 atmosphere. ^{31}P NMR (202 MHz, Toluene-D_8) δ 29.84, 26.43, -12.27, -13.59. After stir for 12h at RT, the mixture was transferred into a sealing tube and heated to 120 ℃ for 4h under N_2, then cool to rt and transferred into the NMR tube under N_2 atmosphere. ^{31}P NMR (202 MHz, Toluene-D_8) δ 29.74, 27.67, 25.61, 15.39, -12.38, -13.67. After stir for 4 h at 120 ℃, The mixture was detected by HRMS (ESI) *m/z*: $[M-F]^+$ calcd for $C_{45}H_{40}NNiO_4P_2$, 778.1781; found 778.1679.

7. X-Ray crystallographic analysis

A. Crystal Data

Identification code	cxy1738_0m
Empirical formula	C25H19NO
Formula weight	349.41
Temperature/K	100
Crystal system	monoclinic
Space group	P21
a/Å	8.5649(3)
b/Å	10.4376(3)
c/Å	9.9968(3)
α /°	90
β /°	98.4180(10)
γ /°	90
Volume/Å3	884.06(5)
Z	2
ρ calcg/cm3	1.313
μ /mm-1	0.619
F(000)	368.0
Crystal size/mm3	0.31 × 0.25 × 0.23
Radiation	CuK α （λ = 1.54178)
2Θ range for data collection/°	8.942 to 136.952
Index ranges	-10 ⩽ h ⩽ 10, -12 ⩽ k ⩽ 11, -12 ⩽ l ⩽ 11
Reflections collected	15418
Independent reflections	3227 [Rint = 0.0264, Rsigma = 0.0203]
Data/restraints/parameters	3227/1/246
Goodness-of-fit on F2	1.071
Final R indexes [I>=2σ (I)]	R1 = 0.0251, wR2 = 0.0642
Final R indexes [all data]	R1 = 0.0253, wR2 = 0.0644
Largest diff. peak/hole / e Å-3	0.18/-0.14
Flack parameter	0.02(6)

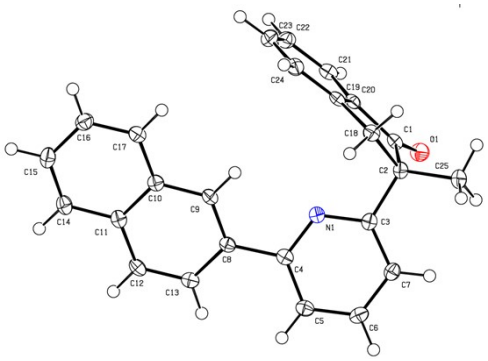


Figure S1. X-Ray crystal structure of **3ap (CCDC 2156742)**

8. Reference

1 R. T. Skerlj, D. Bogucki and G. J. Bridger, *Synlett*, **2000**, 1488-1490.

2 M. S. Viciu, L. Gupta and D. B. Collum, *J. Am. Chem. Soc.*, **2010**, *132*, 6361-6365.

3 Y.-L. Zhao, G.-J. Wu, Y. Li, L.-X. Gao and F.-S. Han, *Chem. Eur. J.*, **2012**, *18*, 9622-9627.

4 Y. Yang, J. Schiessl, S. Zallouz, V. Goeker, J. Gross, M. Rudolph, F. Rominger and A. S. K. Hashmi, *Chem. Eur. J.*, **2019**, *25*, 9624-9628.

5 J. Zhou, B. Li, Z.-C. Qian and B.-F. Shi, *Adv. Synth. Catal.*, **2014**, *356*, 1038-1046.

6 X. Yuan, J.-F. Yao and Z.-Y. Tang, *Org. Lett.*, **2017**, *19*, 1410-1413.

7 S.Siek; D. B. Burks, D. L. Gerlach, G.Liang, J. M. Tesh, C. R. Thompson, F. Qu, J. E. Shankwitz, R. M. Vasquez, N. Chambers, G. J. Szulczewski, D. B. Grotjahn, C. E. Webster and E. T. Papish, *Organometallics*, **2017**, *36*, 1091− 1106.

8 X.-L. Zhou, X.-G. Liu, M. Hu, W.-H. Luo, H. Wen, J.-L. Huang and J.-Y. Zhang, CN110483520 [P]. 2019.

9 J.-Y. Tsai, A. B. Dyatkin, Z.-Q. Ji, P.-L. T. Boudreault, M. A. Esteruelas, L. Benavent, Llorenc, A. M. Lopez and E. Onate, US20190341561[P]. 2019.

9. BDE (Bond dissociation energy) of C_{Ar}–F bond

Density-functional theory (DFT) calculations were performed with Gaussian 16.[1] Geometry optimizations were performed with the ωB97X-D/6-31G(d) in gas phase.[2] Frequency calculations were performed at the same level of theory as for geometry optimization to characterize the stationary points as minima (no imaginary frequencies). Single-point energies were calculated with ωB97X-D/6-311++G(d,p) in gas phase. BDE (Bond dissociation energy) was calculated by the reaction enthalpy in gas phase.

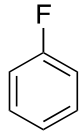
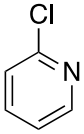
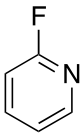
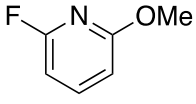
References:

1. Frisch, M. J.; Trucks, G. W.; Schlegel, H. B.; Scuseria, G. E.; Robb, M. A.; Cheeseman, J. R.; Scalmani, G.; Barone, V.; Petersson, G. A.; Nakatsuji, H.; Li, X.; Caricato, M.; Marenich, A. V.; Bloino, J.; Janesko, B. G.; Gomperts, R.; Mennucci, B.; Hratchian, H. P.; Ortiz, J. V.; Izmaylov, A. F.; Sonnenberg, J. L.; Williams-Young, D.; Ding, F.; Lipparini, F.; Egidi, F.; Goings, J.; Peng, B.; Petrone, A.; Henderson, T.; Ranasinghe, D.; Zakrzewski, V. G.; Gao, J.; Rega, N.; Zheng, G.; Liang, W.; Hada, M.; Ehara, M.; Toyota, K.; Fukuda, R.; Hasegawa, J.; Ishida, M.; Nakajima, T.; Honda, Y.; Kitao, O.; Nakai, H.; Vreven, T.; Throssell, K.; Montgomery, J. A., Jr.; Peralta, J. E.; Ogliaro, F.; Bearpark, M. J.; Heyd, J. J.; Brothers, E. N.; Kudin, K. N.; Staroverov, V. N.; Keith, T. A.; Kobayashi, R.; Normand, J.; Raghavachari, K.; Rendell, A. P.; Burant, J. C.; Iyengar, S. S.; Tomasi, J.; Cossi, M.; Millam, J. M.; Klene, M.; Adamo, C.; Cammi, R.; Ochterski, J. W.; Martin, R. L.; Morokuma, K.; Farkas, O.; Foresman, J. B.; Fox, D. J. Gaussian, Inc., Wallingford CT, 2016.
2. Chai, J. D.; Head-Gordon, M. Long-Range Corrected Hybrid Density Functionals with Damped Atom-Atom Dispersion Correc- tions. Phys. Chem. Chem. Phys. 2008, 10, 6615.
3. The literature reported BDEs were from ibond database: http://ibond.nankai.edu.cn/accounts/login/?next=/bde/

Energies (performed with ωB97X-D/6-311++G(d,p)//ωB97X-D/6-31G(d))

Structure	E_SPC	E	H_SPC
fluorobenzene	-331.46322	-331.373662	-331.363466
benzene radical	-231.529948	-231.474904	-231.436026
2-chloropyridine	-707.865944	-707.779052	-707.779313
pyridine radical	-247.573846	-247.514532	-247.491675
2-fluoropyridine	-347.506102	-347.412529	-347.418218
2-fluoro-6-methoxypyridine	-462.039964	-461.91437	-461.916263
2-methoxypyridine radical	-362.106992	-362.015722	-361.988973
Cl radical	-460.145539	-460.11662	-460.143179
F radical	-99.731408	-99.690741	-99.729048

BDE calculated (KJ/mol)

Structure	BDE (from ibond database)[3]	BDE (calculated)
	526	521
	379	379
	/	519
 (**2a**)	/	521

Cartesian coordinates

fluorobenzene

C	-0.260367	-1.214064	-0.000008
C	1.131537	-1.205052	-0.000028
C	1.830186	0.000005	0.000025
C	1.131534	1.205052	-0.000006
C	-0.260378	1.214059	-0.000021
C	-0.930313	0.000003	0.000005
H	-0.826024	-2.138642	-0.000027
H	1.670605	-2.146996	0.000027
H	2.914968	0.000015	0.000056
H	1.670599	2.146996	0.000031
H	-0.826038	2.138619	-0.000063
F	-2.273034	-0.000001	0.000019

benzene radical

C	1.223537	-0.769082	0.000000
C	1.210787	0.630599	0.000000
C	-0.000001	1.321228	0.000000
C	-1.210789	0.630595	0.000000
C	-1.223537	-0.769083	0.000000
C	0.000004	-1.397615	-0.000000
H	2.159053	-1.320589	-0.000000
H	2.150070	1.177156	-0.000003
H	-0.000002	2.407026	-0.000002
H	-2.150072	1.177152	-0.000000
H	-2.159052	-1.320595	-0.000003

2-chloropyridine

C	-1.583051	1.176125	-0.000001
C	-2.231554	-0.056331	-0.000006
C	-1.453605	-1.206879	0.000001
C	0.470659	-0.015028	0.000002
C	-0.195582	1.209585	0.000005
H	-2.149579	2.102263	-0.000003
H	-3.313773	-0.125195	0.000003
H	-1.914451	-2.191377	0.000005
H	0.357334	2.141266	0.000008
N	-0.116527	-1.193873	0.000002
Cl	2.223233	-0.012628	-0.000002

pyridine radical

C	1.032850	0.851310	-0.000002

C	-0.301382	1.269778	0.000004
C	-1.304501	0.311432	-0.000002
C	0.221676	-1.354515	0.000005
C	1.325499	-0.509216	-0.000002
H	1.836041	1.583448	-0.000003
H	-0.555379	2.324340	0.000004
H	-2.356131	0.584942	-0.000005
H	2.343451	-0.881550	-0.000000
N	-1.016119	-1.003416	-0.000002

2-fluoropyridine

C	-1.141376	1.182586	-0.000001
C	-1.798732	-0.047806	-0.000005
C	-1.027822	-1.202166	0.000001
C	0.894494	-0.023590	0.000002
C	0.244796	1.208093	0.000004
H	-1.703492	2.111423	-0.000003
H	-2.881193	-0.109572	0.000008
H	-1.496184	-2.183284	0.000005
H	0.814765	2.129461	0.000008
N	0.310915	-1.197862	0.000001
F	2.229060	-0.029522	-0.000003

2-fluoro-6-methoxypyridine

C	-1.287636	1.669148	-0.000076
C	0.095883	1.672891	0.000025
C	0.744061	0.430079	0.000098
C	-1.215168	-0.687697	0.000017
C	-1.986197	0.460697	-0.000089
H	-1.832653	2.608021	-0.000129
H	0.678855	2.585357	0.000089
H	-3.067022	0.404458	-0.000164
N	0.101985	-0.732928	0.000093
F	-1.827553	-1.873197	0.000032
O	2.084004	0.436192	0.000130
C	2.738044	-0.826545	-0.000158
H	3.804027	-0.598026	-0.000239
H	2.472529	-1.405900	0.888619
H	2.472388	-1.405622	-0.889061

2-methoxypyridine radical

C	-1.922731	0.822870	-0.000103
C	-0.602683	1.247238	0.000001

C	0.404287	0.273246	0.000064
C	-1.128684	-1.379021	0.000024
C	-2.228206	-0.544798	-0.000079
H	-2.723337	1.557962	-0.000238
H	-0.331532	2.296043	-0.000120
H	-3.246699	-0.912660	-0.000134
N	0.119526	-1.031727	0.000226
O	1.679160	0.681756	0.000300
C	2.679139	-0.329053	-0.000283
H	3.629643	0.204752	-0.000117
H	2.597789	-0.960894	0.888887
H	2.597456	-0.960059	-0.890005

Cl radical

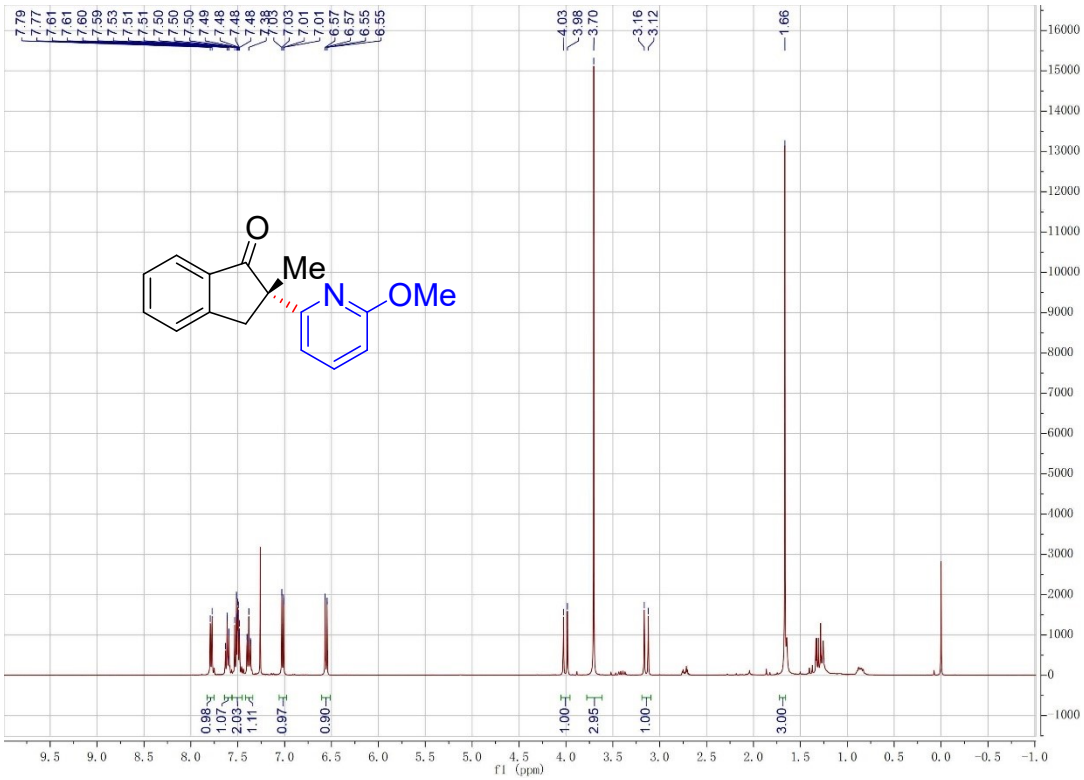
Cl	0.000000	0.000000	0.000000

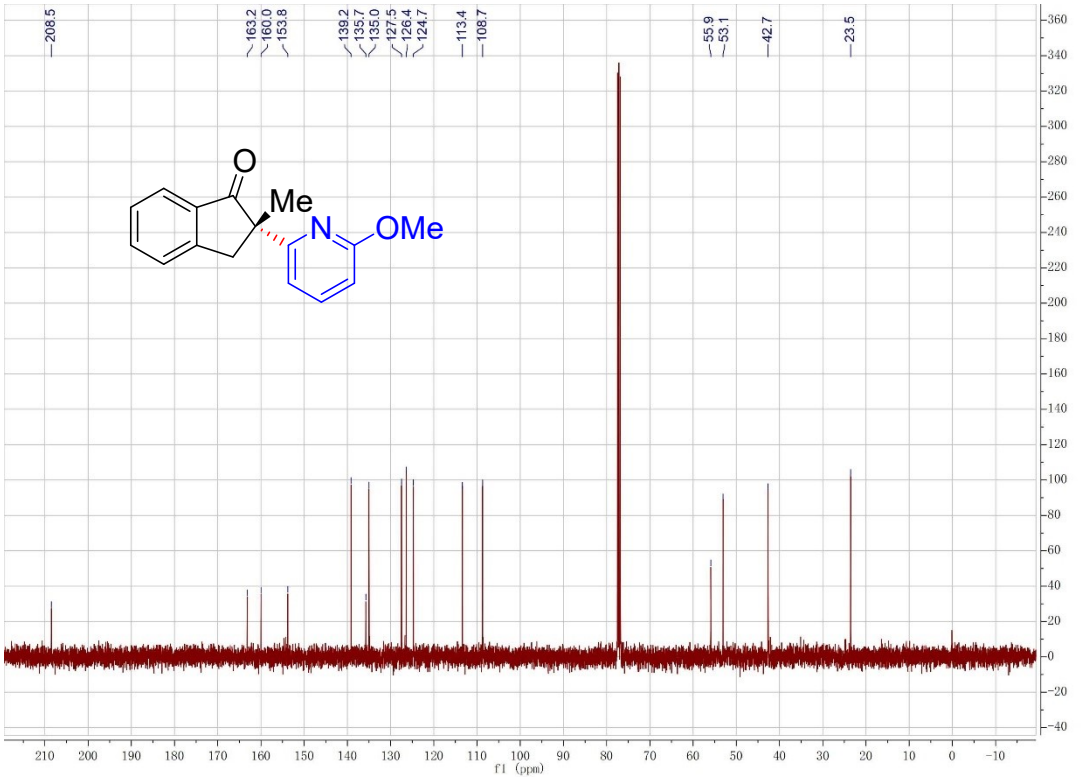
F radical

F	0.000000	0.000000	0.000000

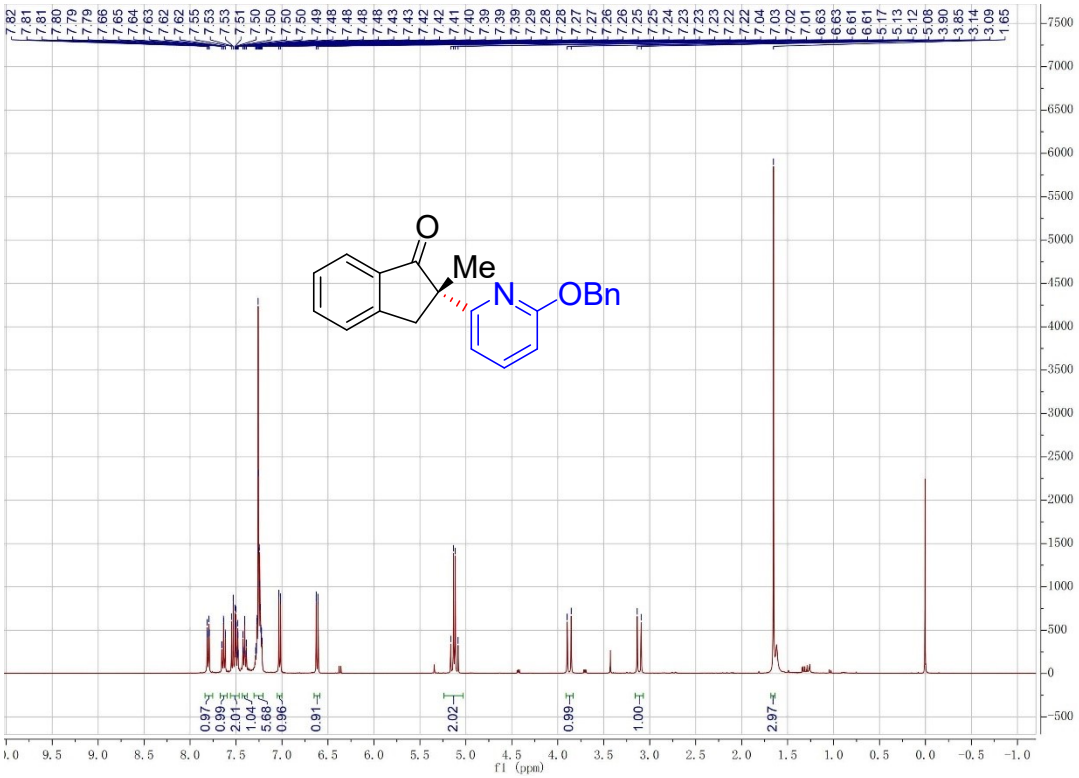
10. NMR spectrum

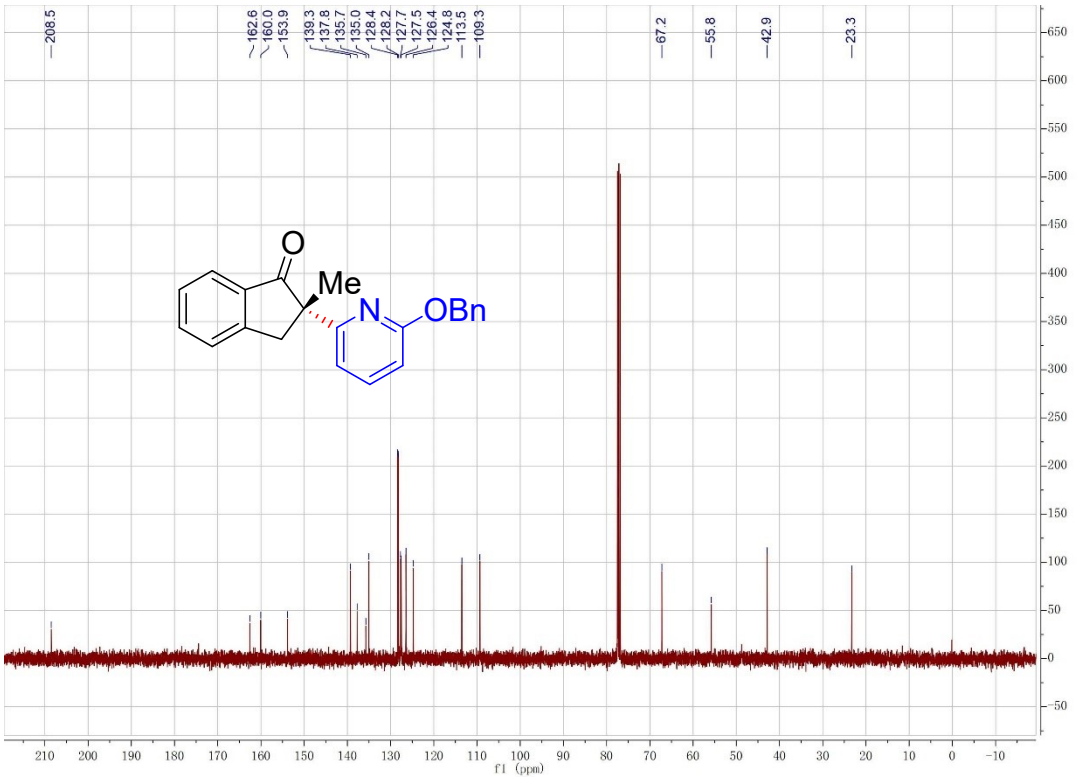
***(S)*-2-(6-Methoxypyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3aa)**



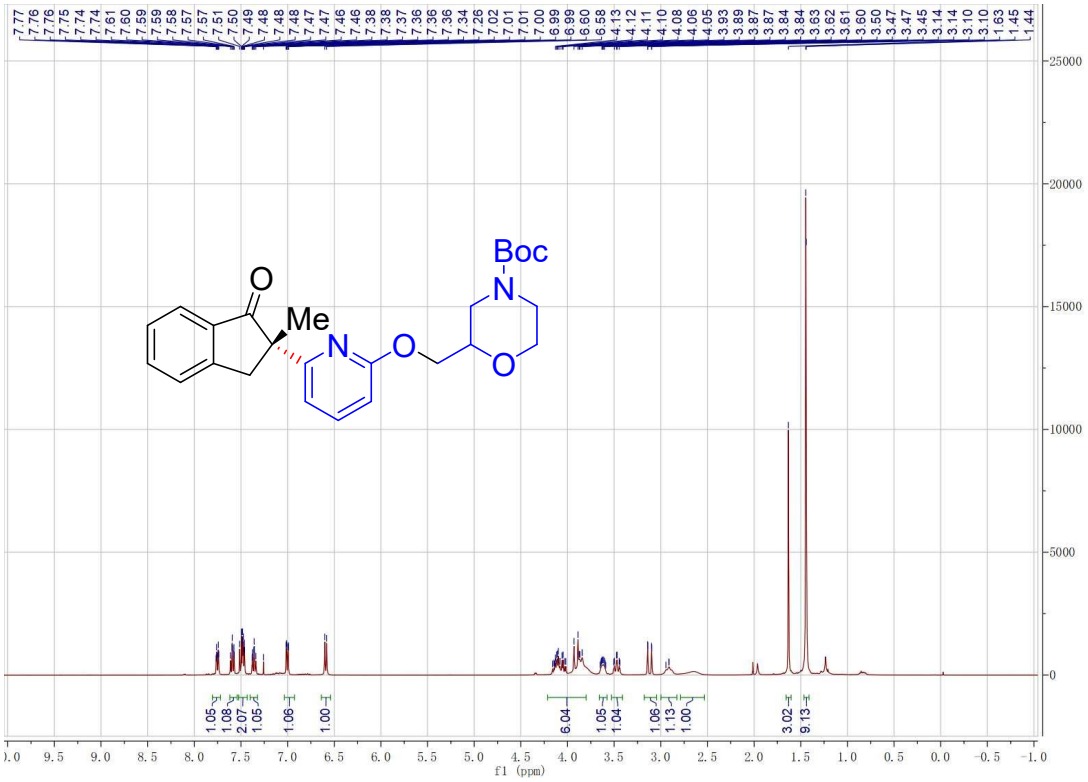


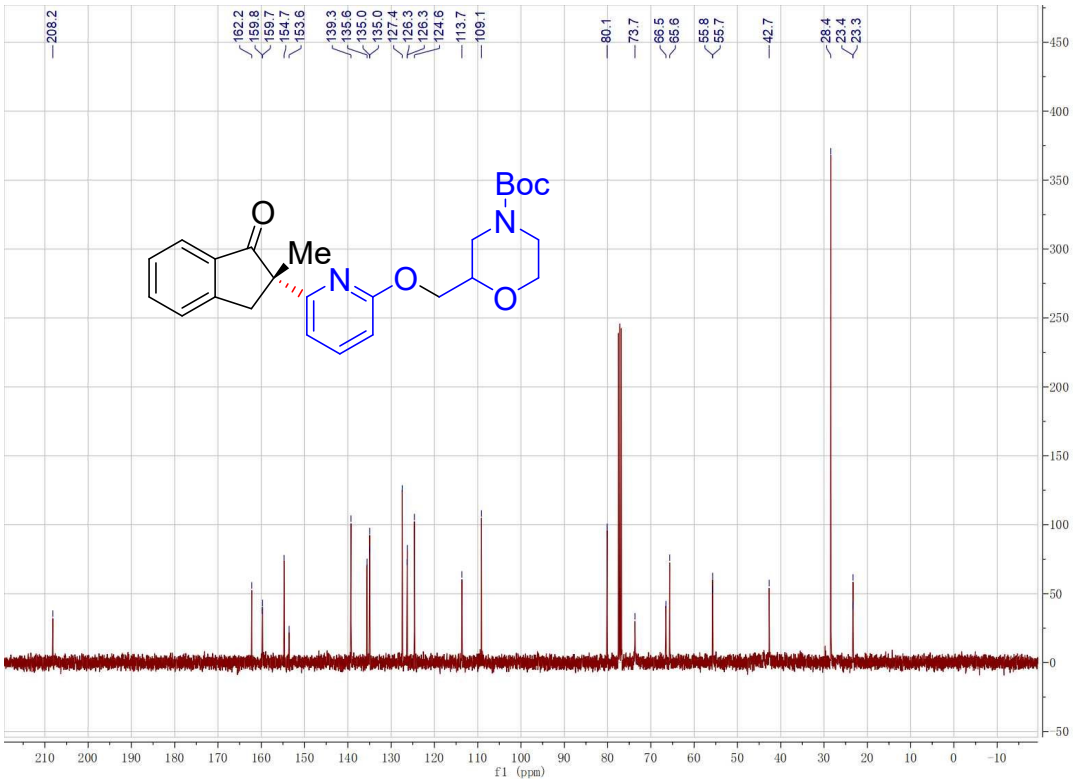
***(S)*-2-(6-(Benzyloxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ab)**



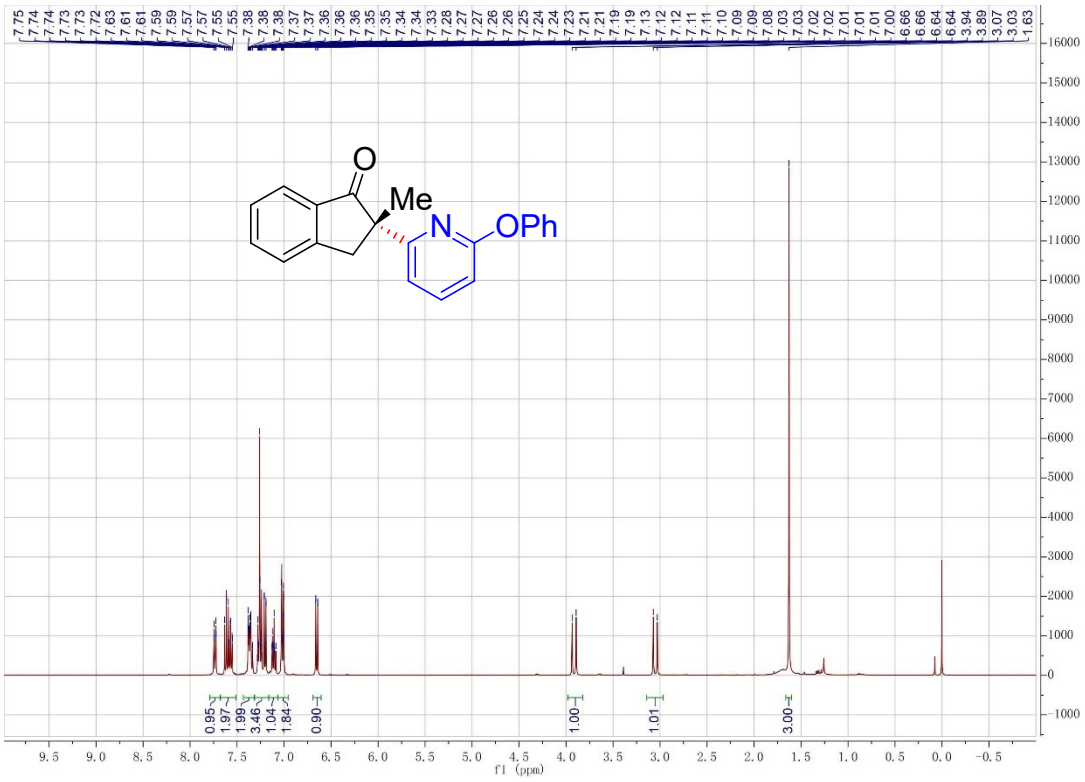


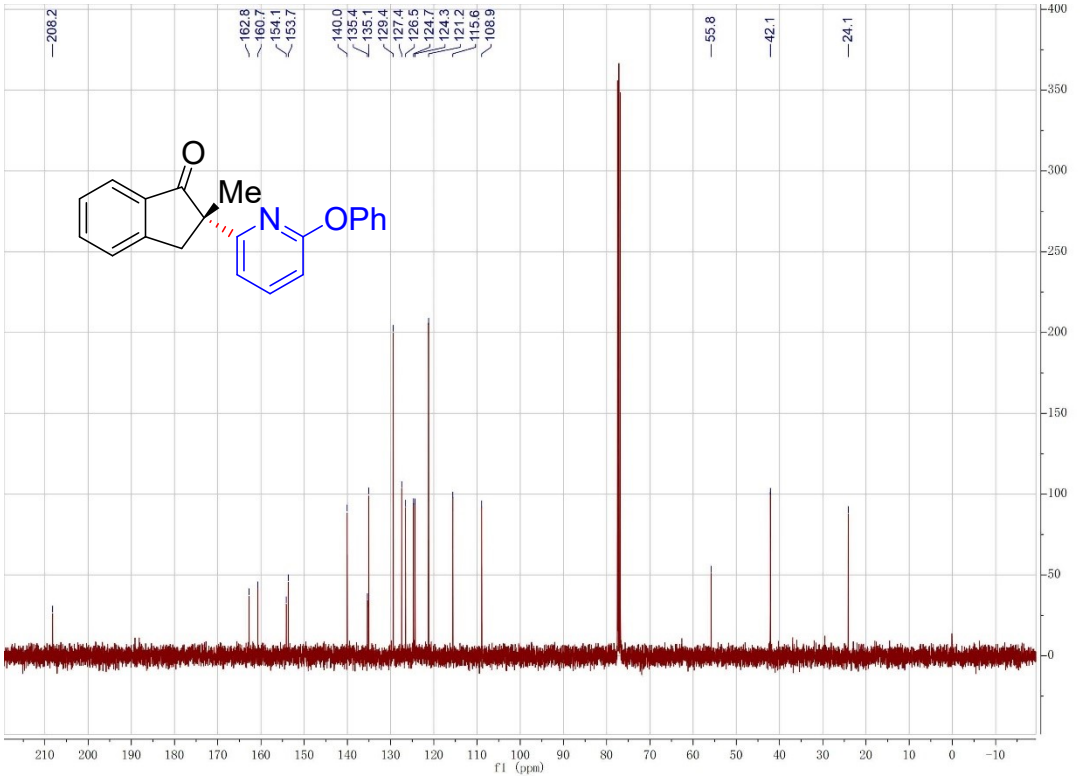
***t*-butyl (*R*)-2-(((6-((*S*)-2-Methyl-1-oxo-2,3-dihydro-1*H*-inden-2-yl) pyridin-2-yl)oxy)methyl) morholine-4-carboxylate (3ac)**



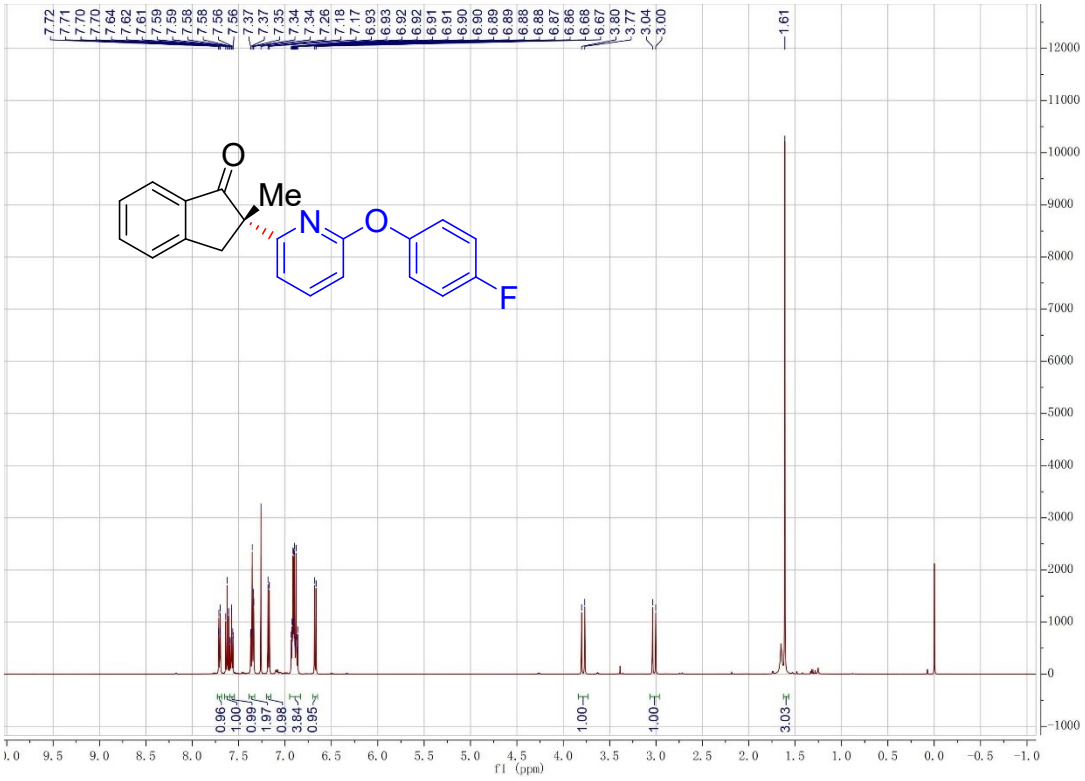


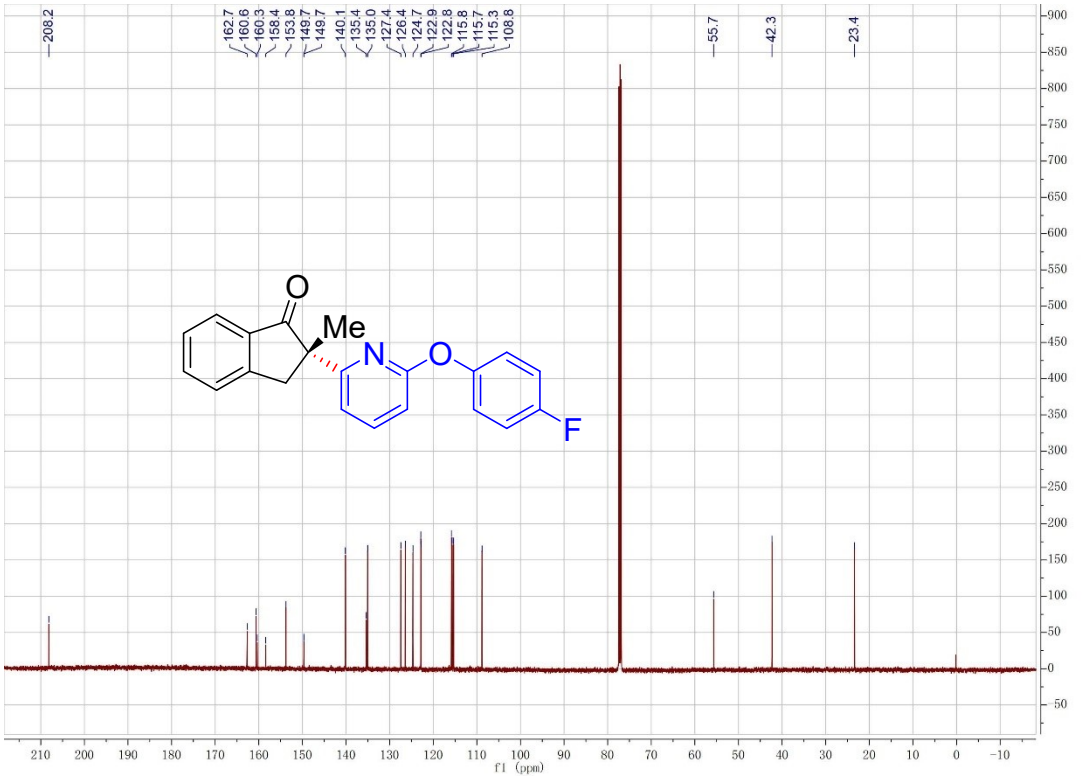
***(S)*-2-Methyl-2-(6-phenoxypyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ad)**

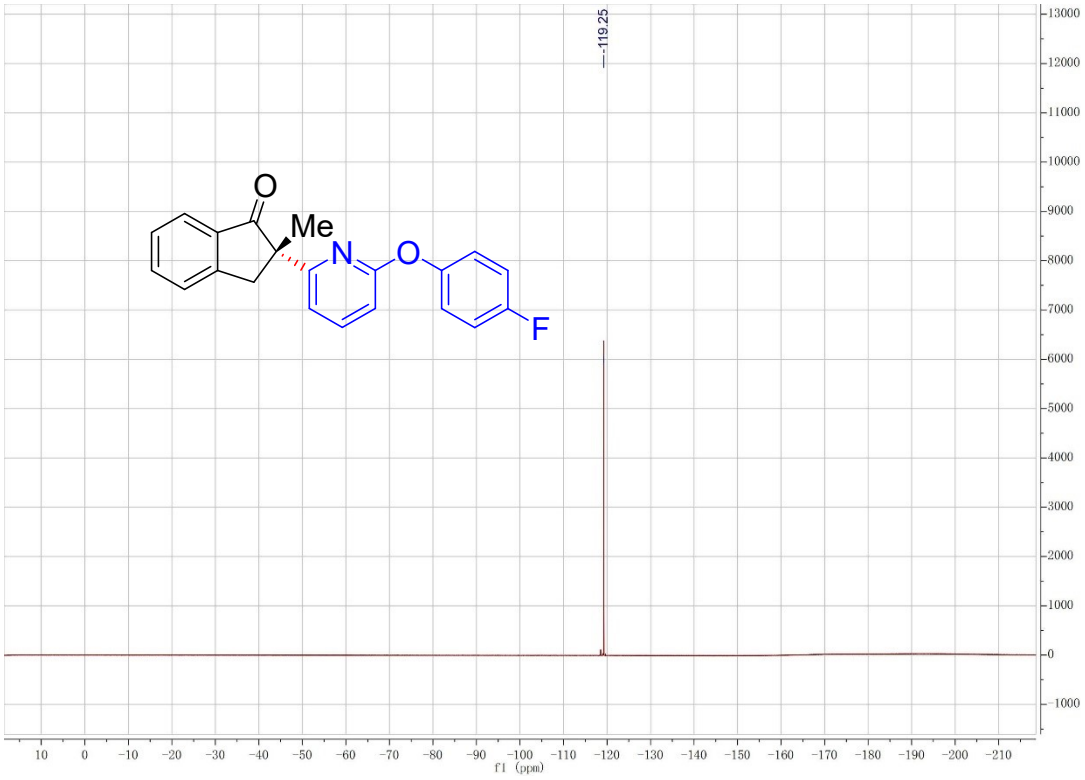




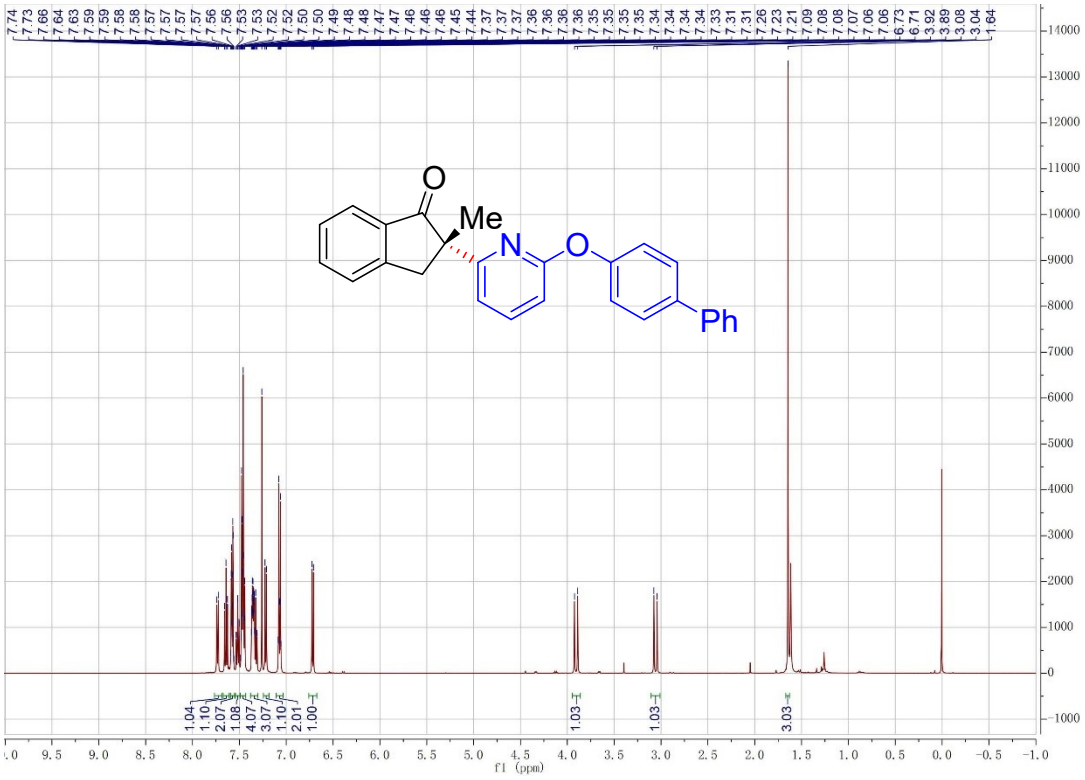
***(S)*-2-(6-(4-Fluorophenoxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ae)**

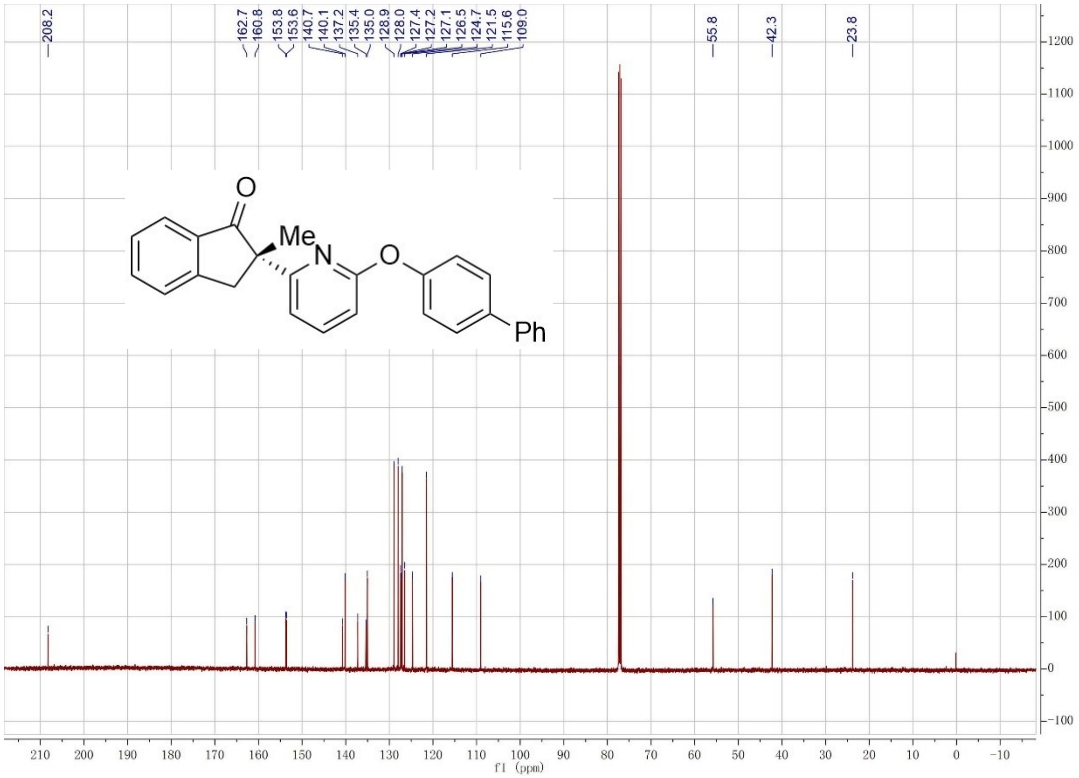




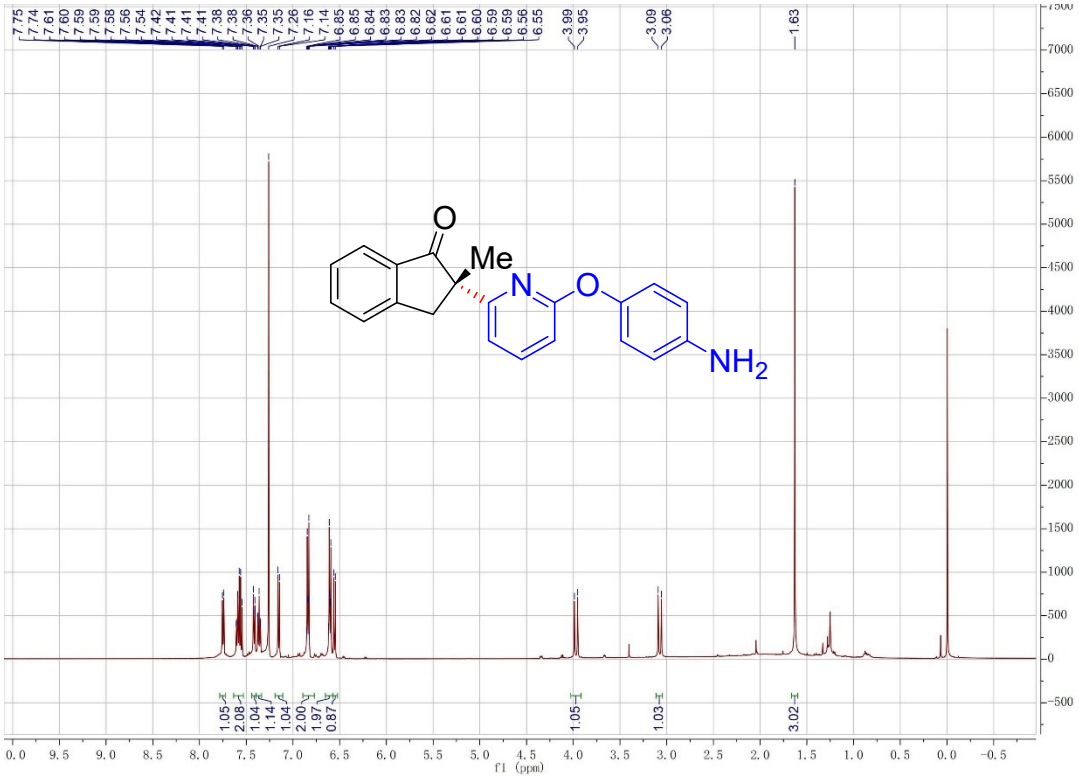


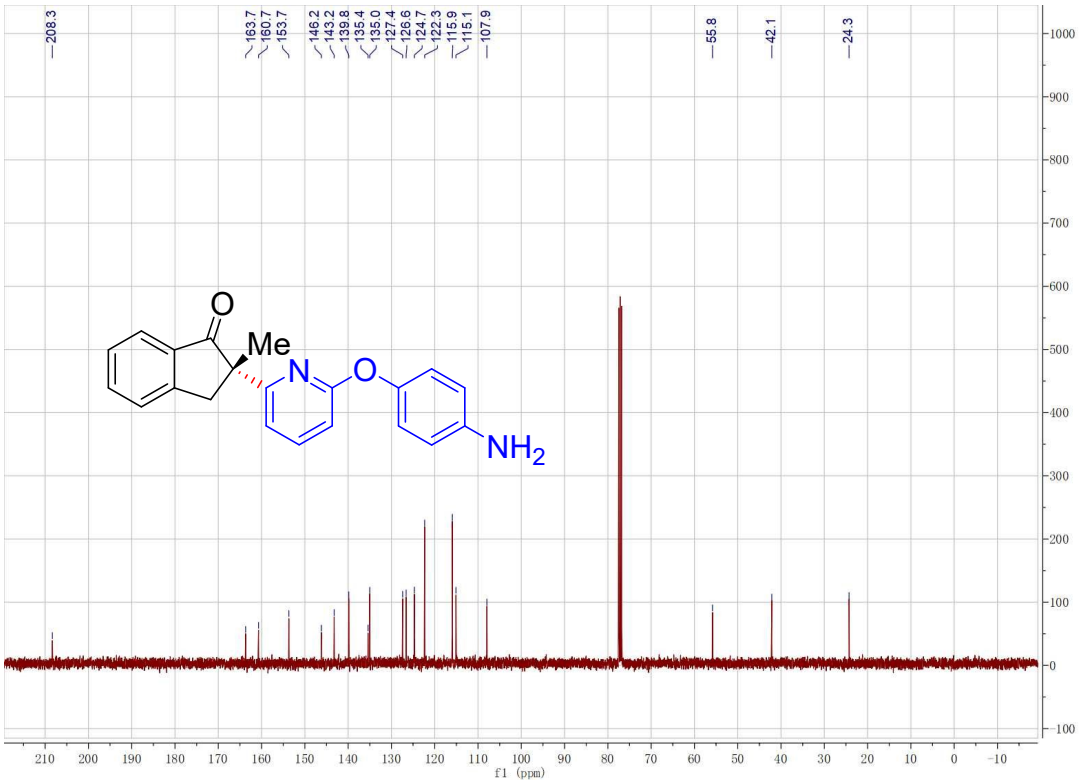
***(S)*-2-(6-([1,1'-Biphenyl]-4-yloxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3af)**



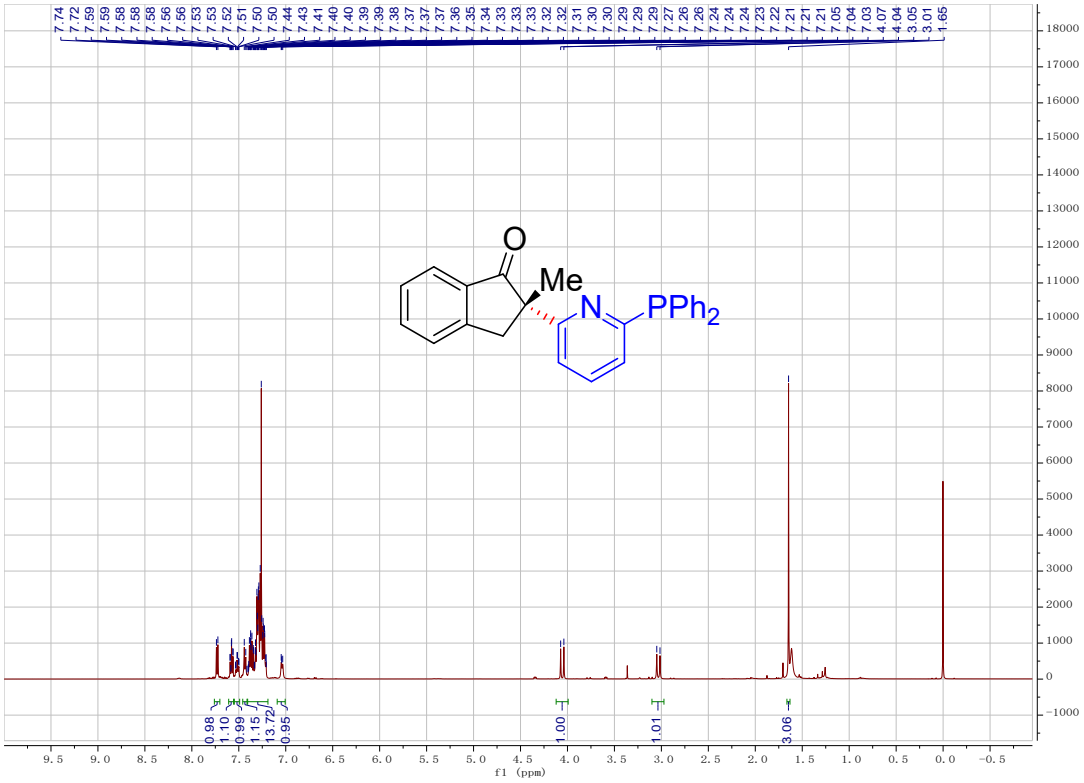


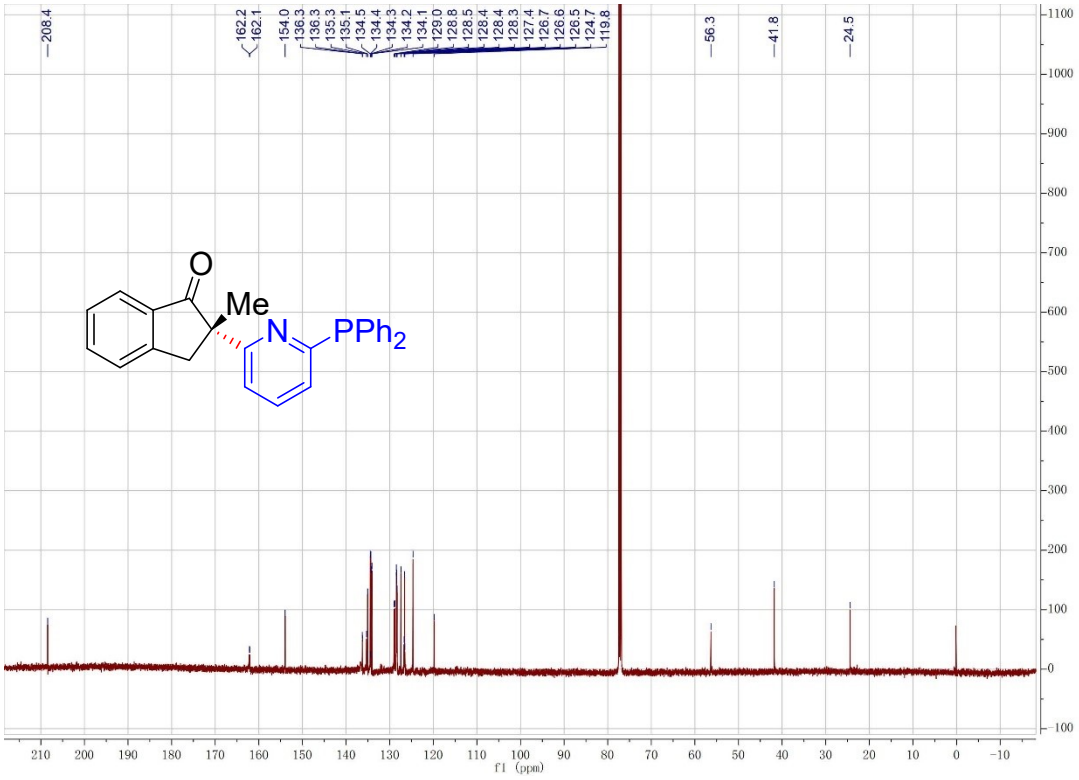
***(S)*-2-(6-(4-Aminophenoxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ag)**

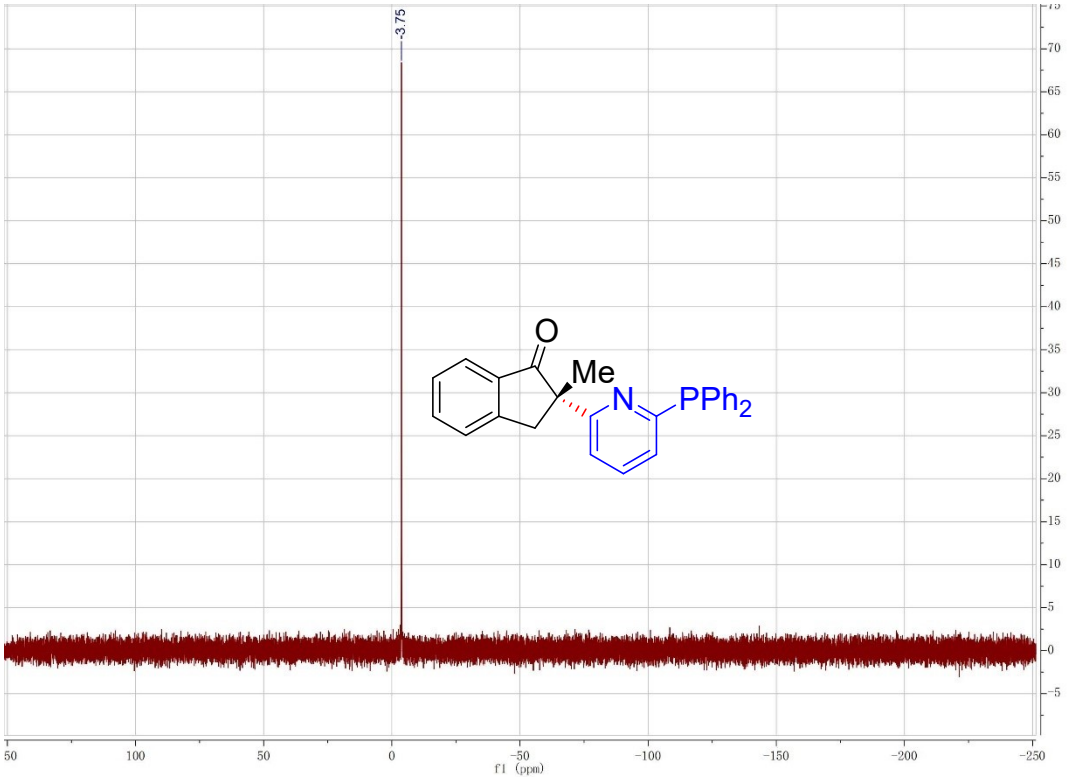




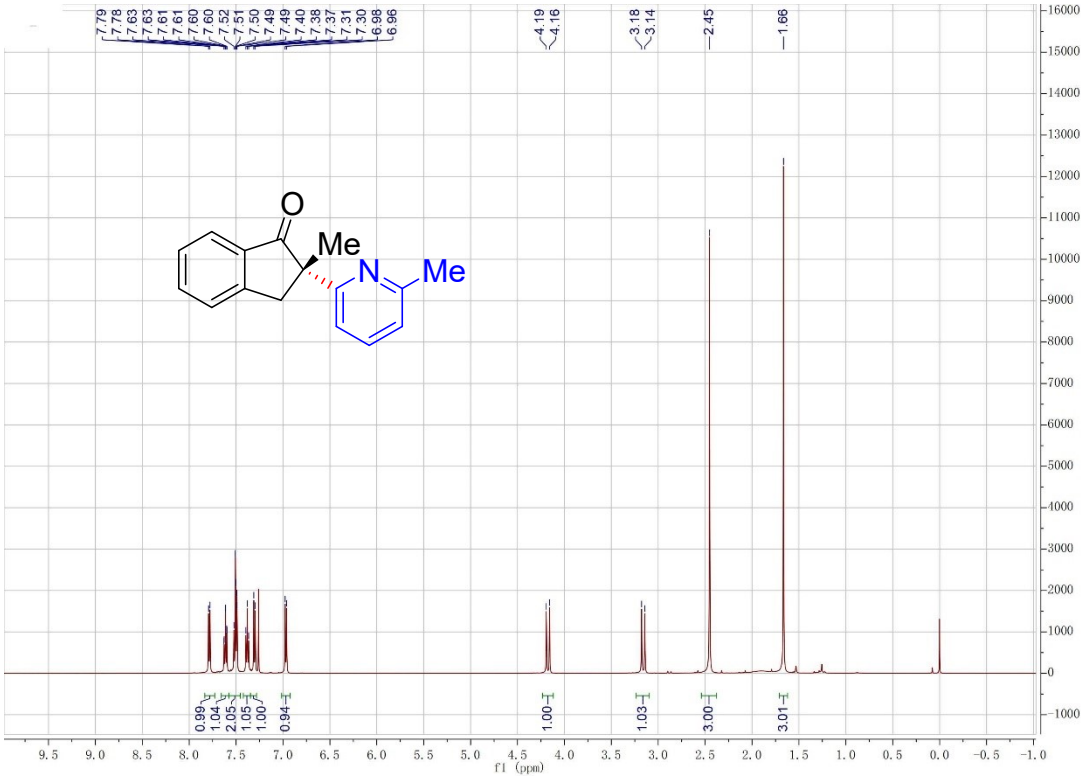
***(S)*-2-(6-(Diphenylphosphaneyl)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ah)**

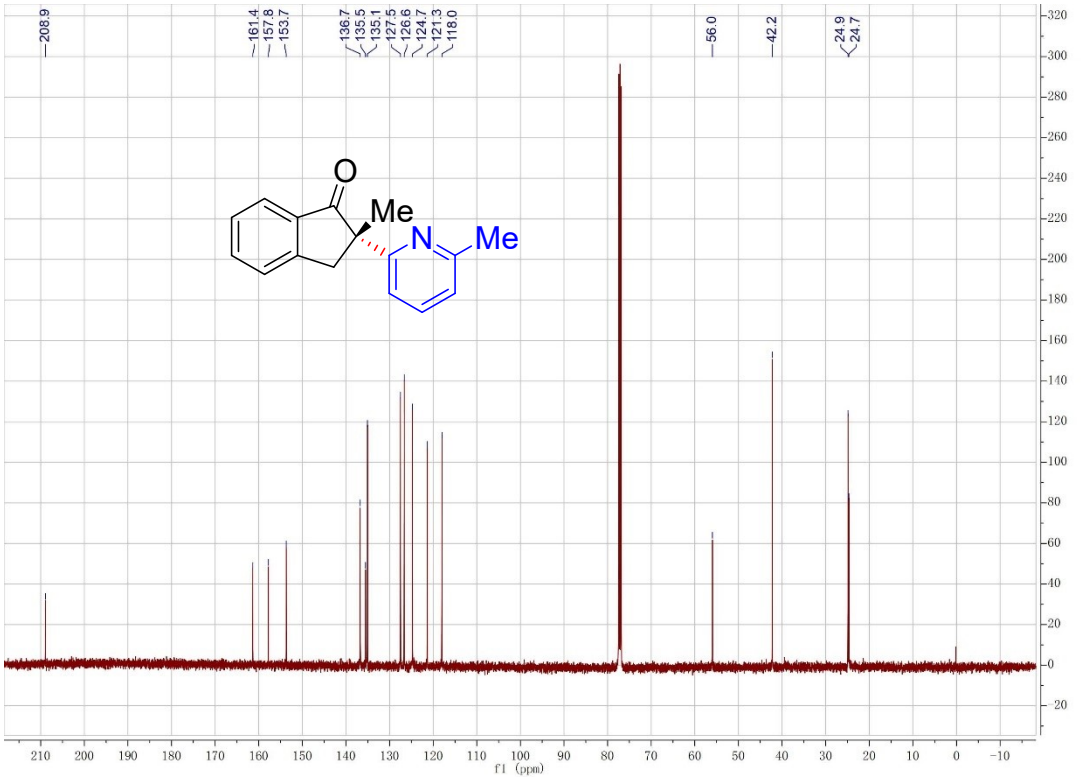




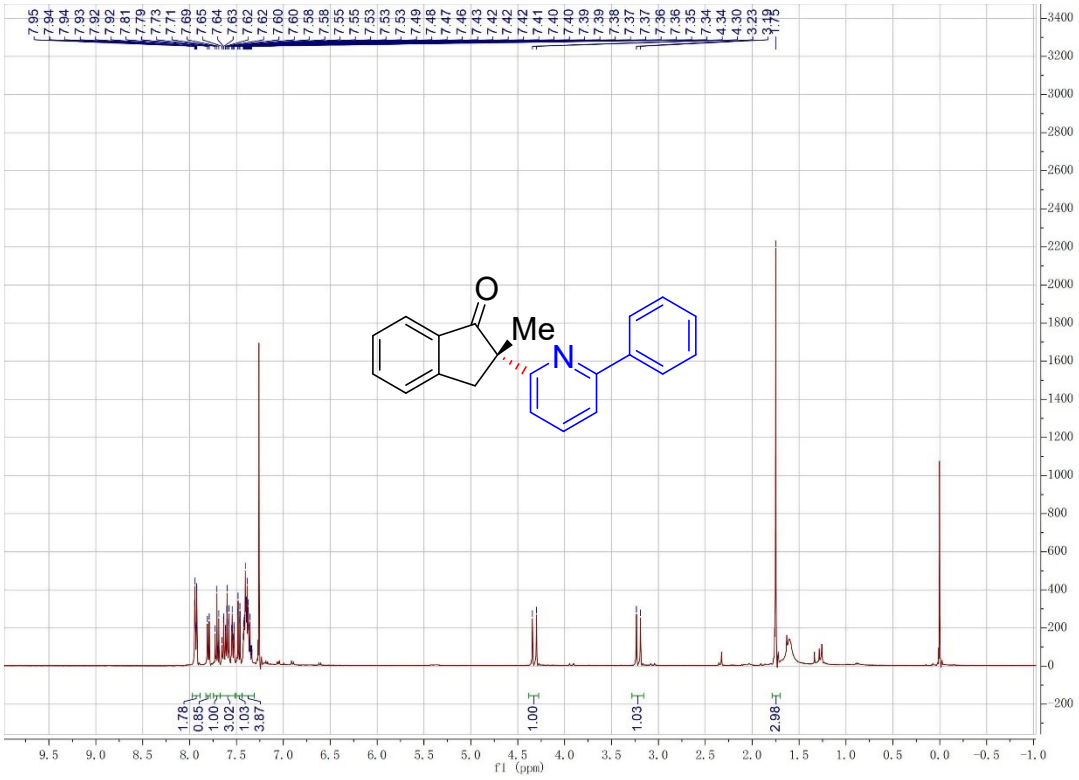


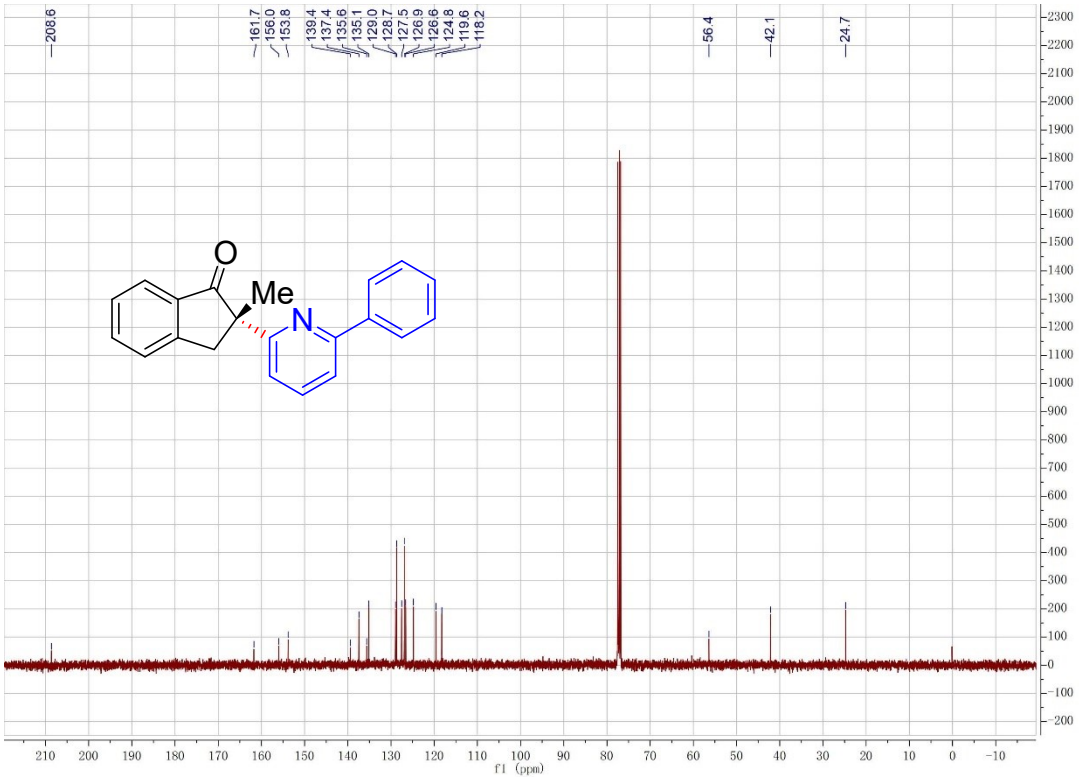
***(S)*-2-Methyl-2-(6-methylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ai)**



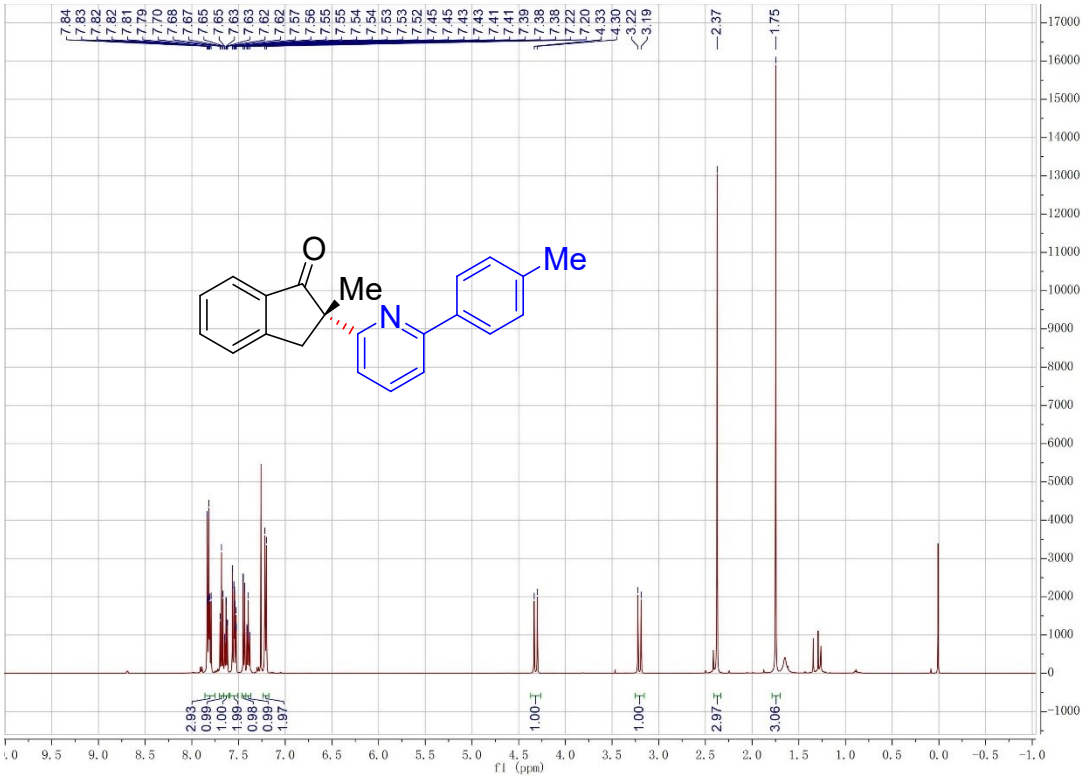


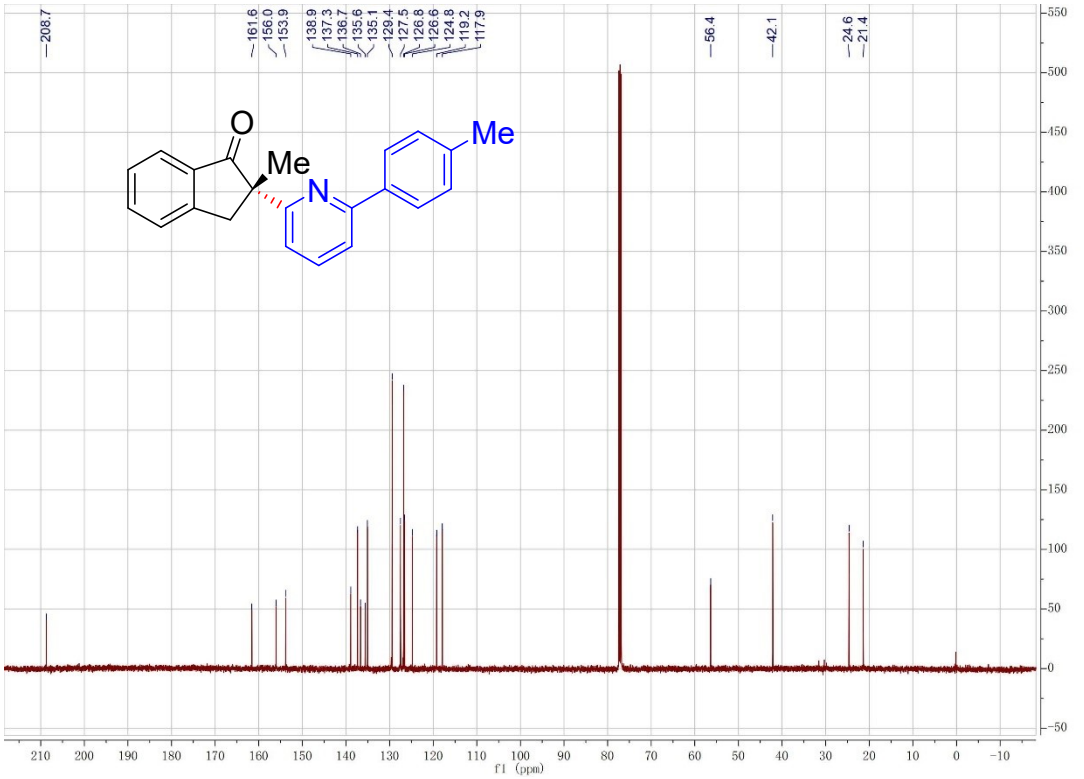
***(S)*-2-Methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3aj)**



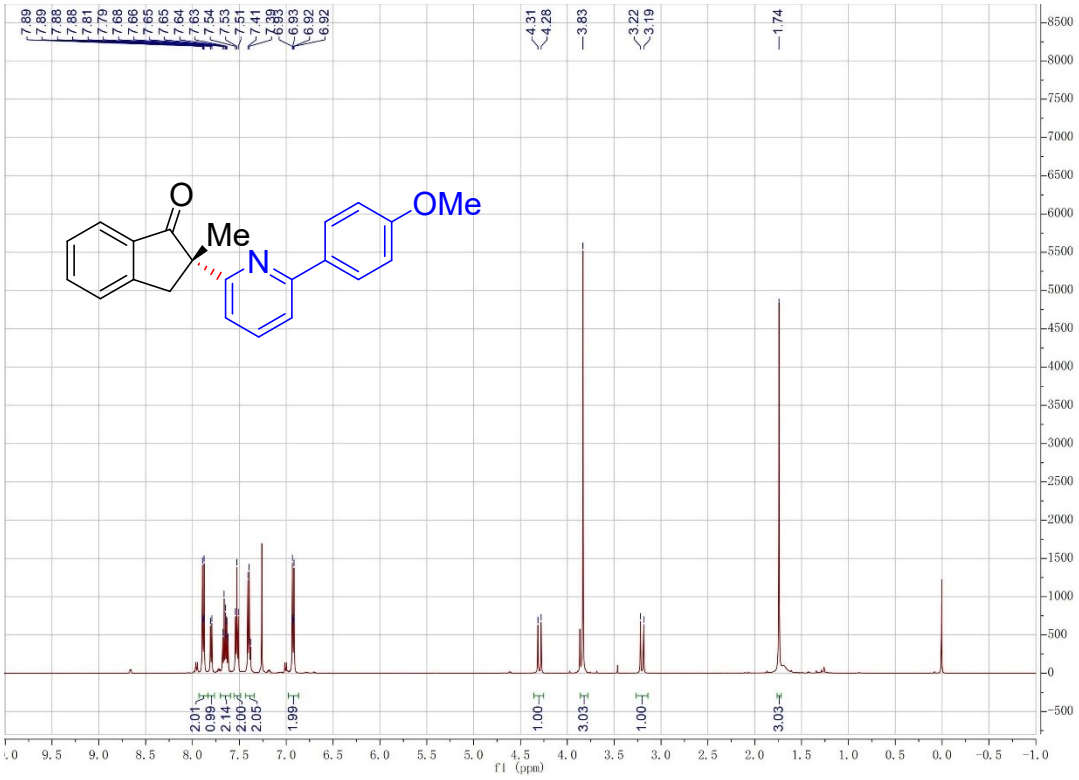


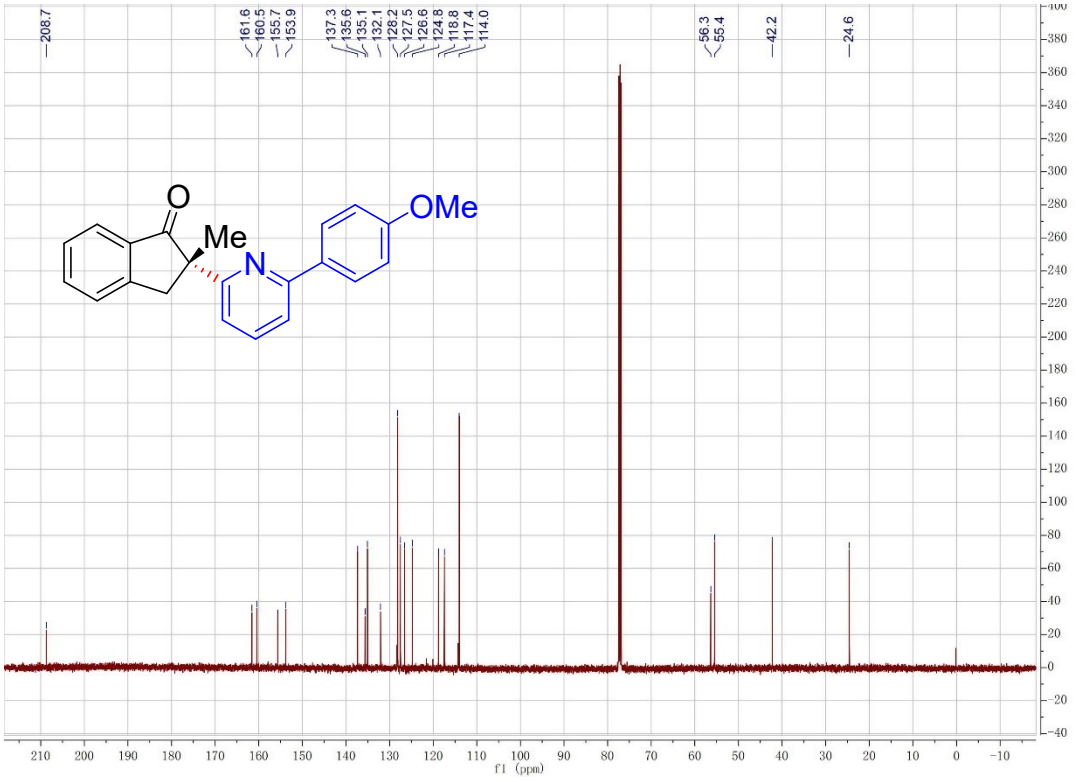
***(S)*-2-Methyl-2-(6-(p-tolyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ak)**



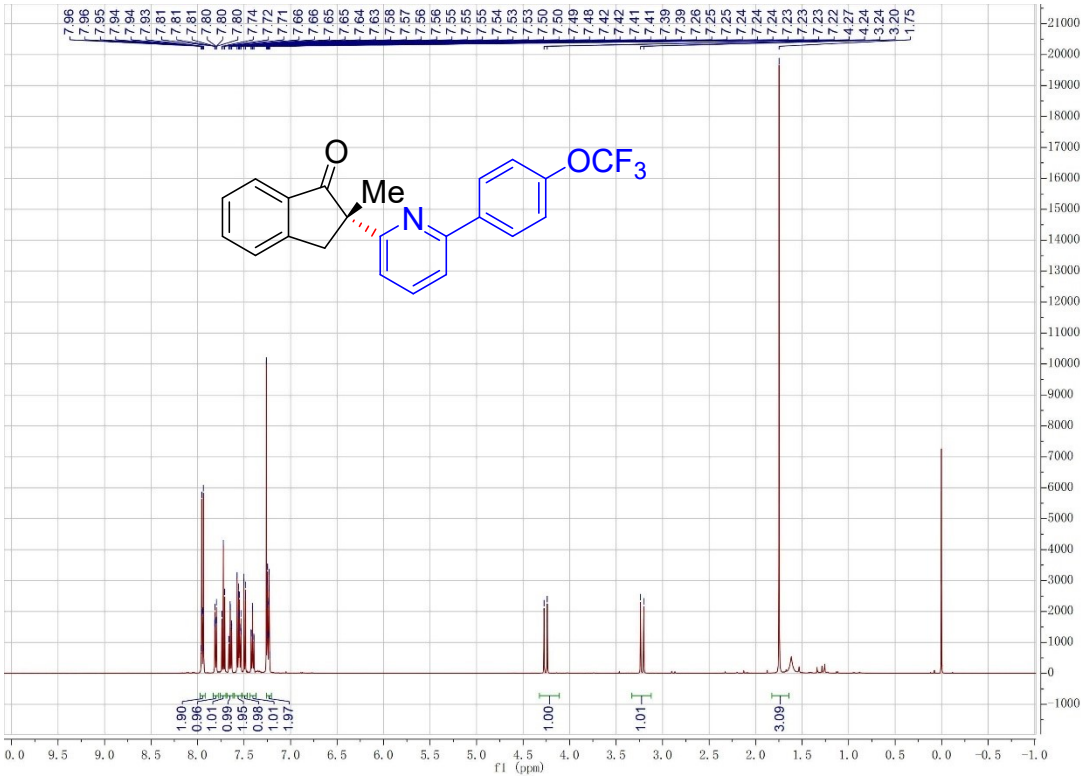


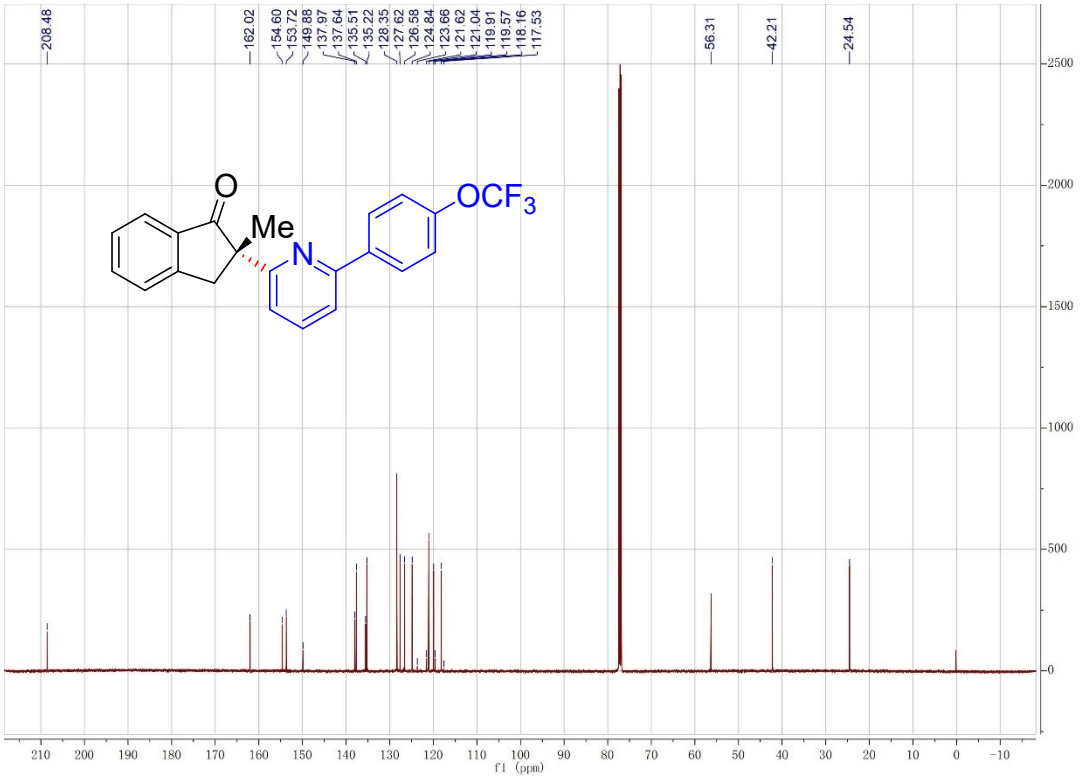
***(S)*-2-(6-(4-Methoxyphenyl)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3al)**

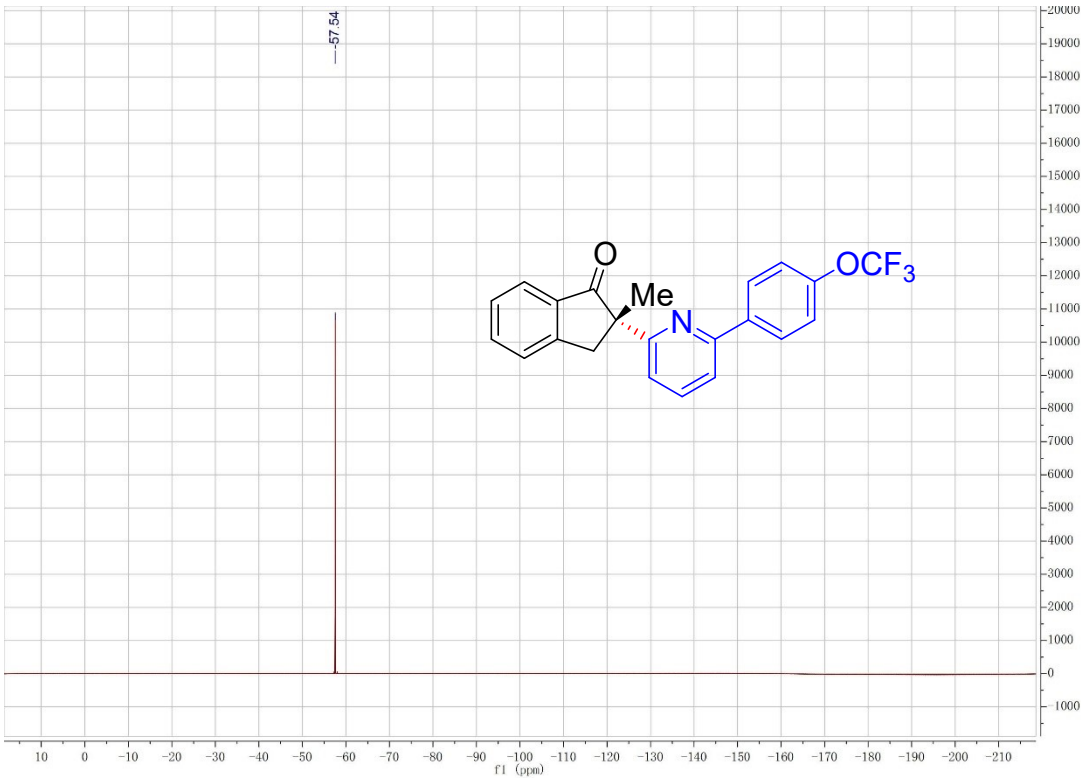




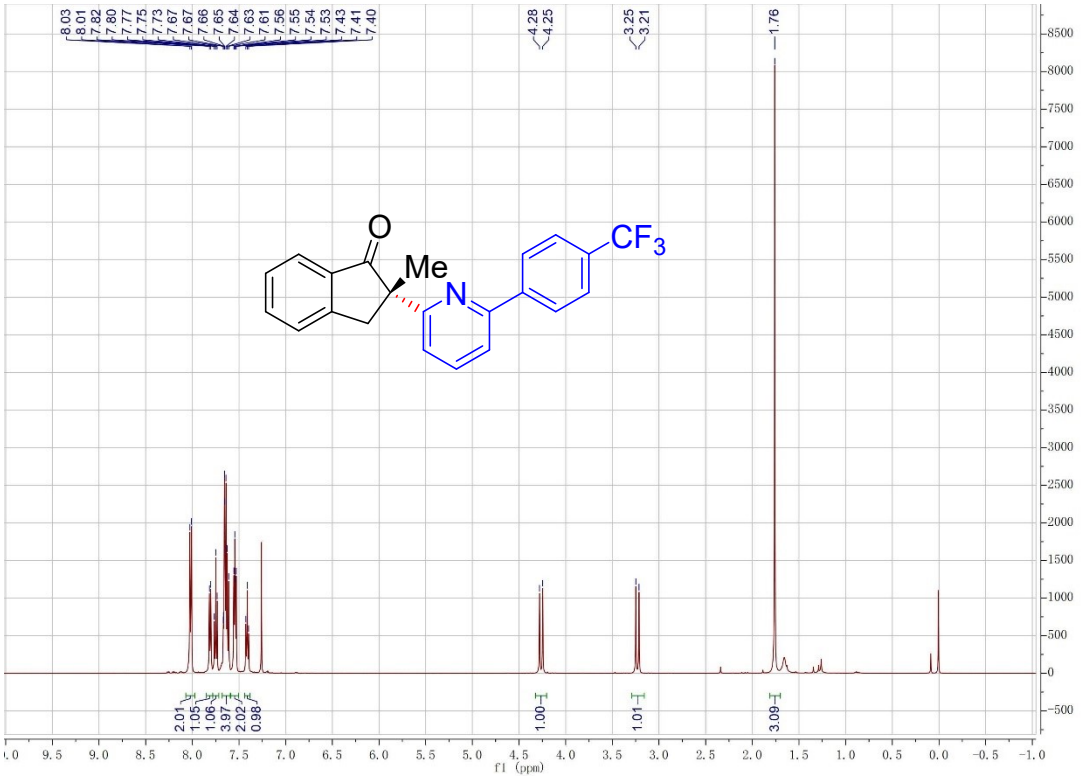
***(S)*-2-Methyl-2-(6-(4-(trifluoromethoxy)phenyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3am)**

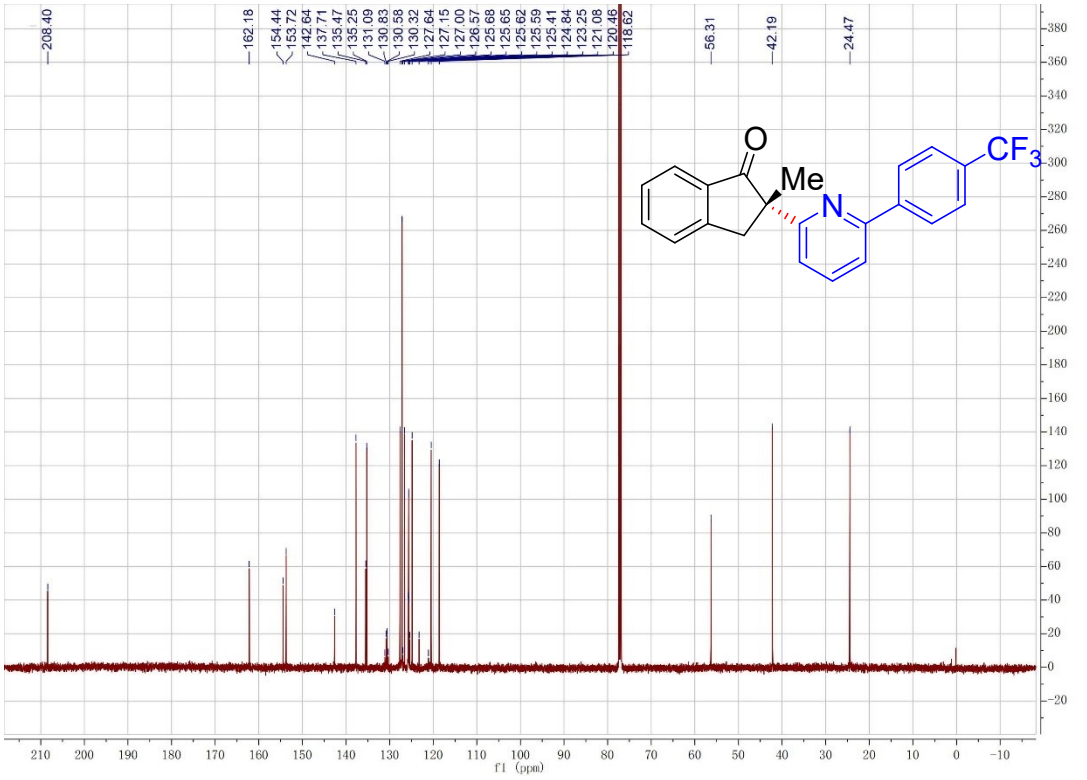

O
Me
N
OCF3

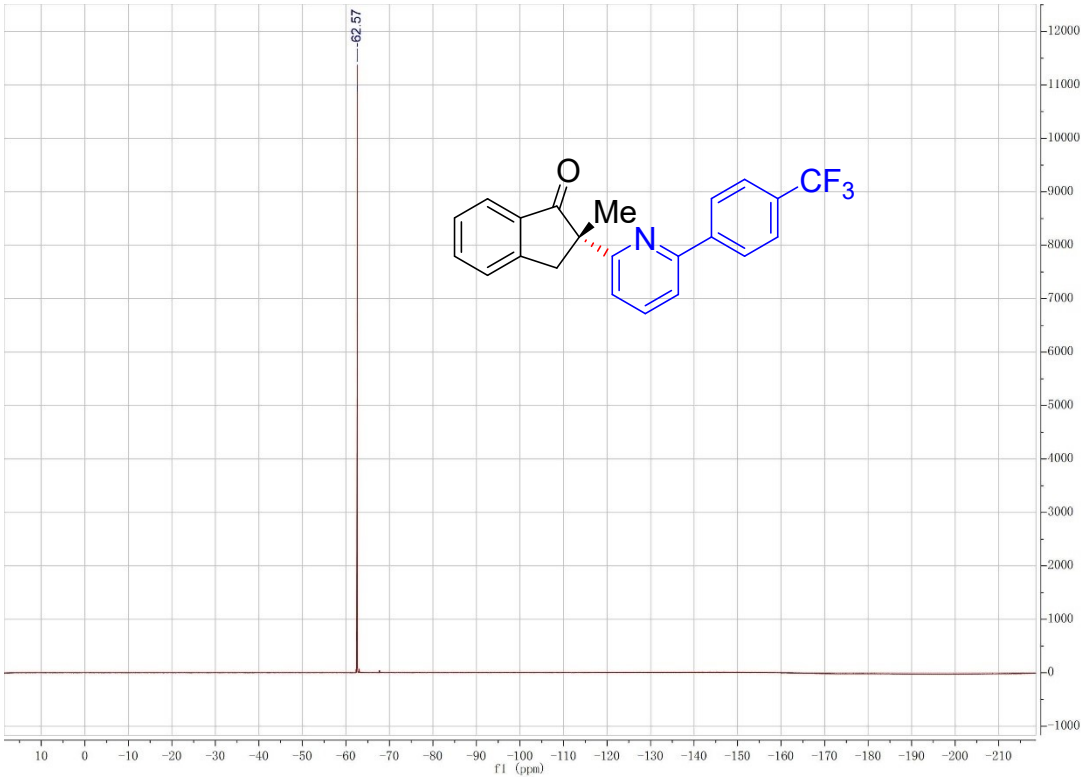

O
Me
N
OCF3



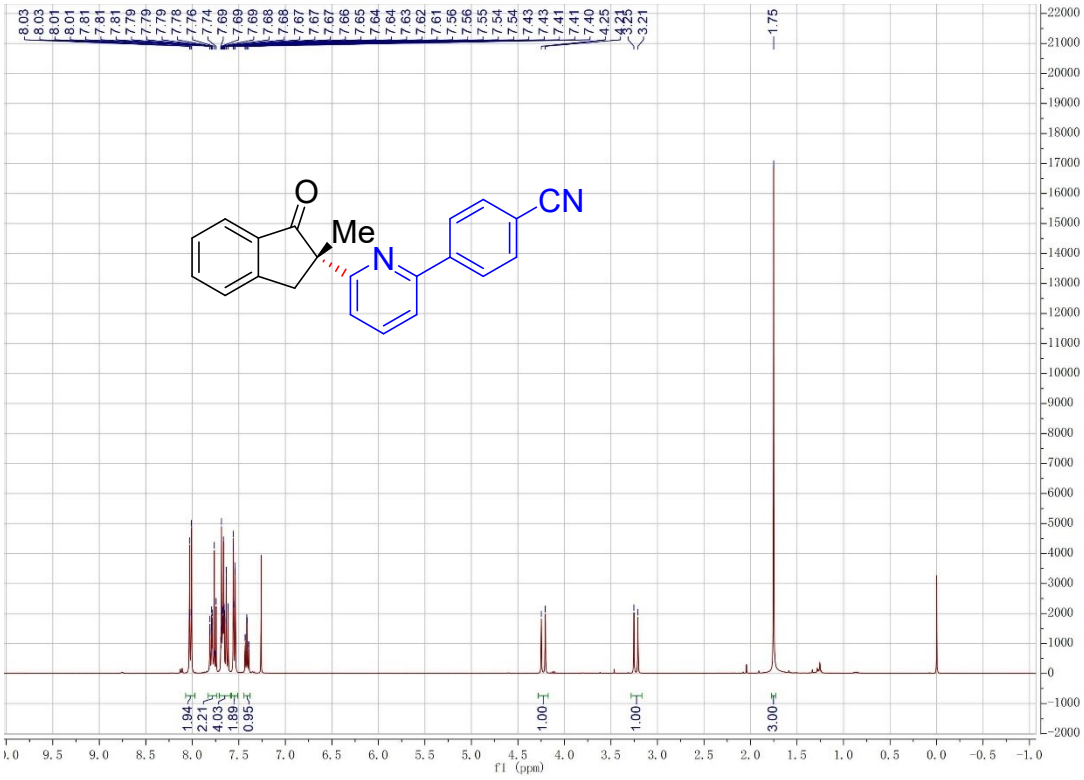
***(S)*-2-Methyl-2-(6-(4-(trifluoromethyl)phenyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3an)**

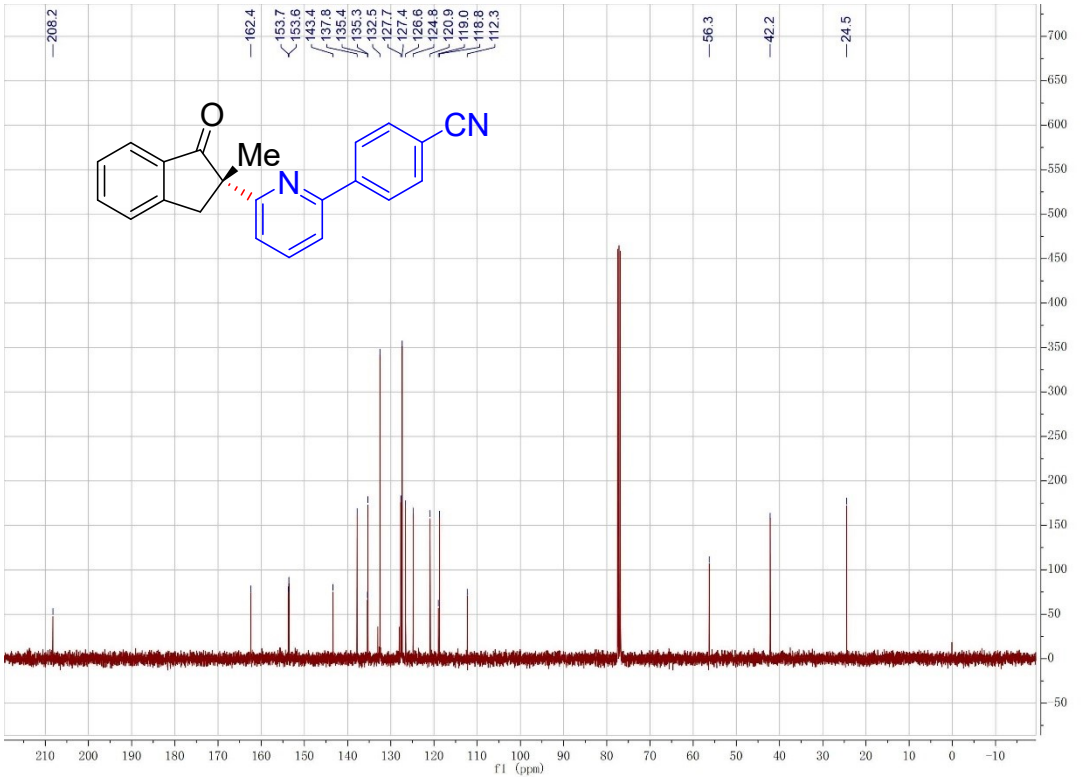




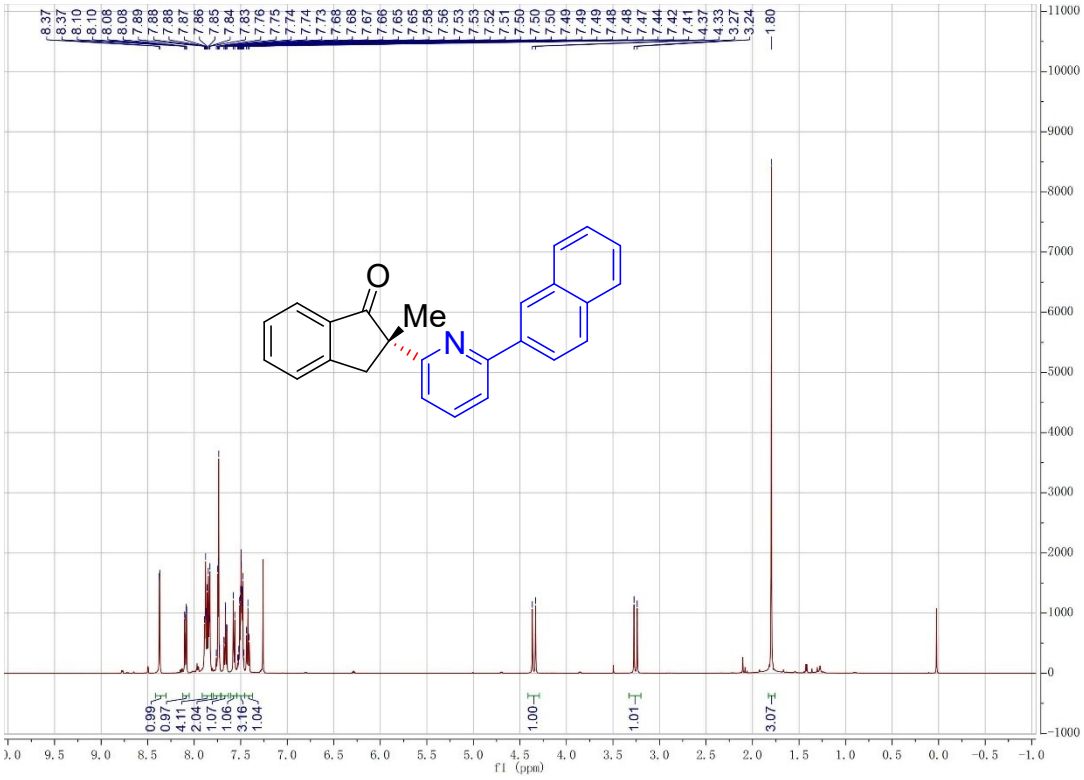


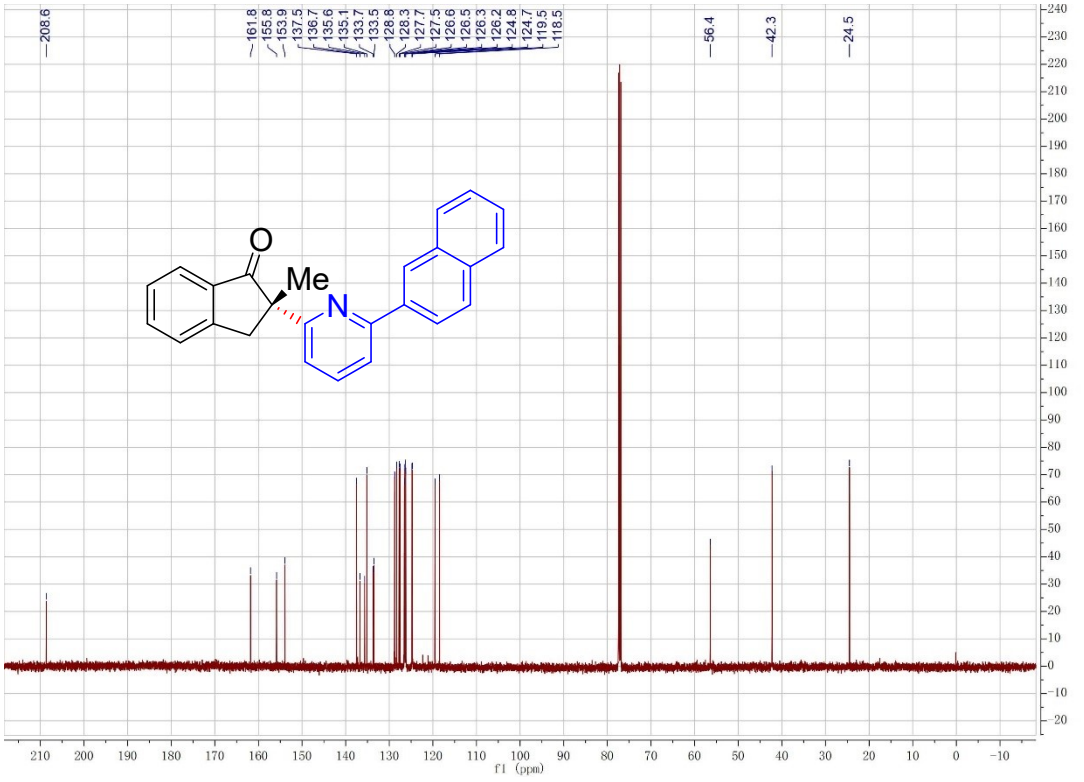
***(S)*-4-(6-(2-Methyl-1-oxo-2,3-dihydro-1*H*-inden-2-yl)pyridin-2-yl)benzonitrile (3ao)**



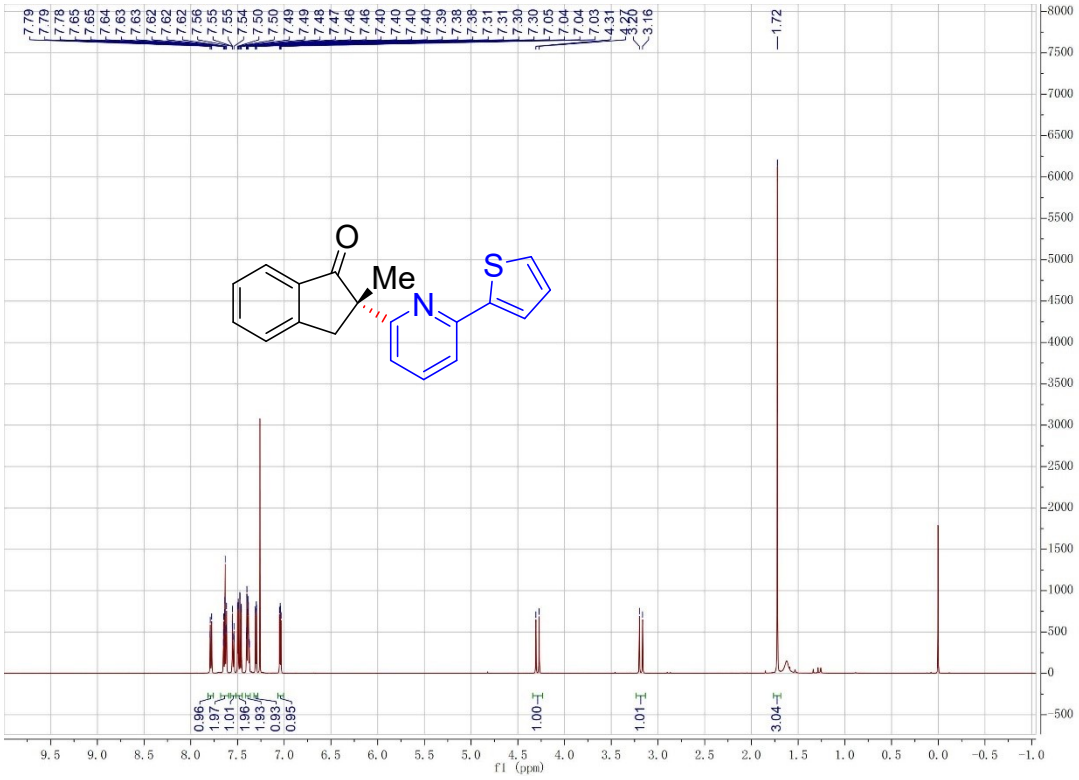


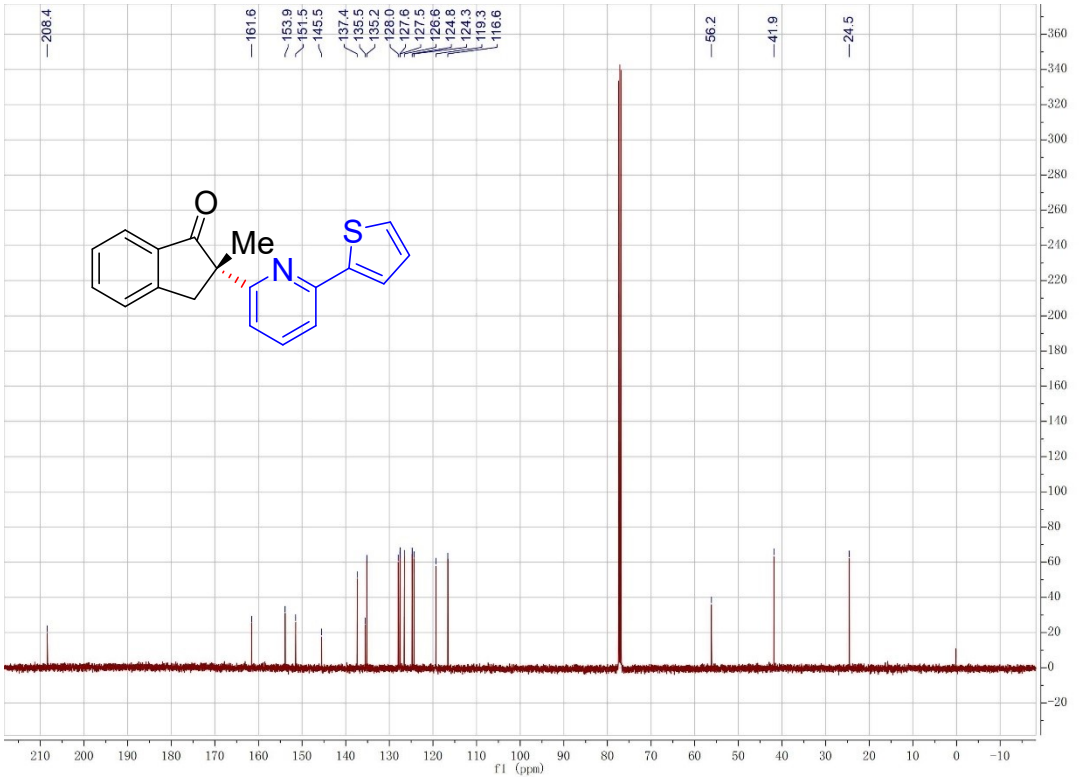
***(S)*-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ap)**



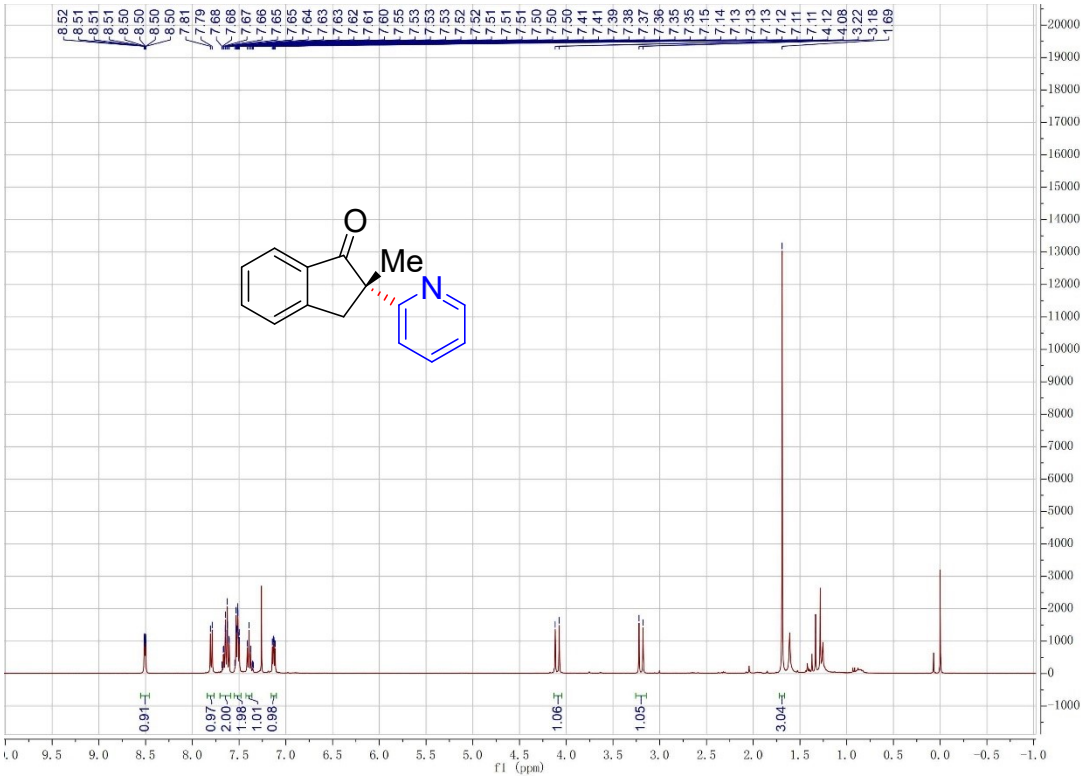


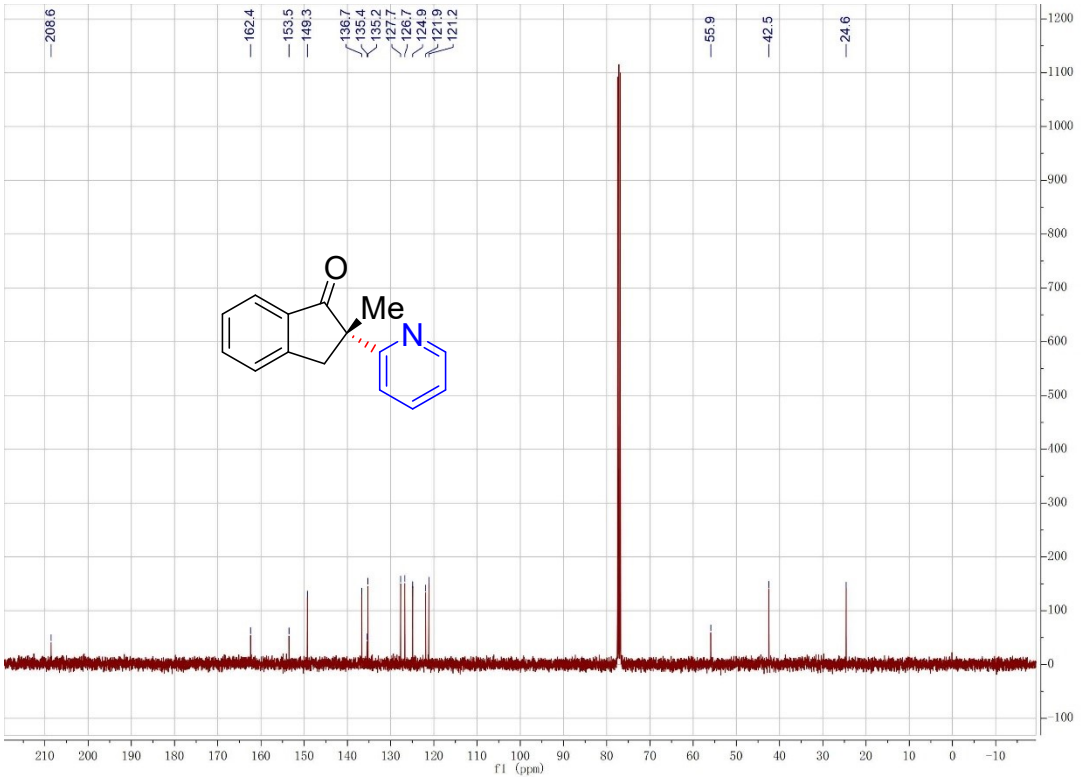
***(S)*-2-Methyl-2-(6-(thiophen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3aq)**



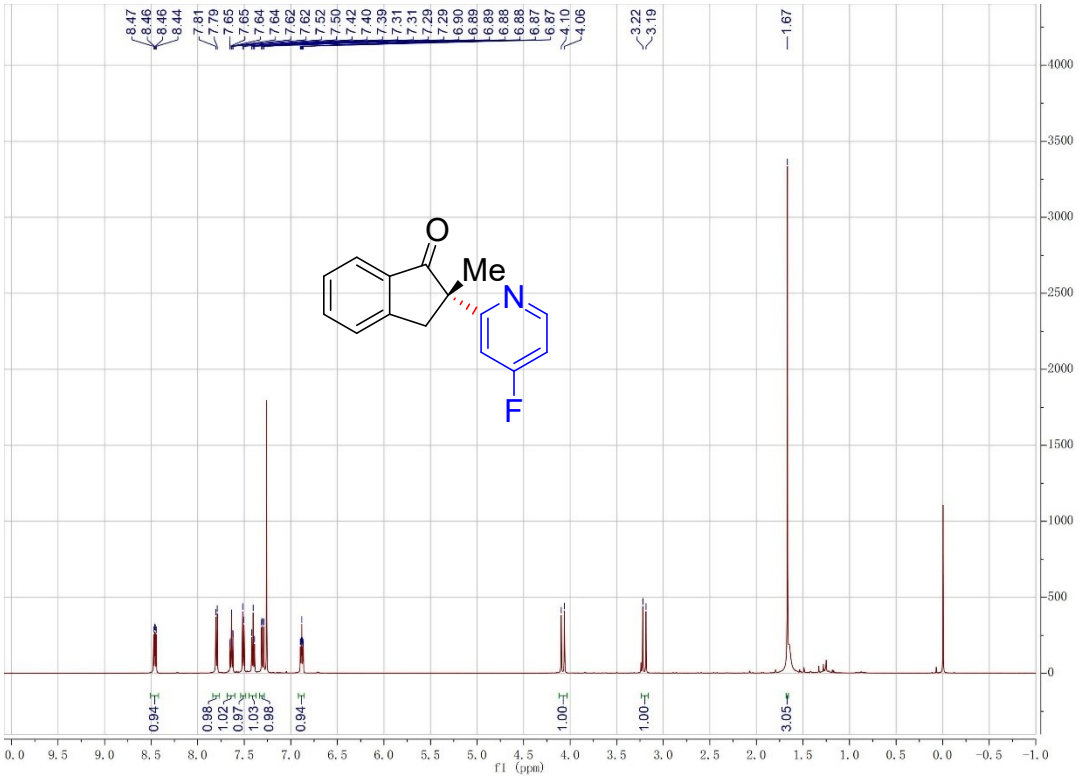


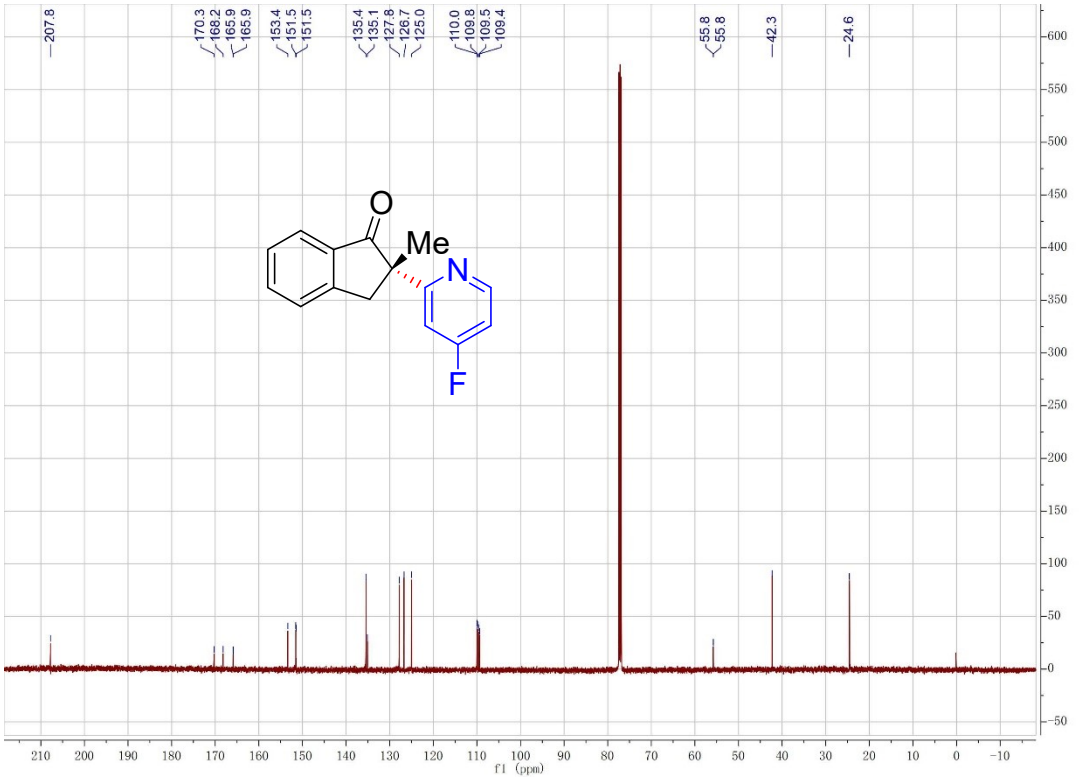
***(S)*-2-Methyl-2-(pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ar)**

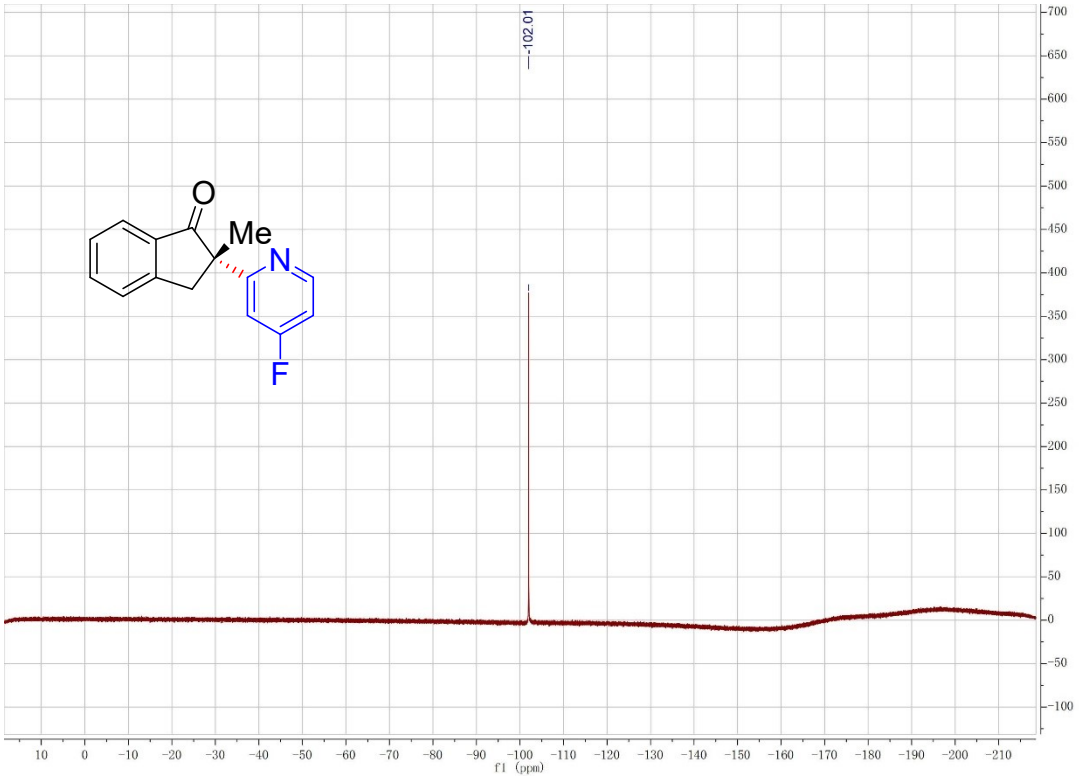




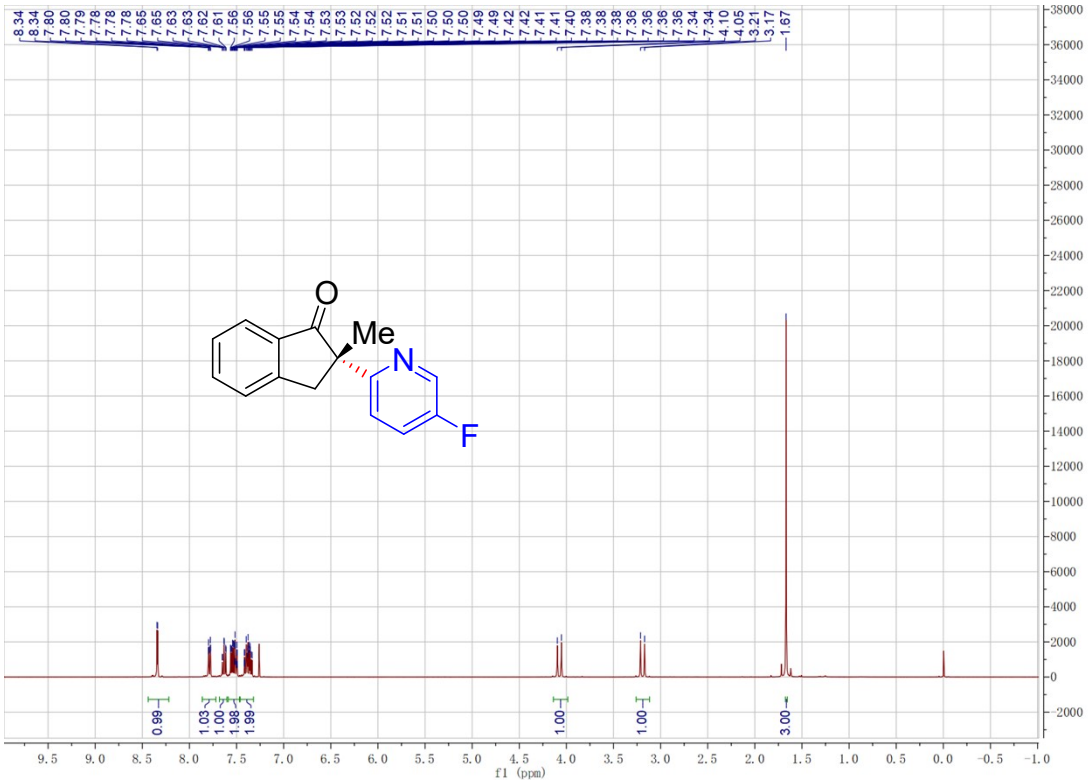
***(S)*-2-(4-Fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3as)**

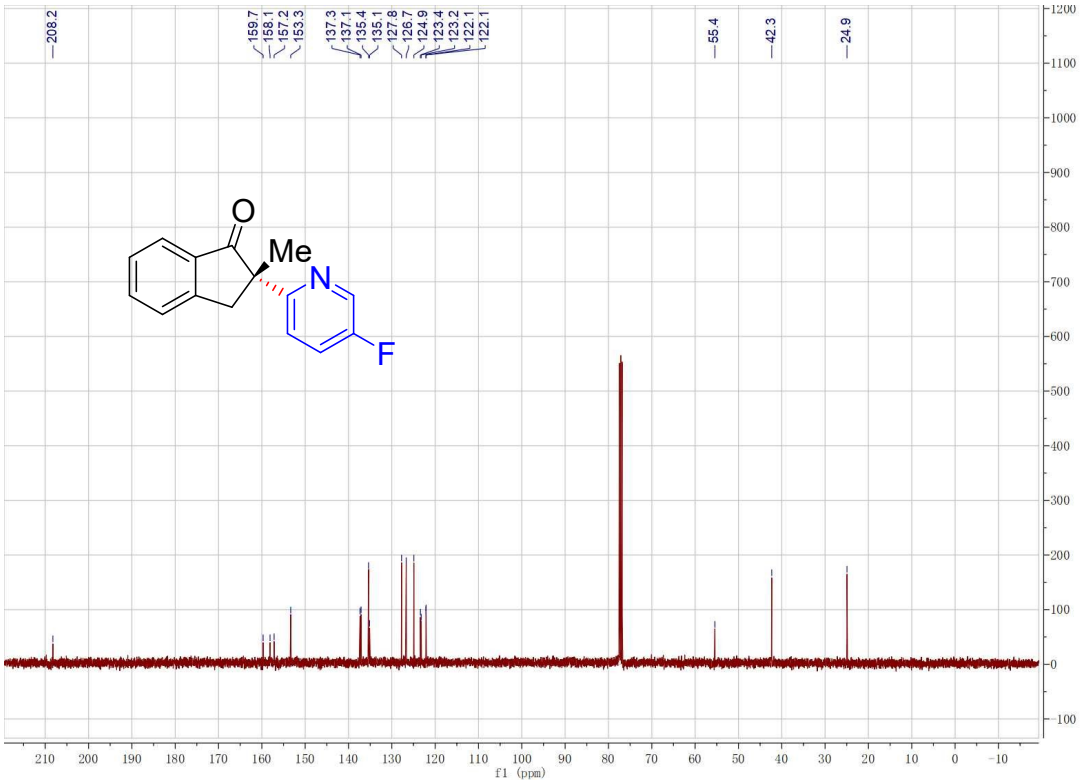

8.47
8.46
8.46
8.44
7.81
7.79
7.65
7.65
7.64
7.64
7.62
7.62
7.52
7.50
7.42
7.40
7.39
7.31
7.31
7.29
7.29
6.90
6.89
6.89
6.88
6.88
6.87
6.87
4.10
4.06
3.22
3.19
1.67
O
Me
N
F
0.94
0.98
1.02
0.97
1.03
0.98
0.94
1.00
1.00
3.05
f1 (ppm)

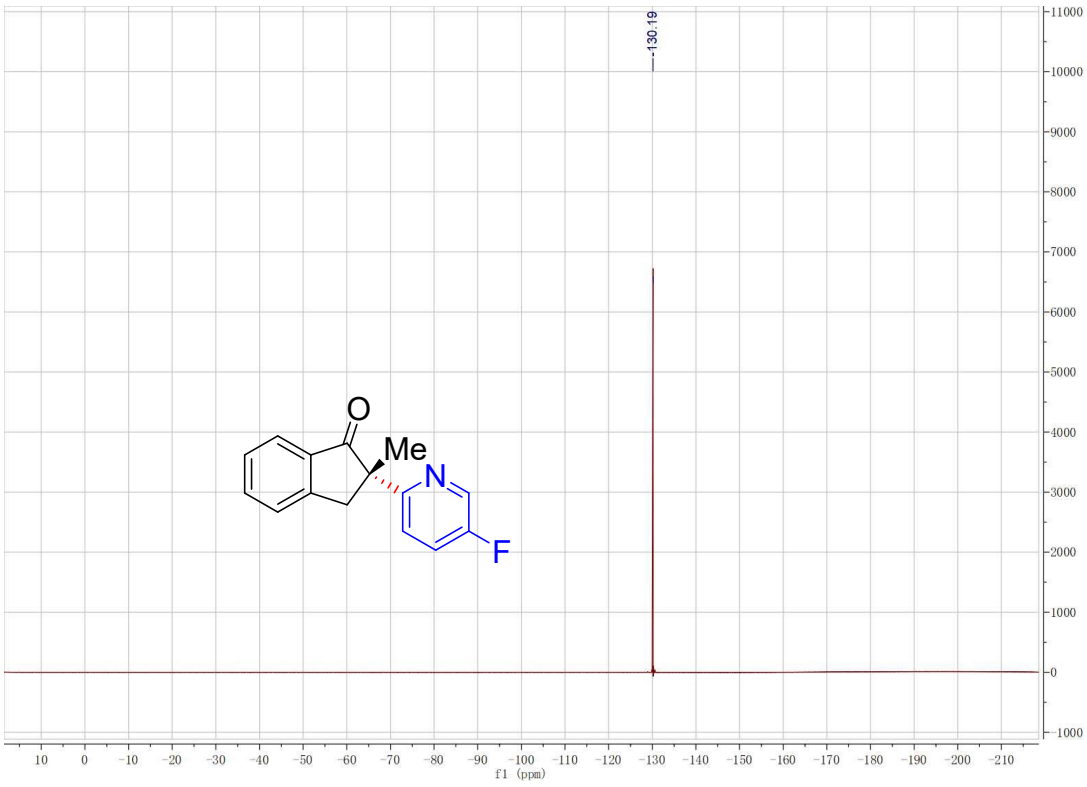

207.8
170.3
168.2
165.9
165.9
153.4
151.5
151.5
135.4
135.1
127.8
126.7
125.0
110.0
109.8
109.5
109.4
55.8
55.8
42.3
24.6
O
Me
N
F
f1 (ppm)



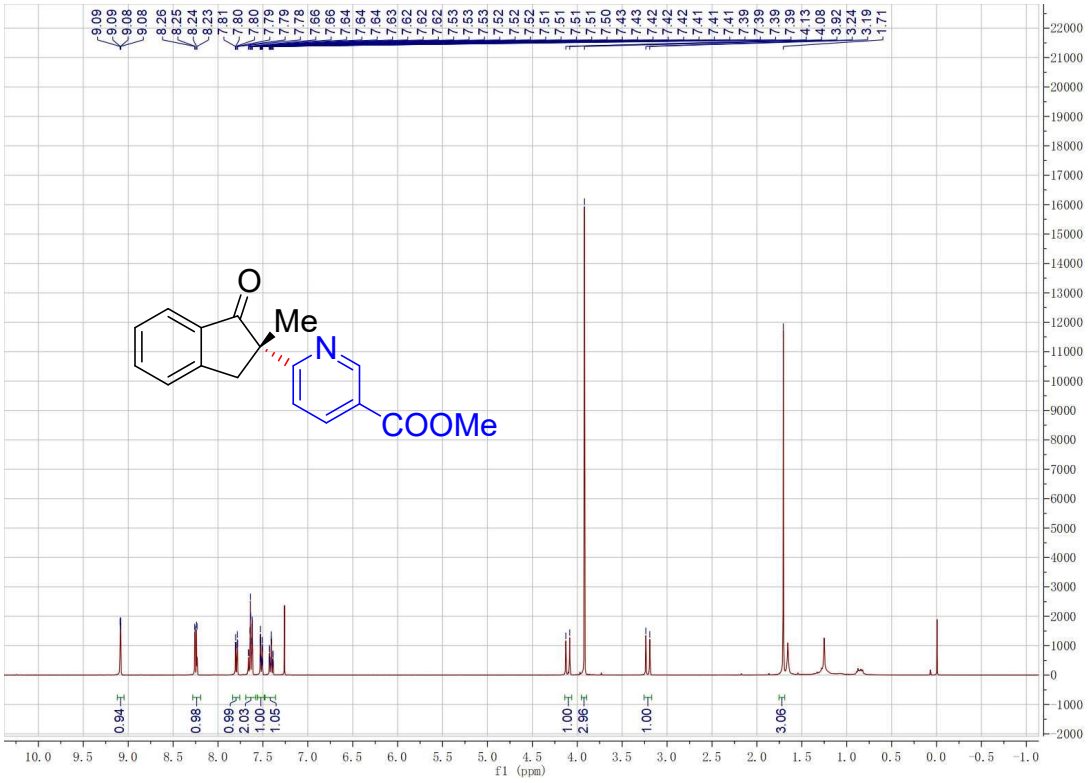
***(S)*-2-(5-fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3at)**

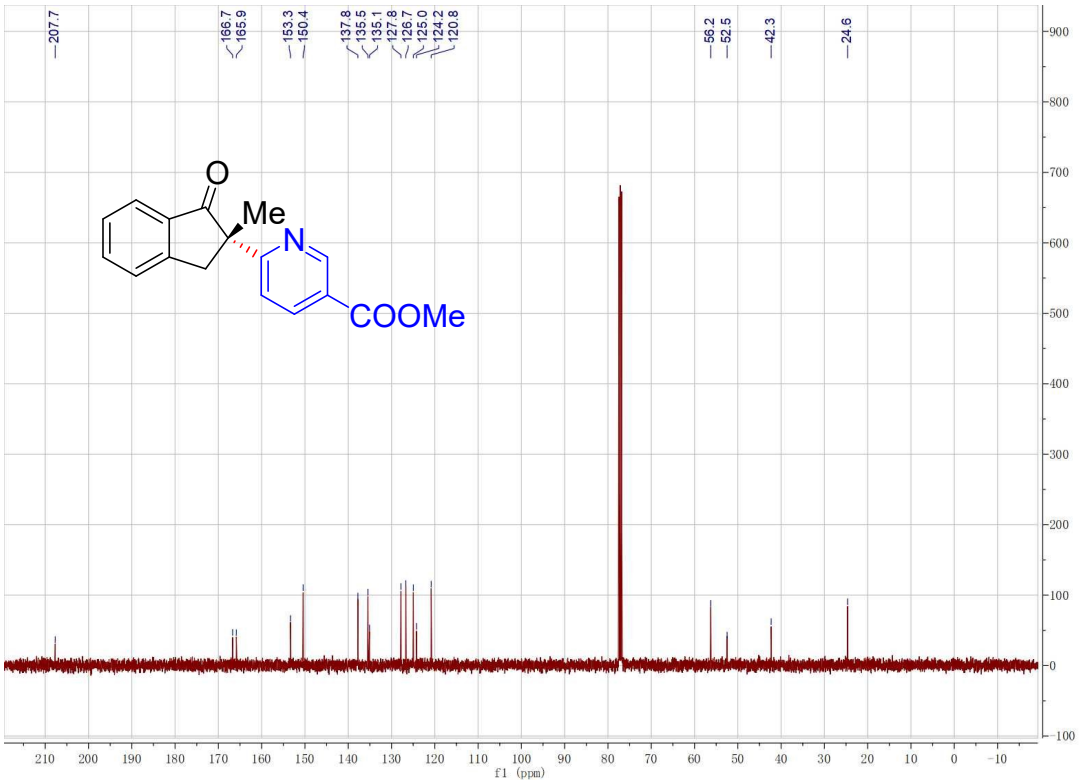



208.2
159.7
158.1
157.2
153.3
137.3
137.1
135.4
135.1
127.8
126.7
124.9
123.4
123.2
122.1
122.1
55.4
42.3
24.9
O
Me
N
F
f1 (ppm)

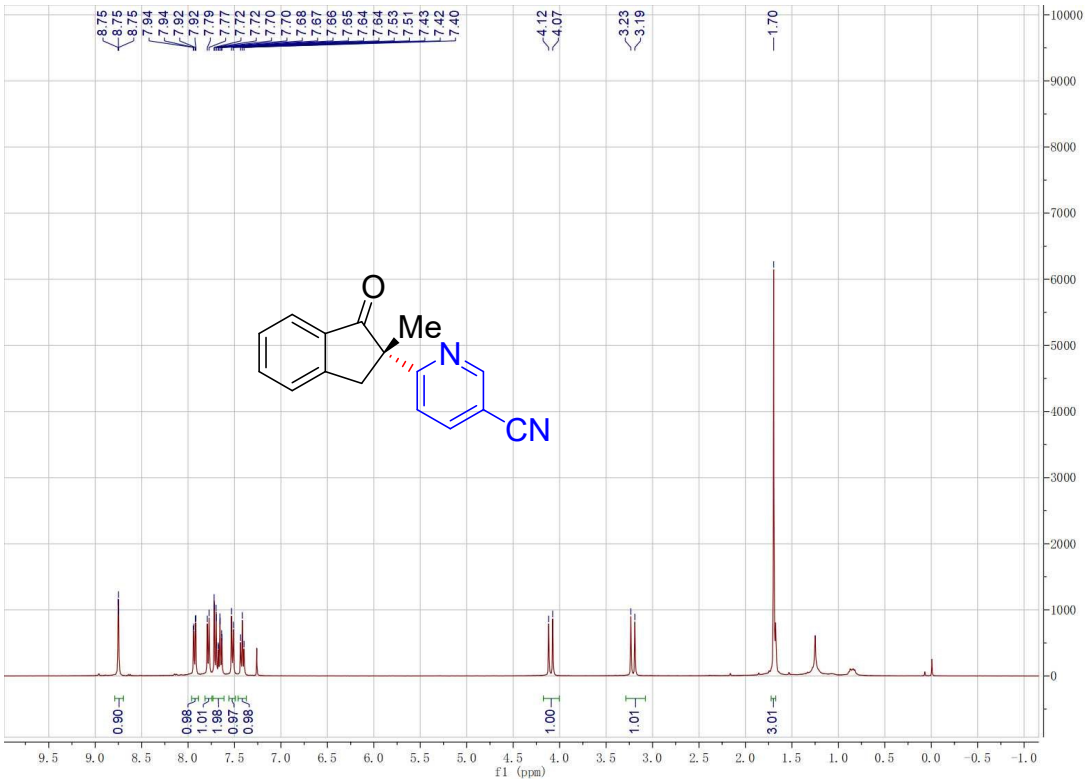

-130.19
O
Me
N
F
f1 (ppm)

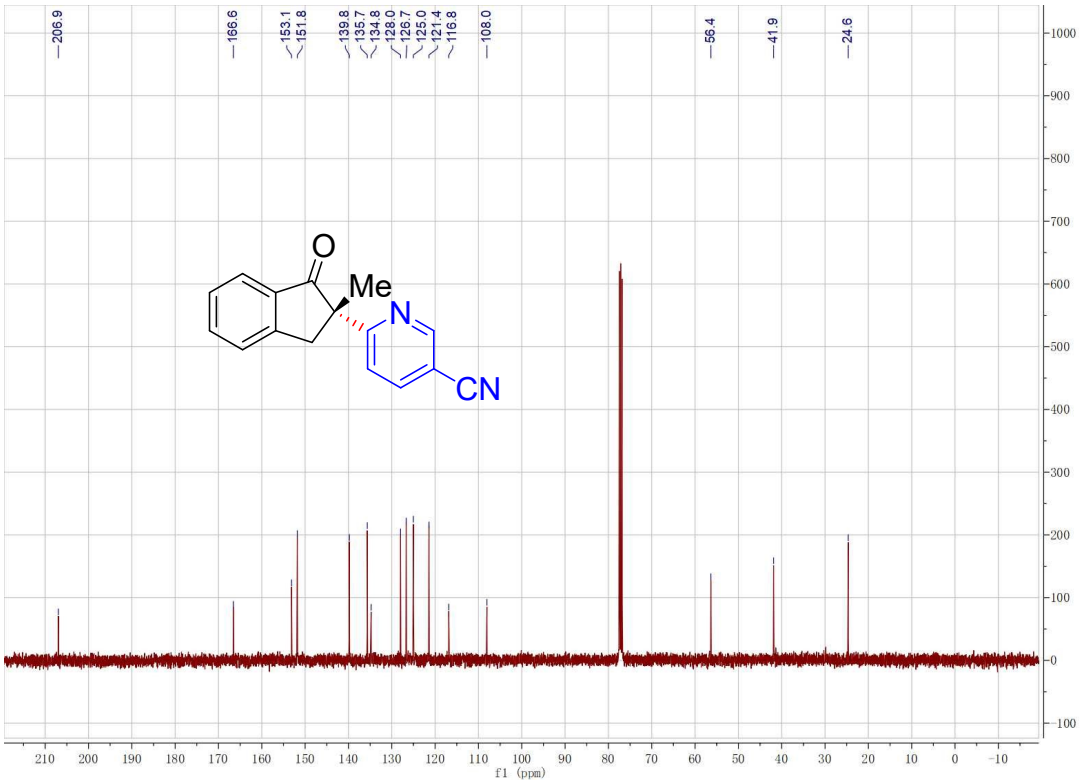
Methyl (S)-6-(2-methyl-1-oxo-2,3-dihydro-1H-inden-2-yl)nicotinate (3au)



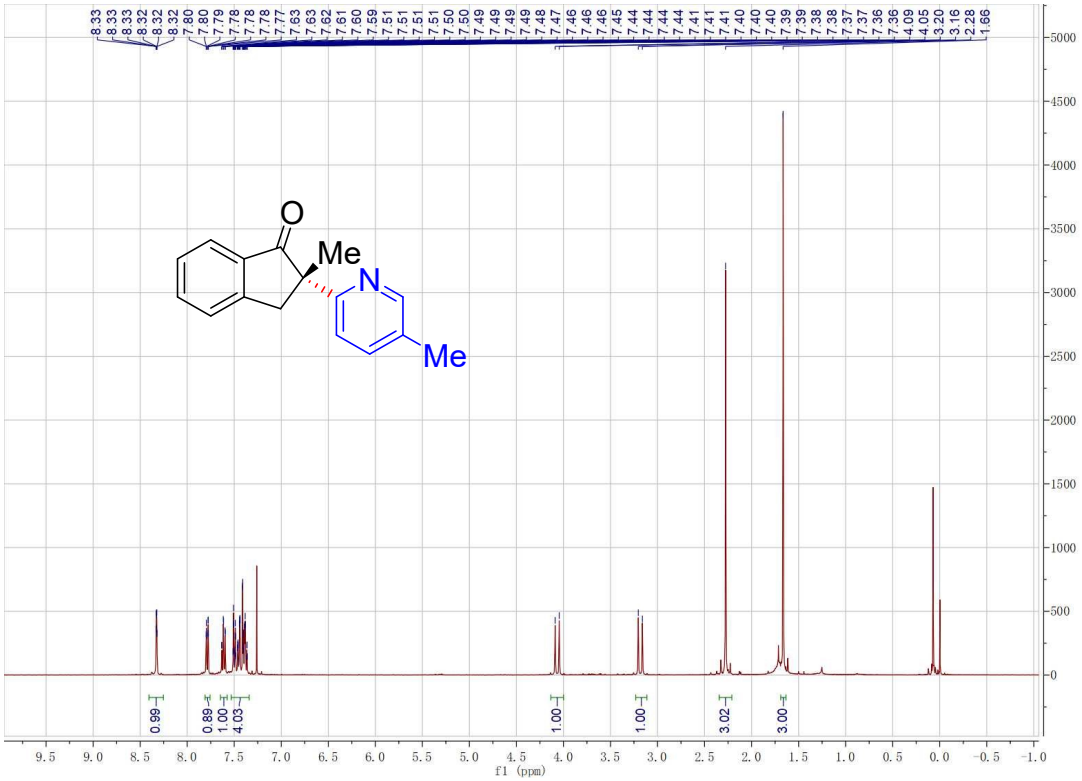


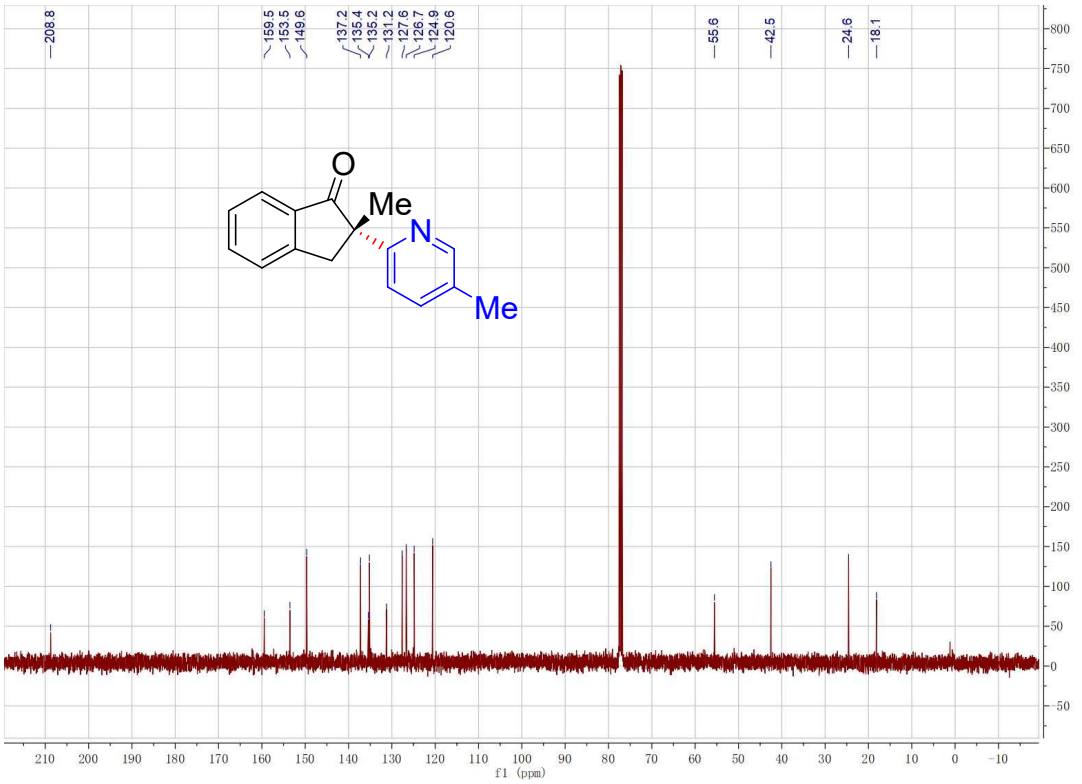
***(S)*-6-(2-methyl-1-oxo-2,3-dihydro-1H-inden-2-yl)nicotinonitrile (3av)**



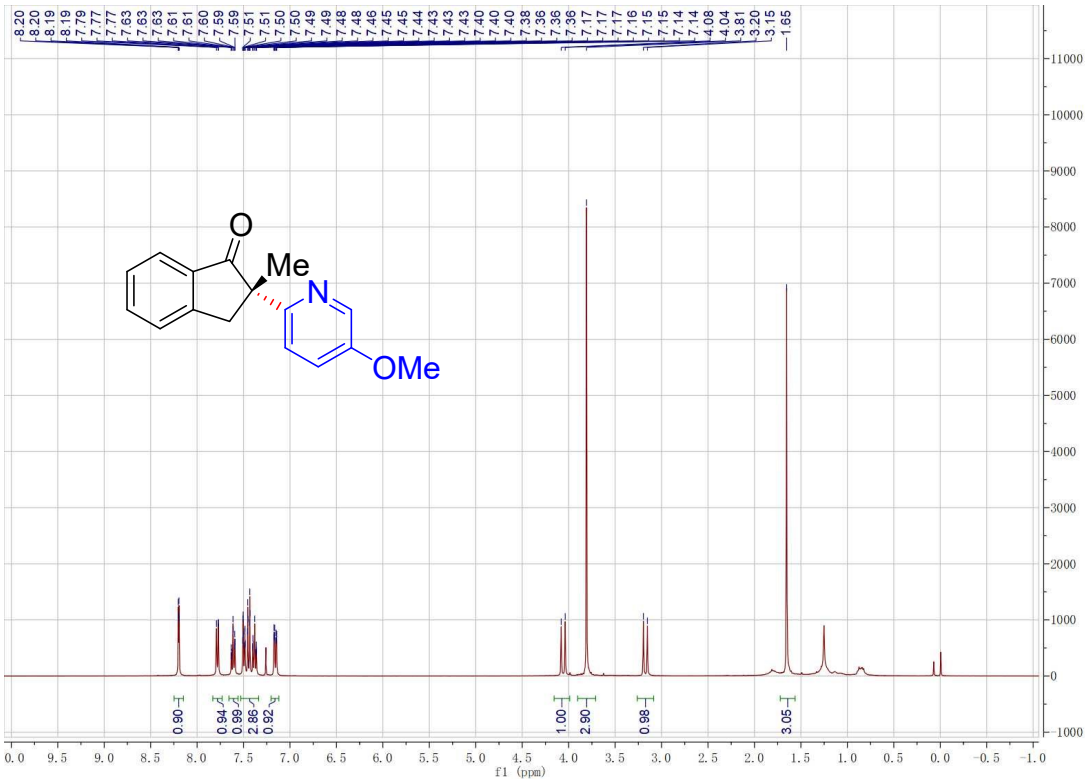


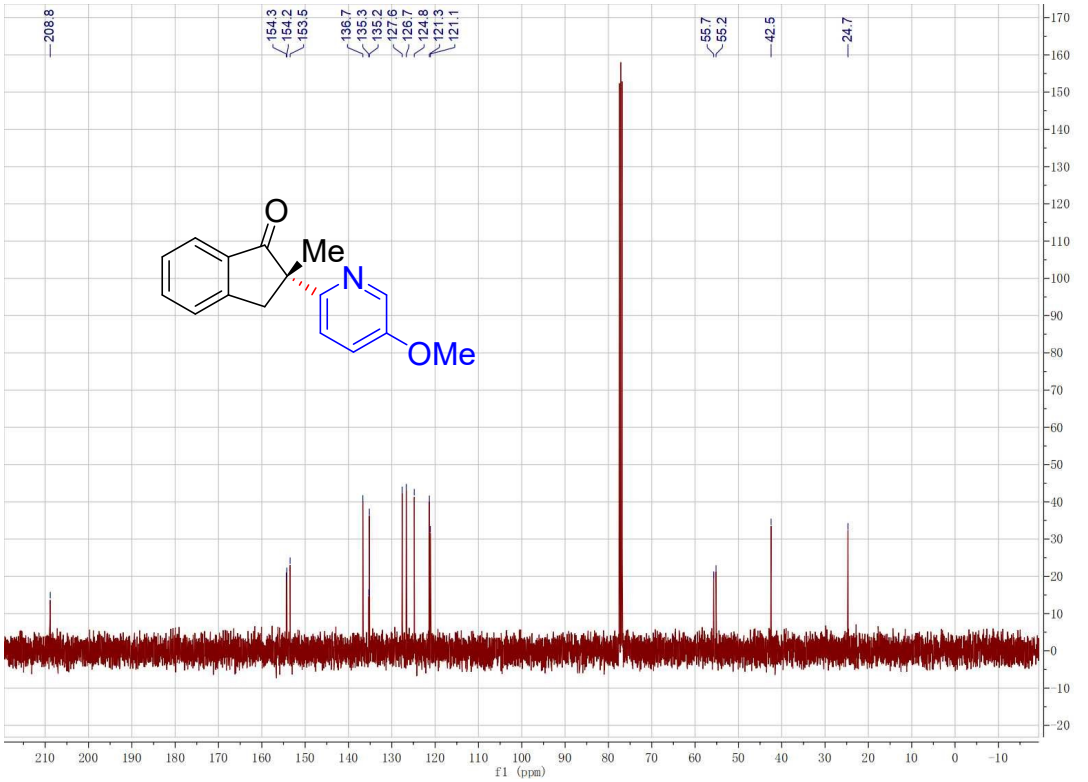
***(S)*-2-(5-fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3aw)**



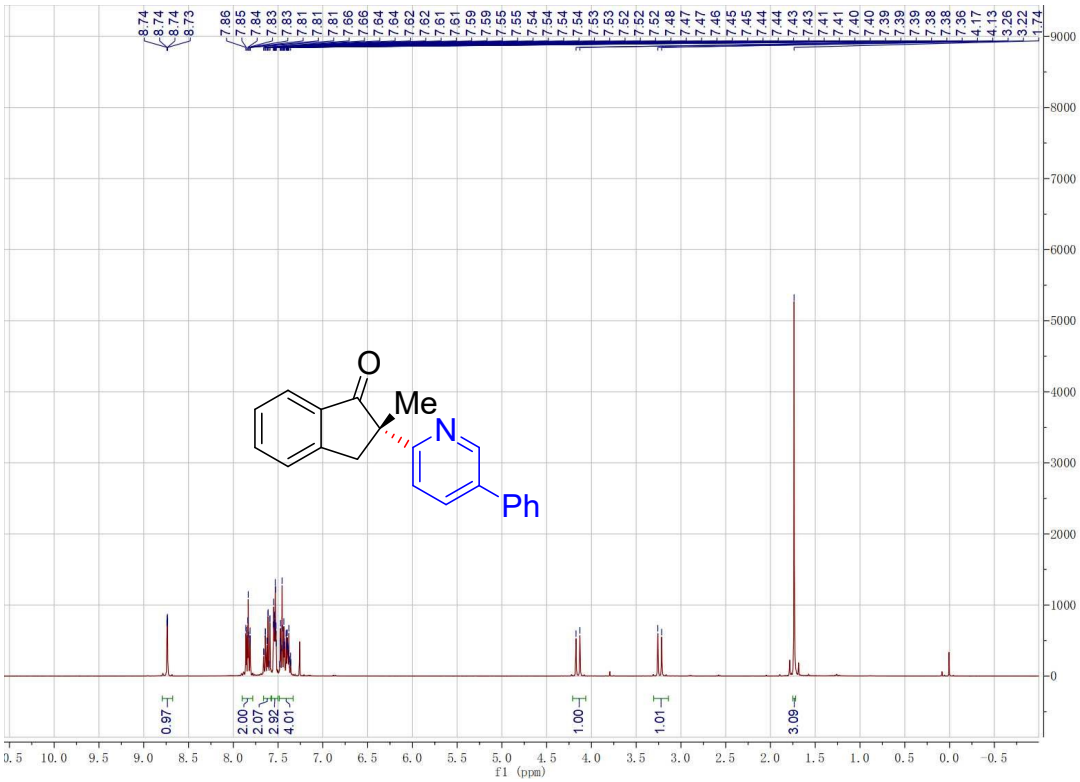


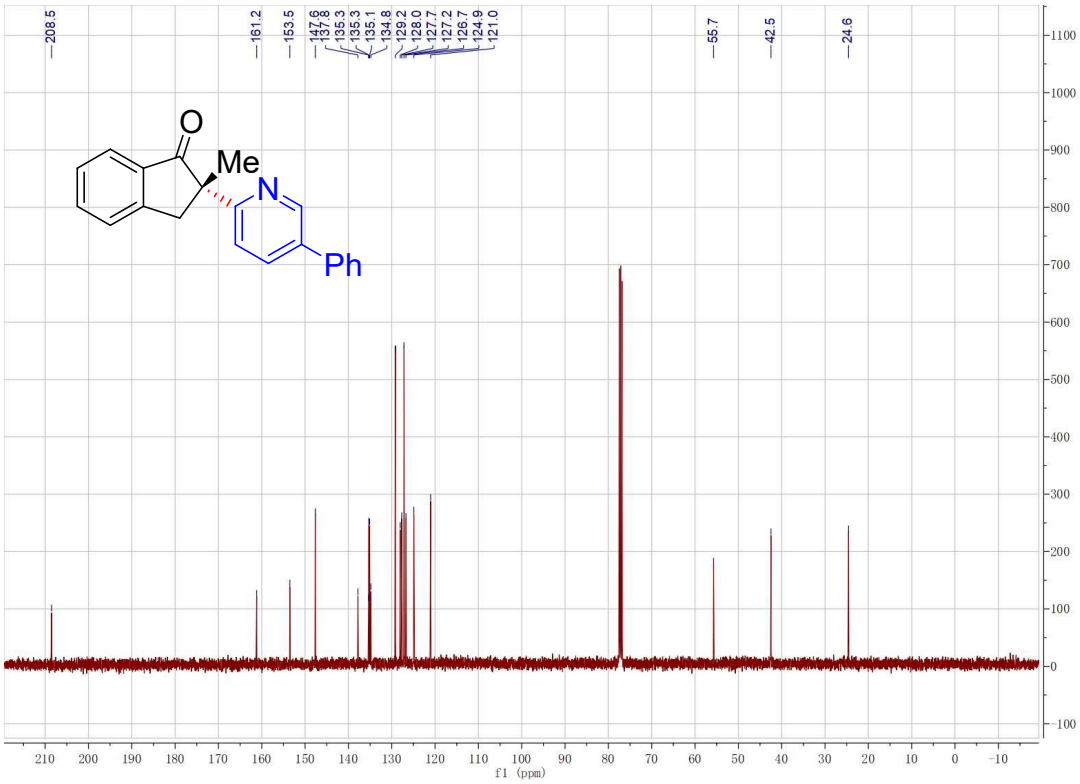
***(S)*- 2-(5-methoxypyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3ax)**



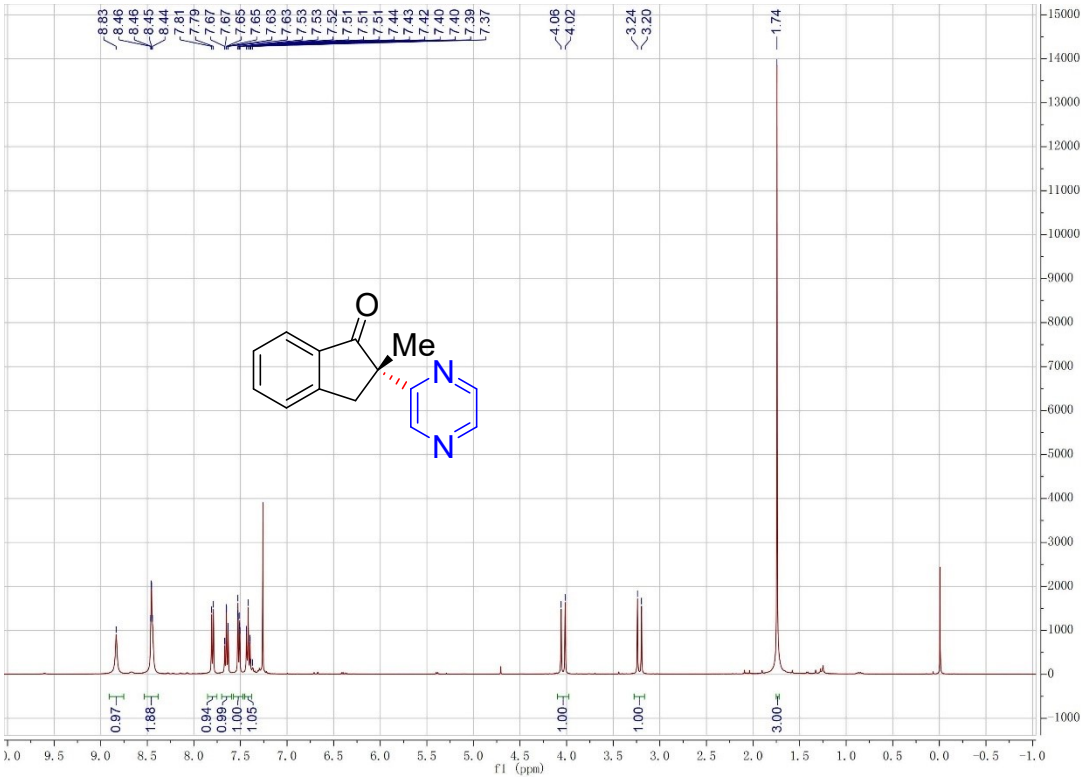


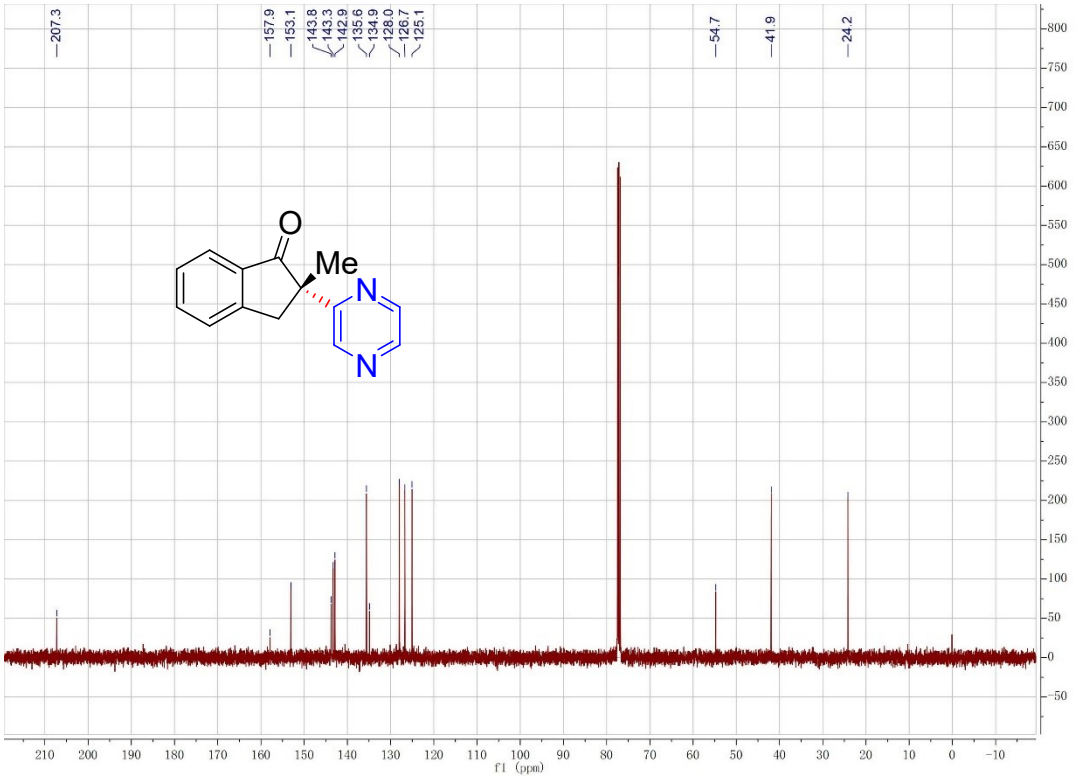
***(S)*-2-methyl-2-(5-phenylpyridin-2-yl)-2,3-dihydro-1H-inden-1-one (3ay)**



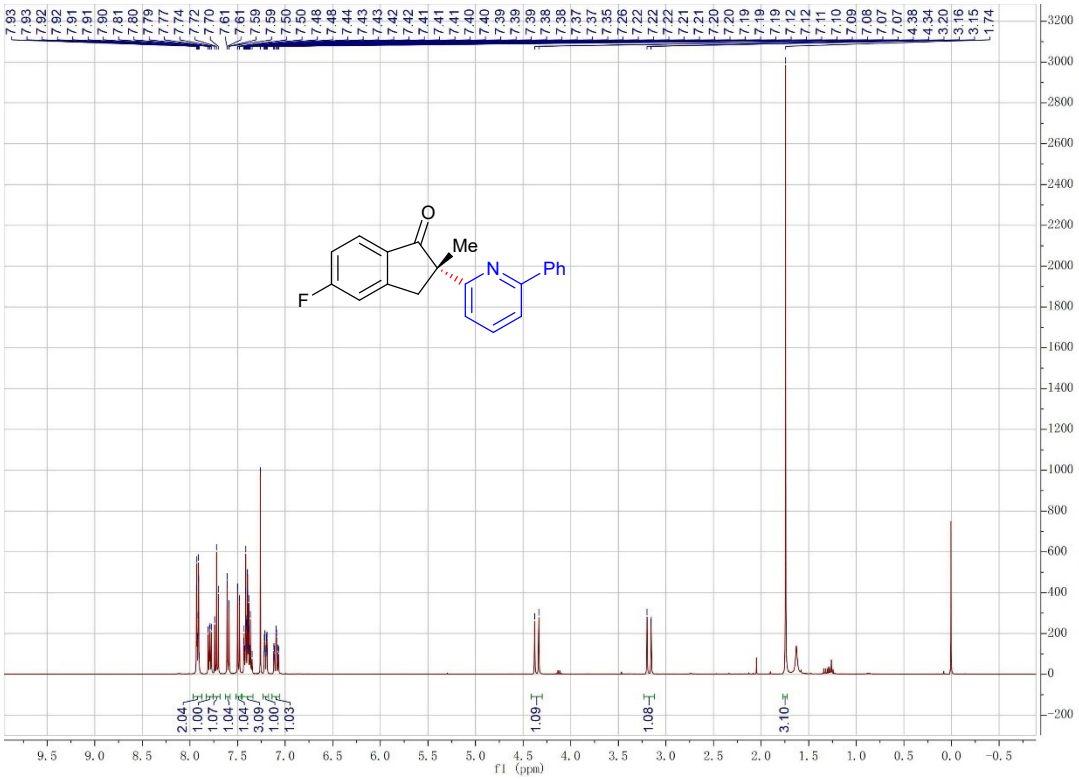


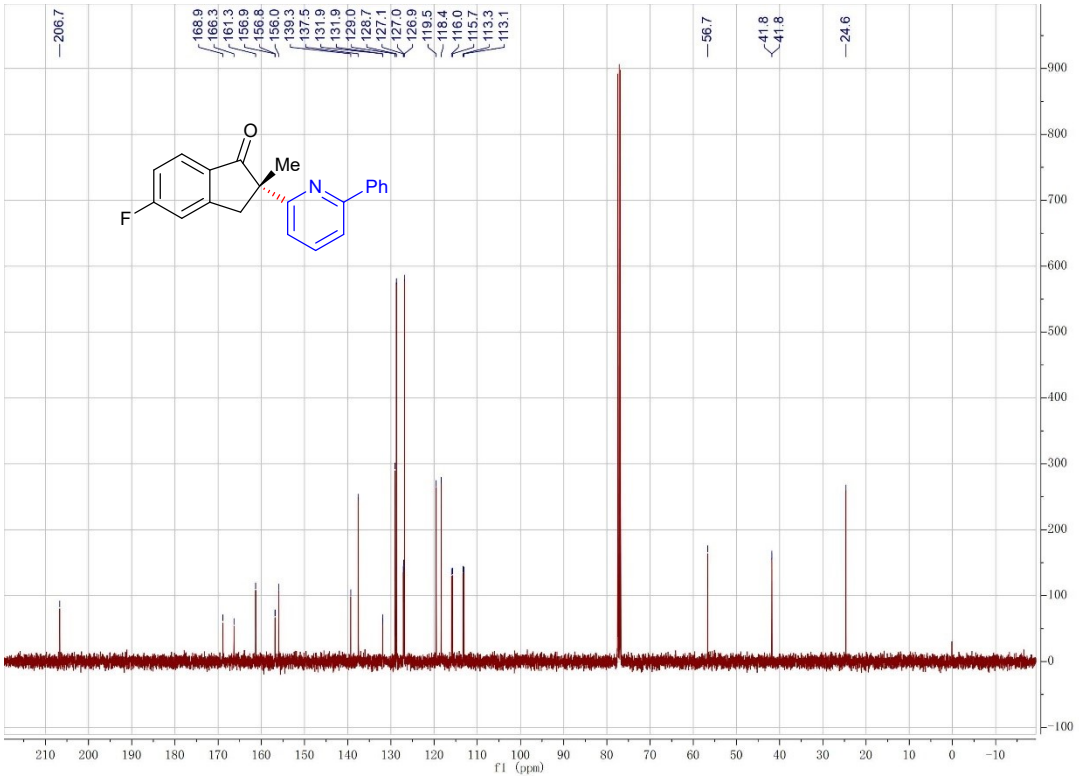
***(S)*-2-(4-Fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3az)**

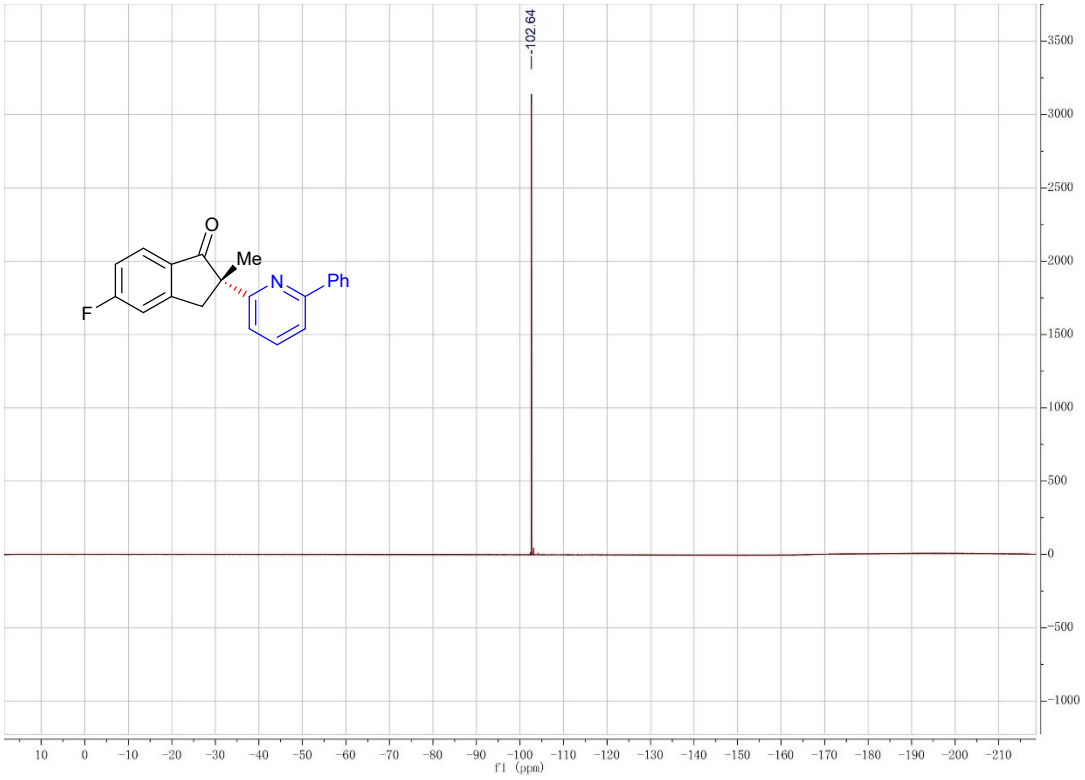




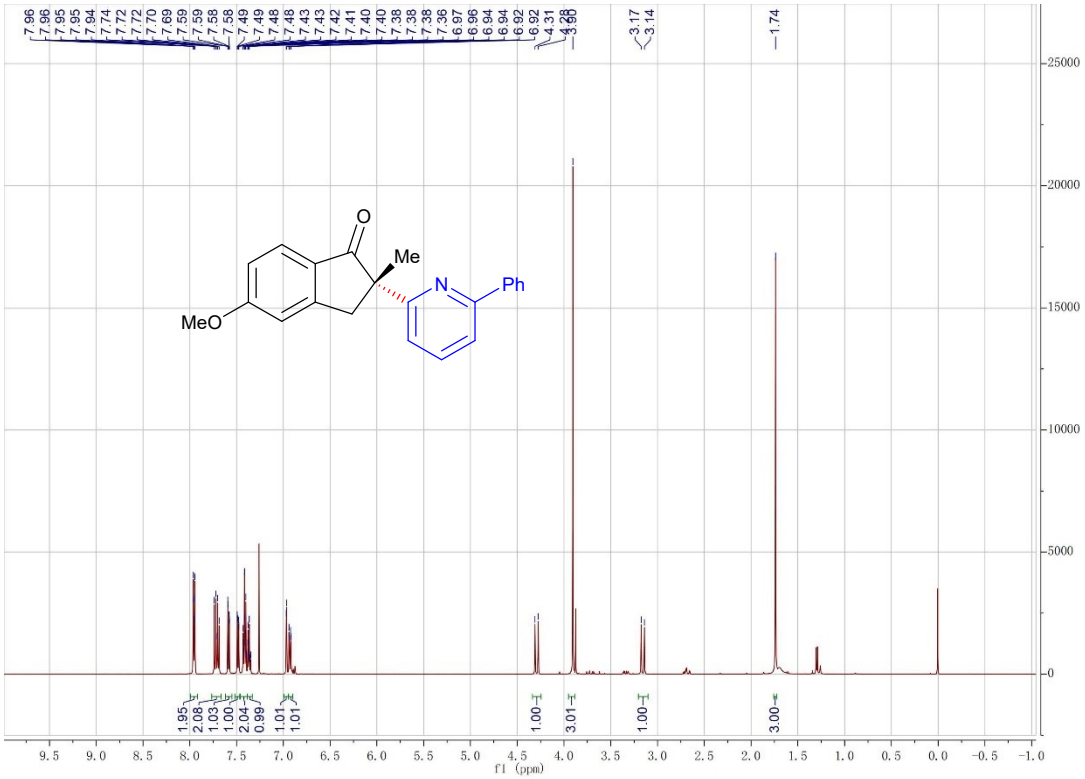
***(S)*-5-Fluoro-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3bj)**

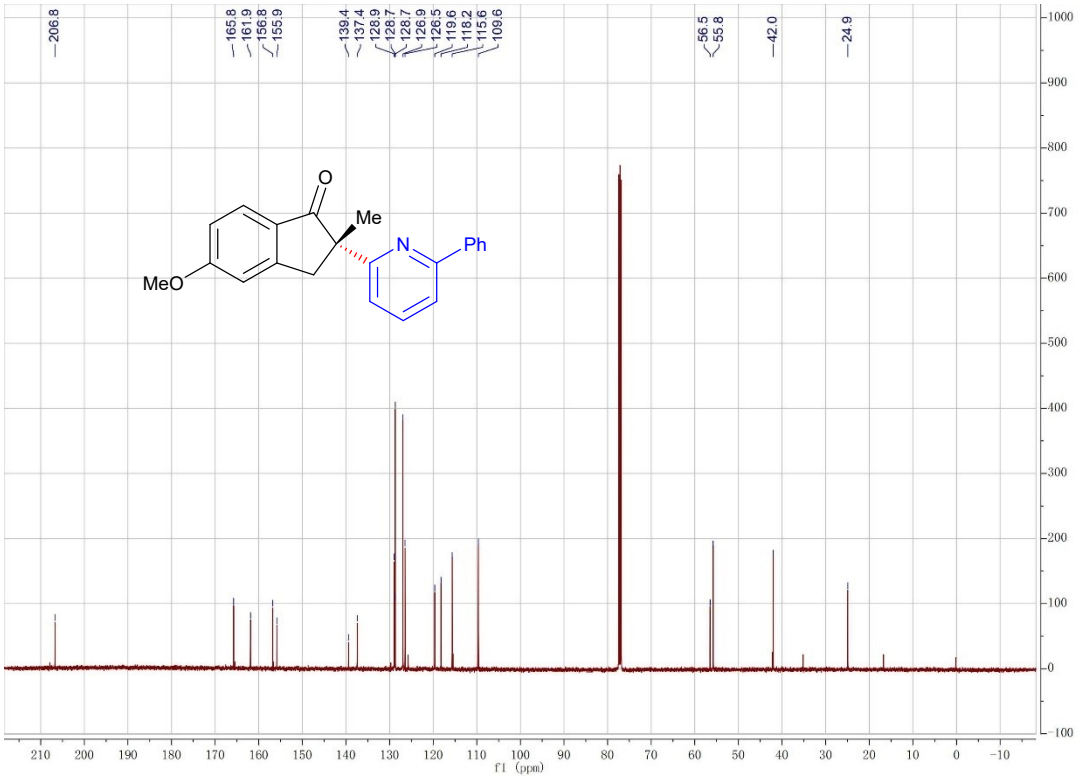




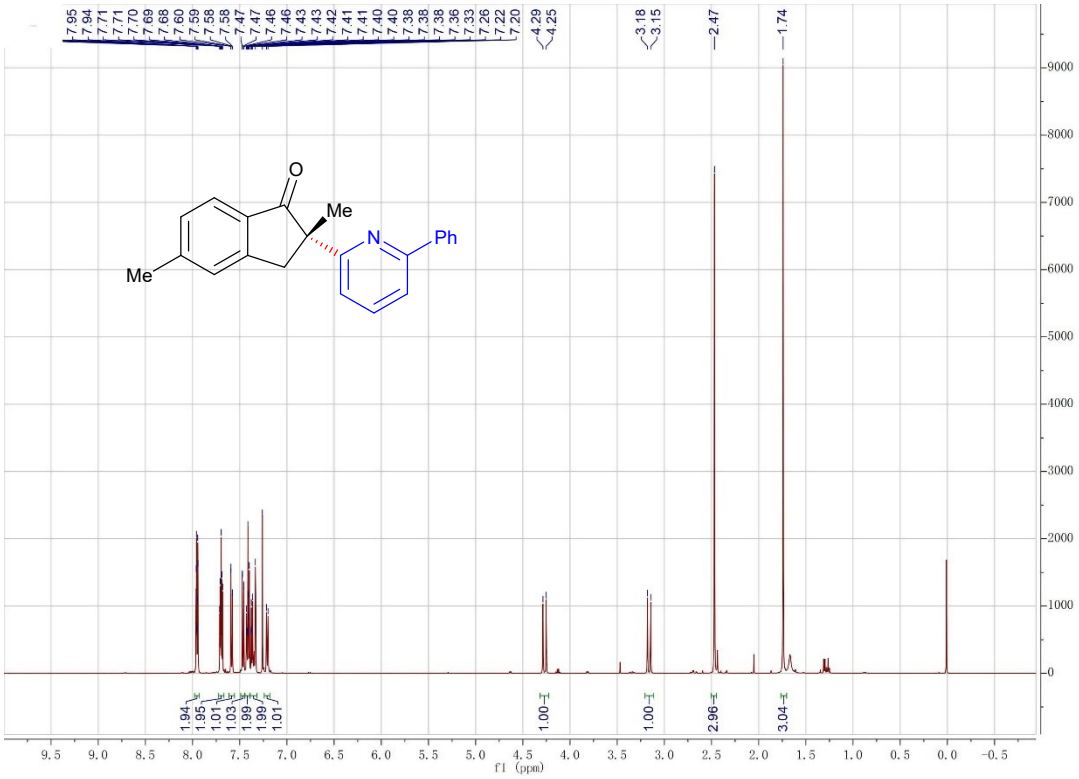


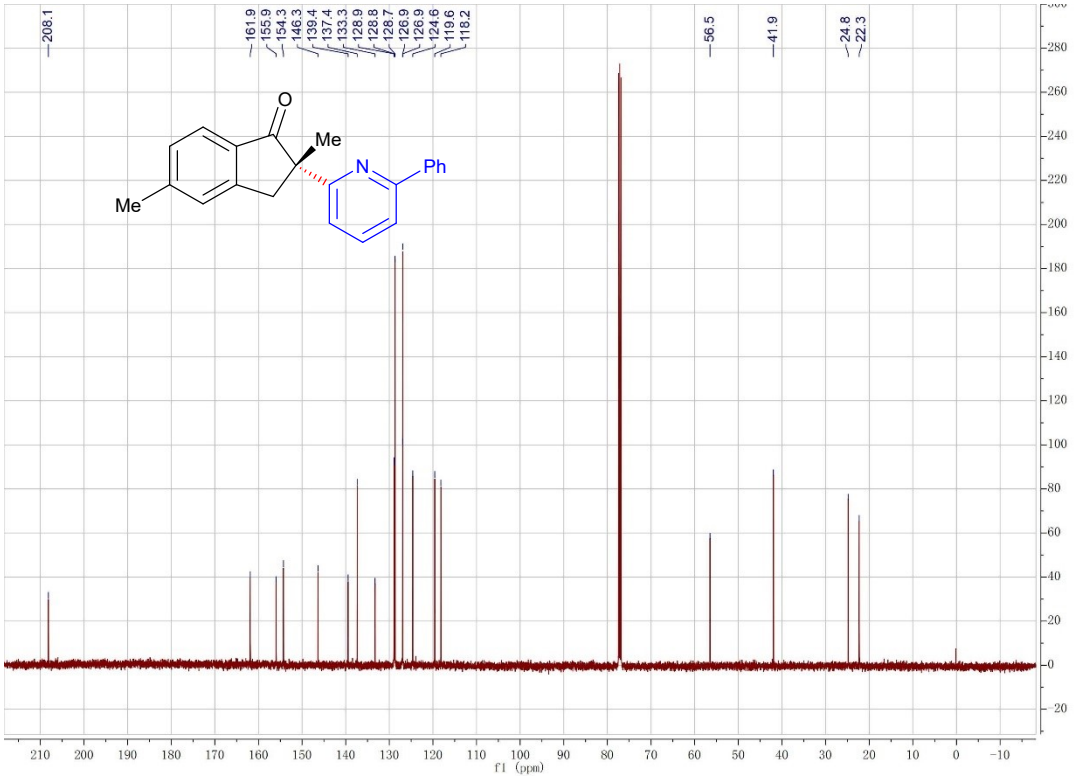
***(S)*-5-Methoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3cj)**



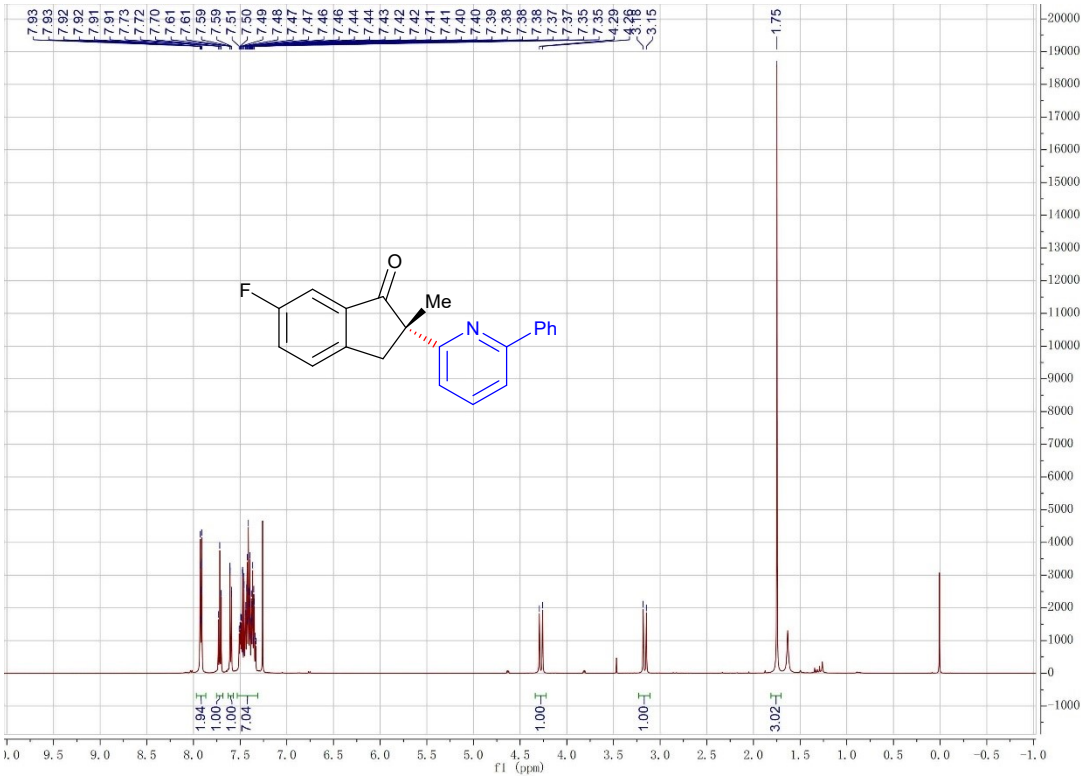


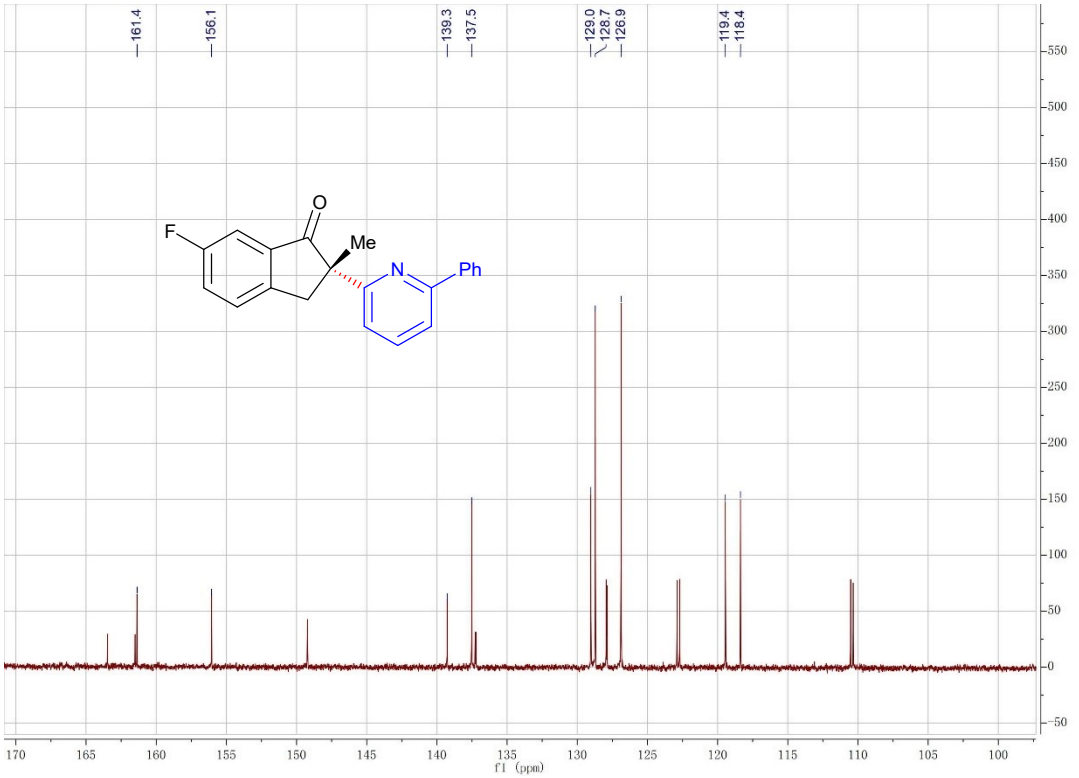
***(S)*-2,5-Dimethyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3dj)**

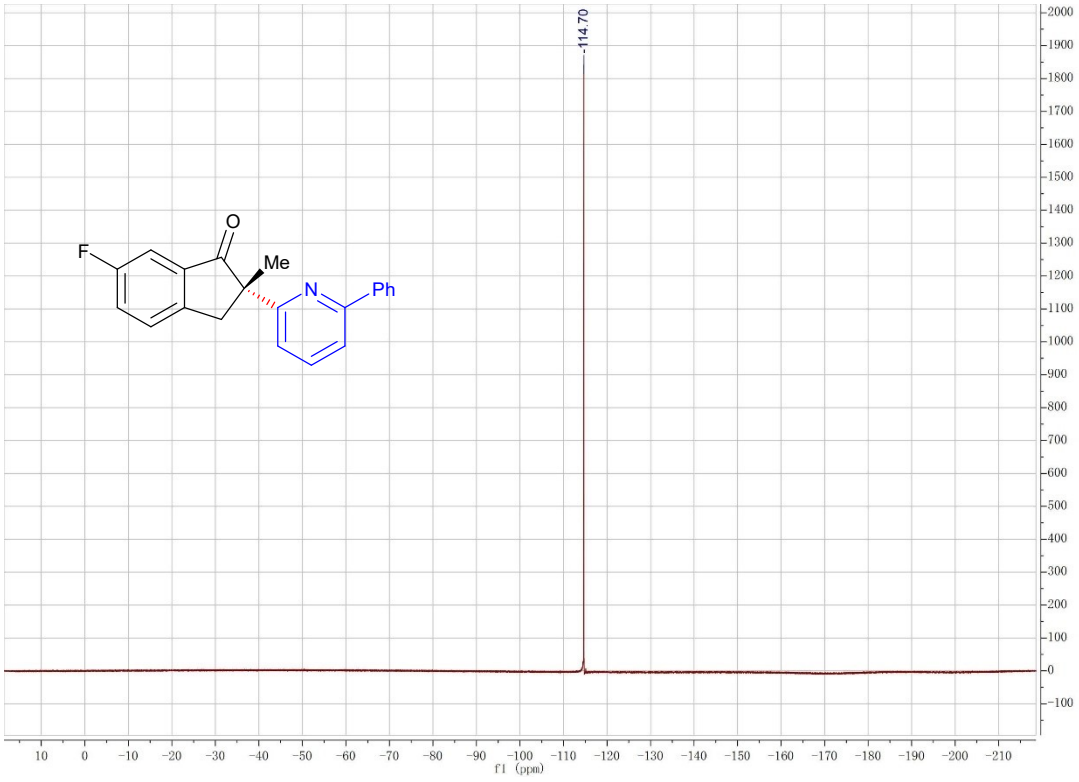




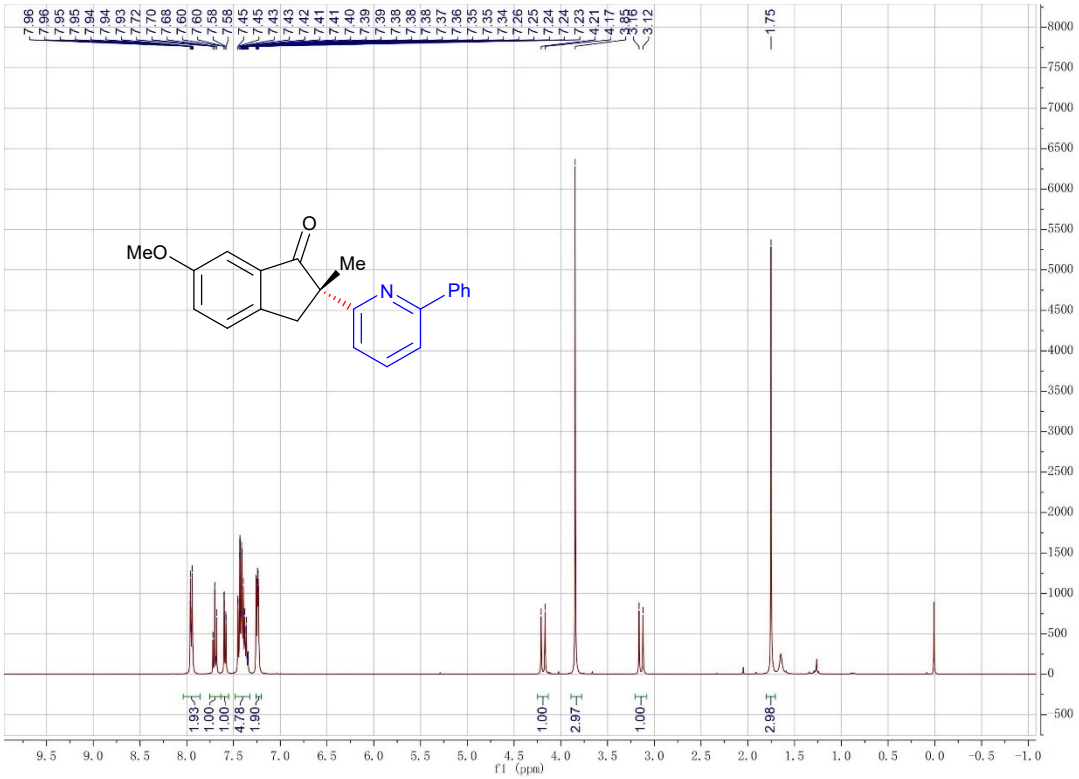
***(S)*-6-Fluoro-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ej)**

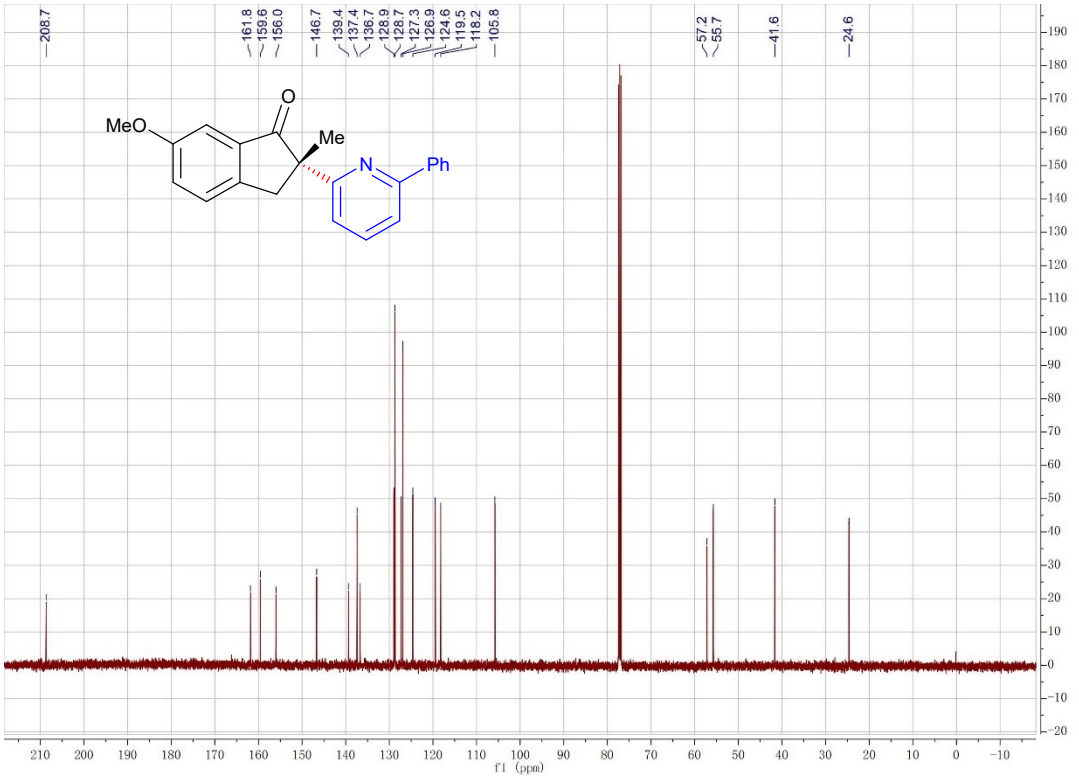



161.4
156.1
139.3
137.5
129.0
128.7
126.9
119.4
118.4
O
F
Me
N
Ph
f1 (ppm)

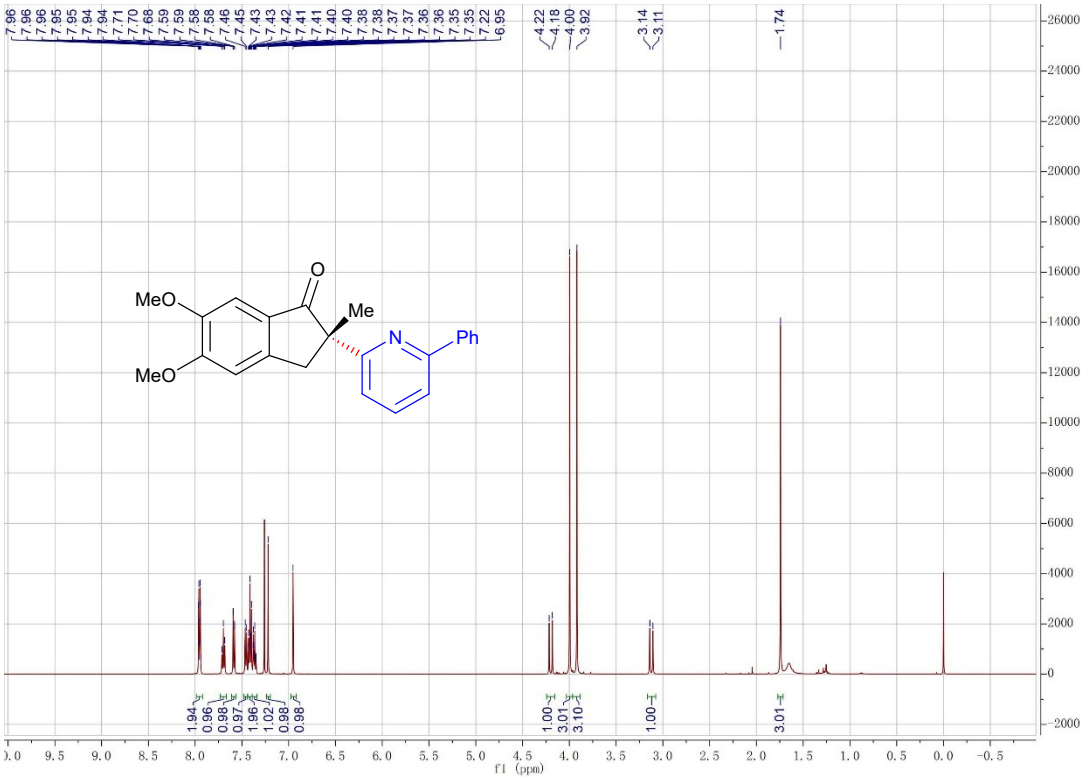

-114.70
O
F
Me
N
Ph
f1 (ppm)

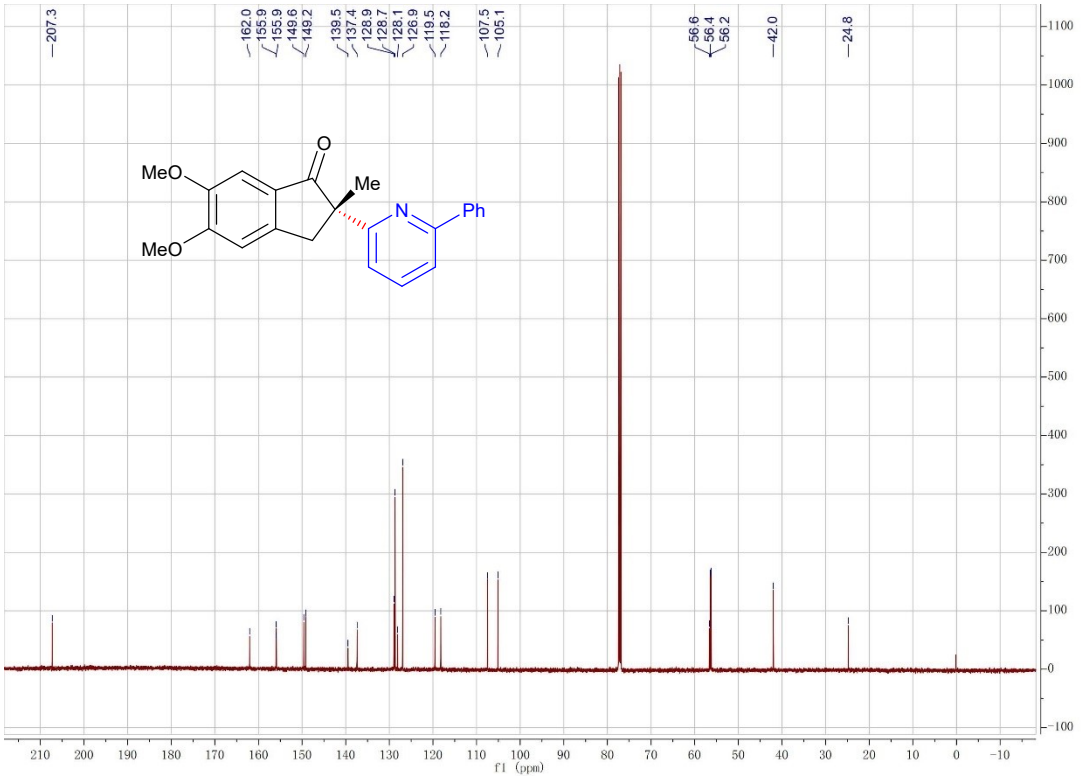
***(S)*-6-Methoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3fj)**



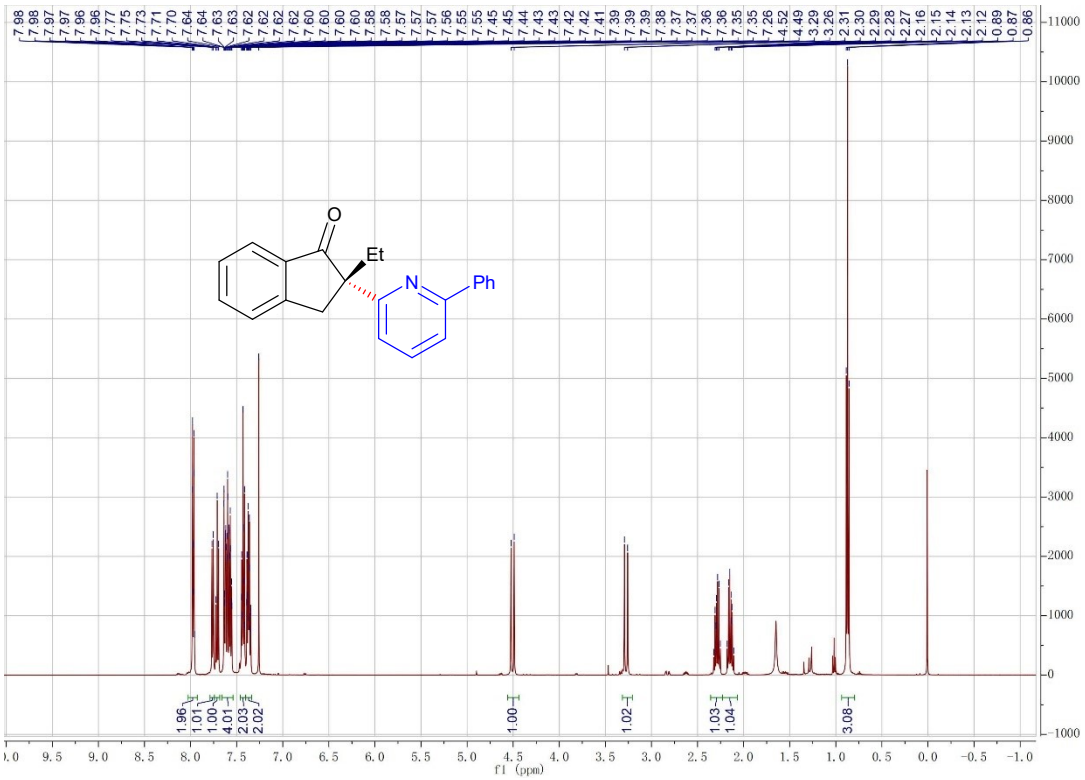


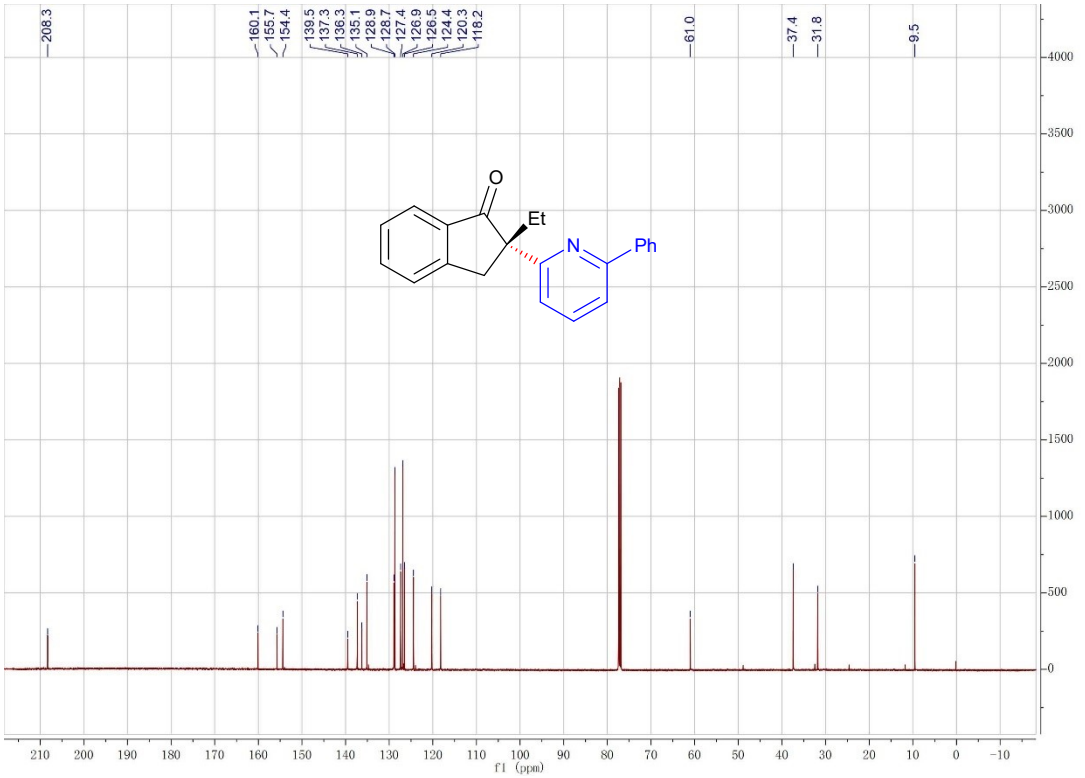
***(S)*-5,6-Dimethoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3gj)**



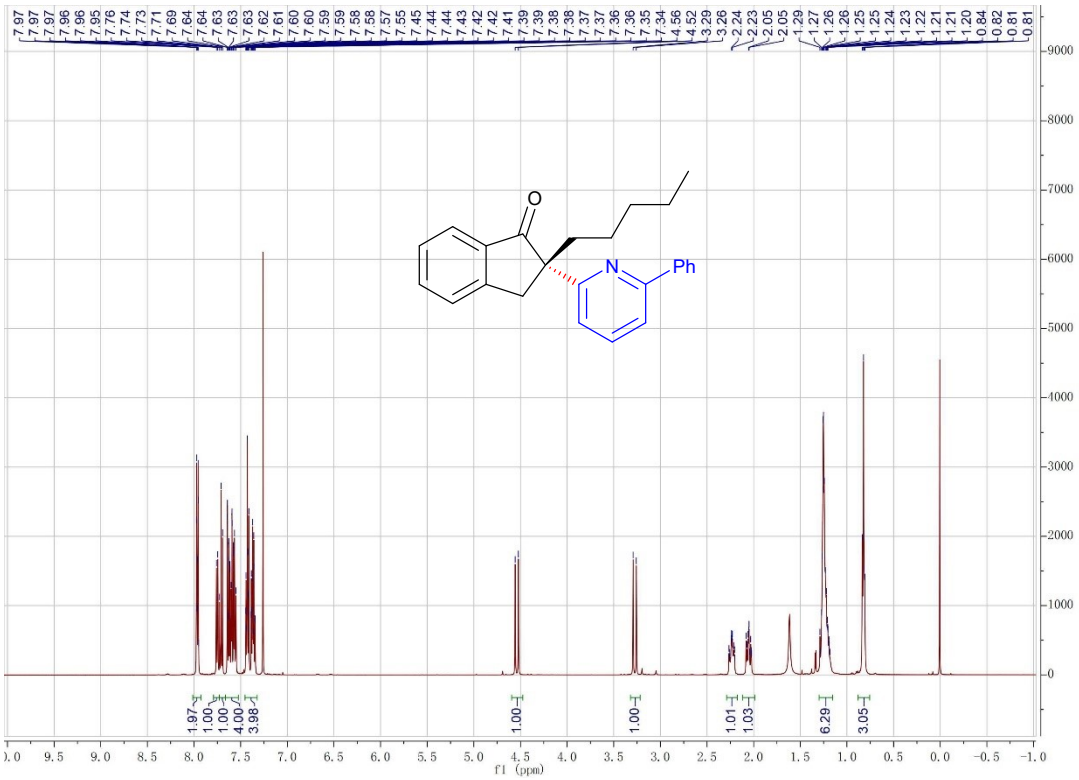


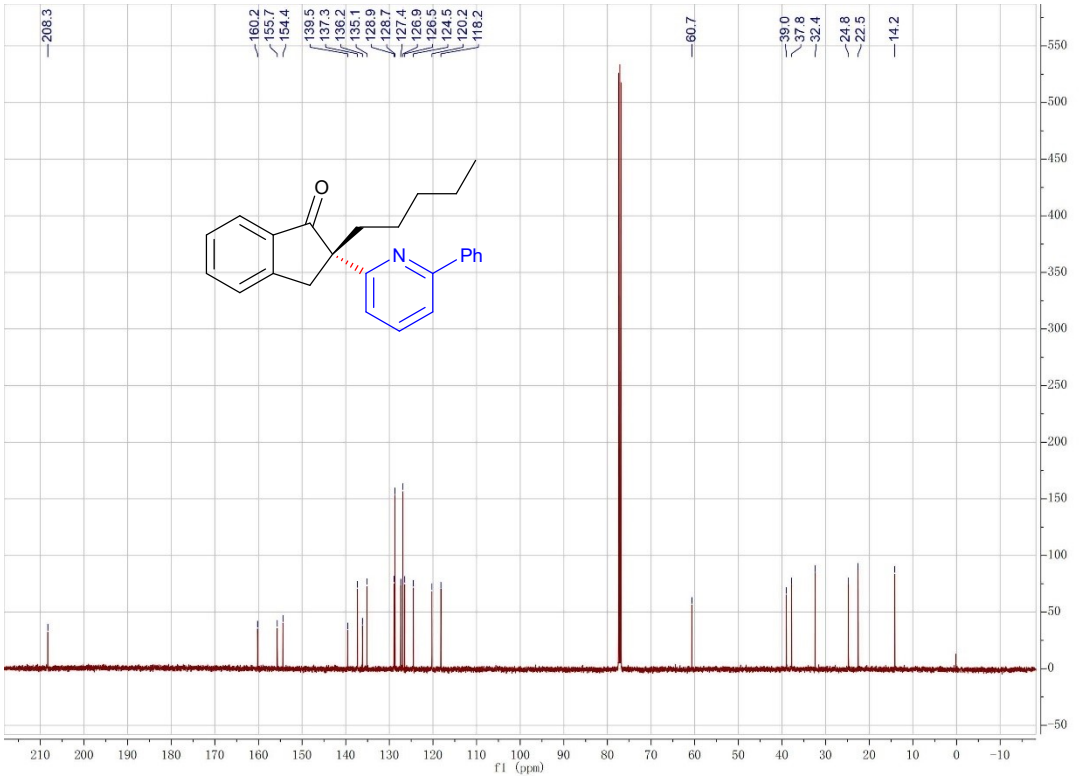
***(S)*-2-Ethyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3hj)**



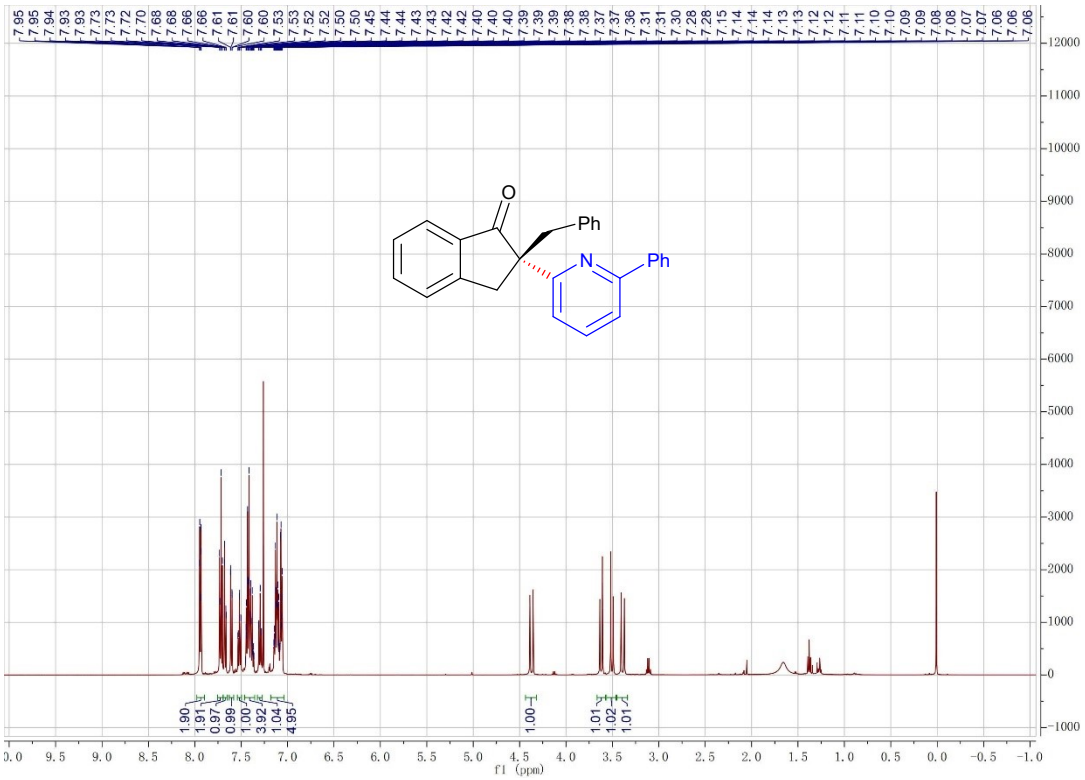


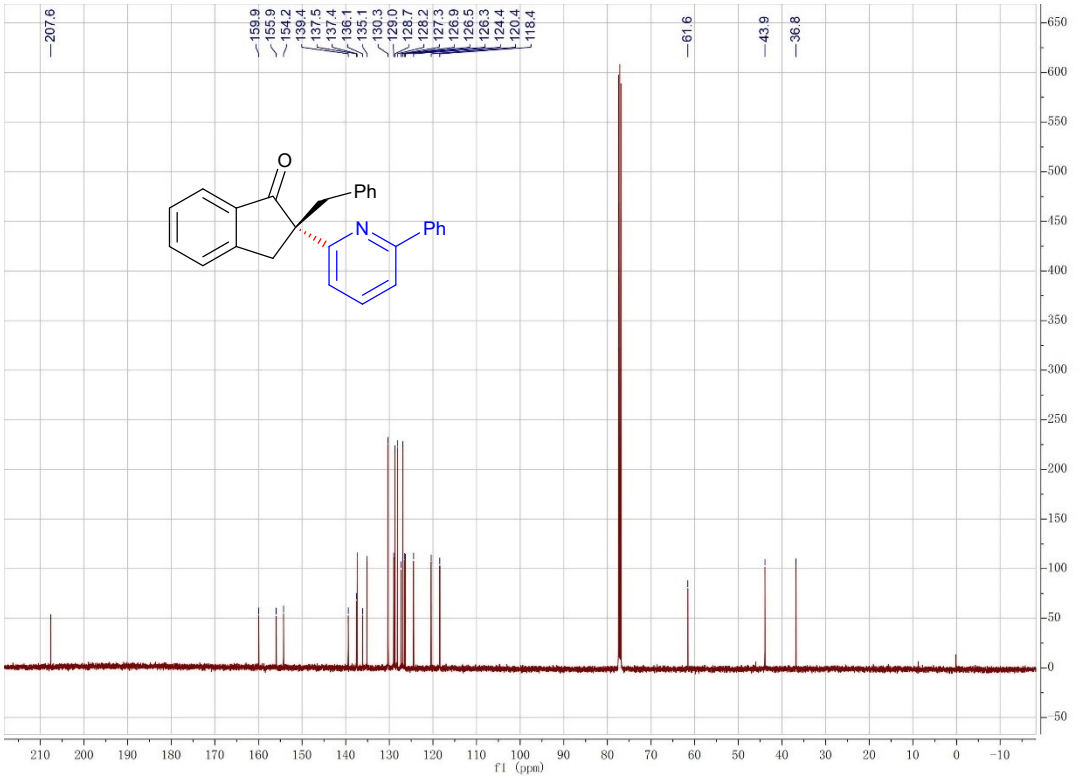
***(S)*-2-Pentyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ij)**



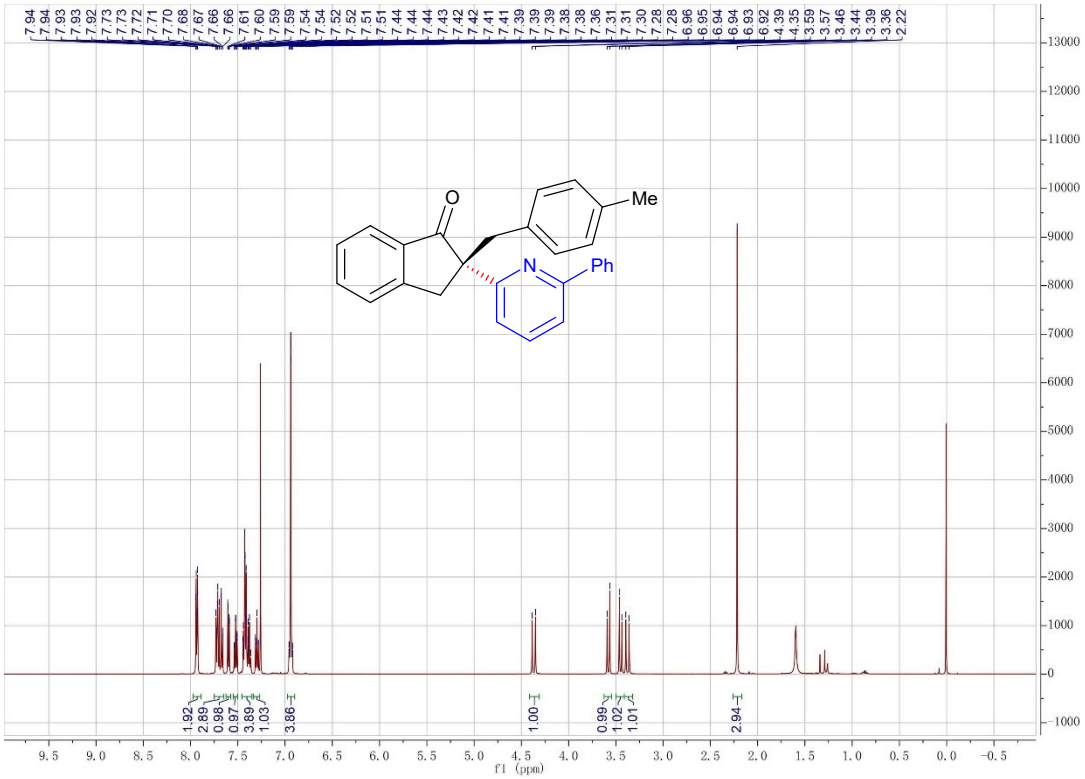


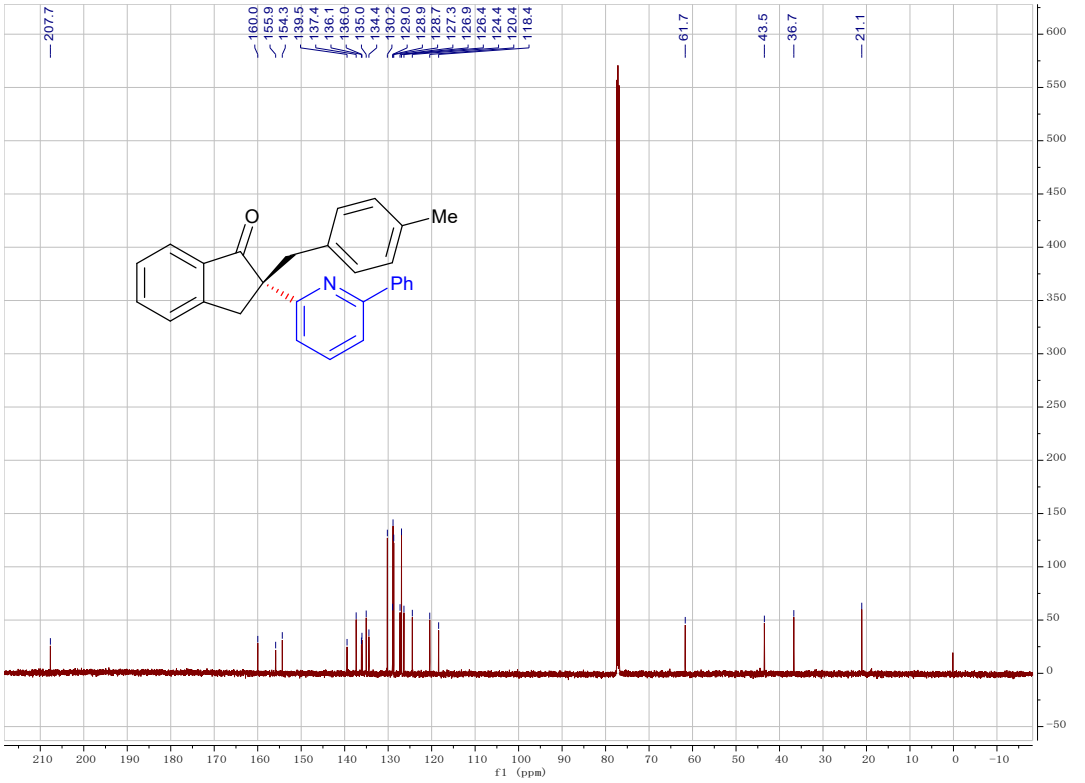
***(S)*-2-Benzyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3jj)**



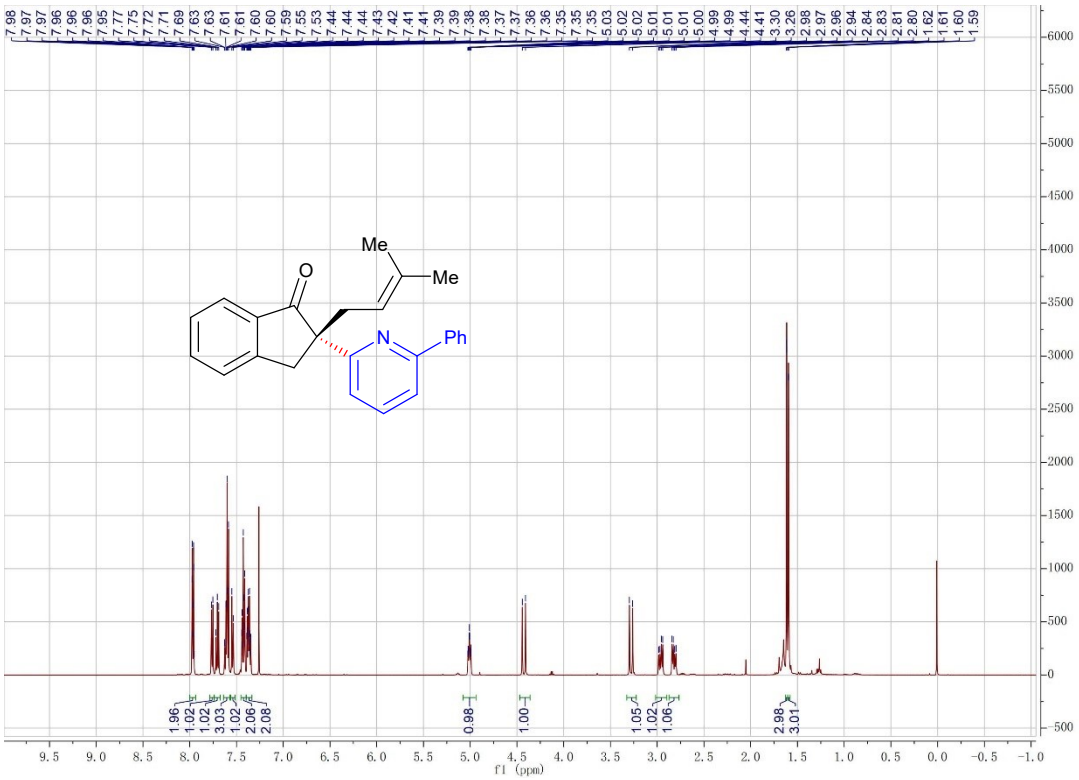


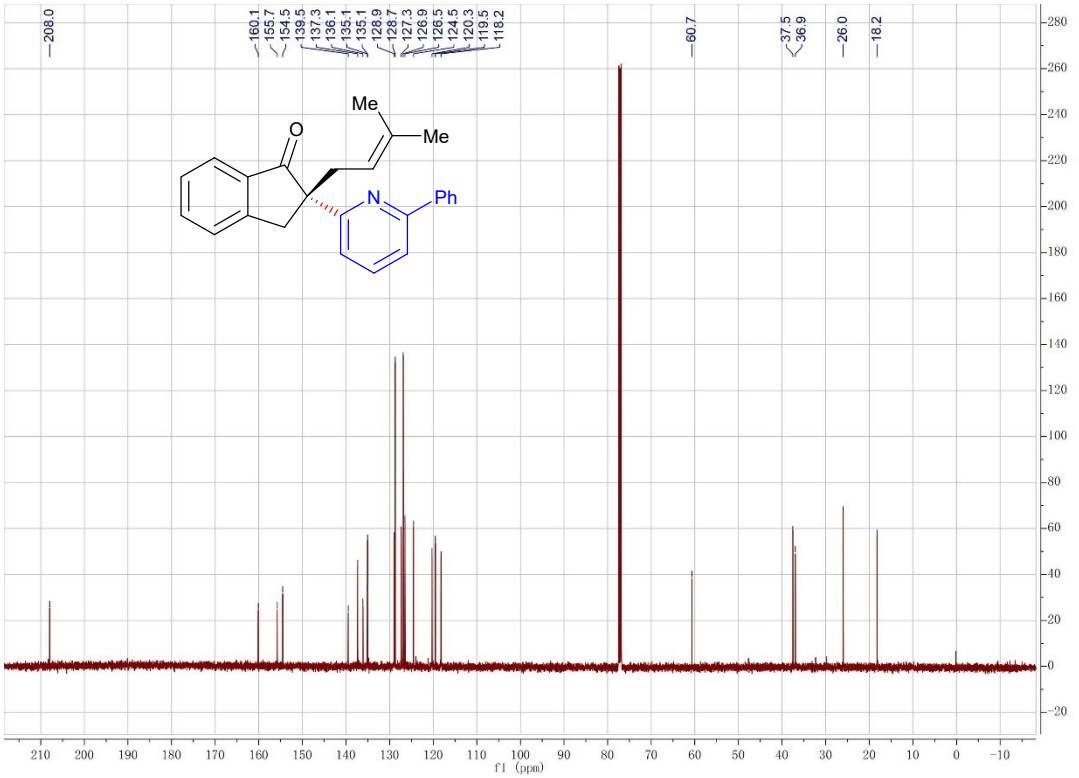
***(S)*-2-(4-Methylbenzyl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3kj)**



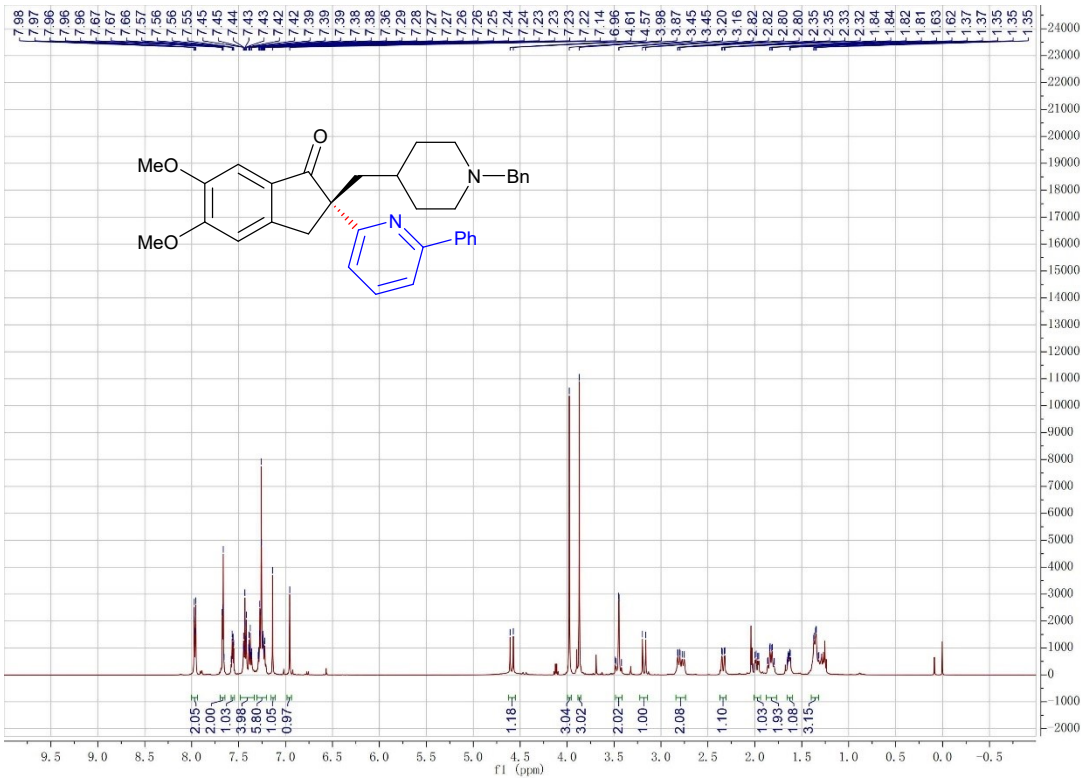


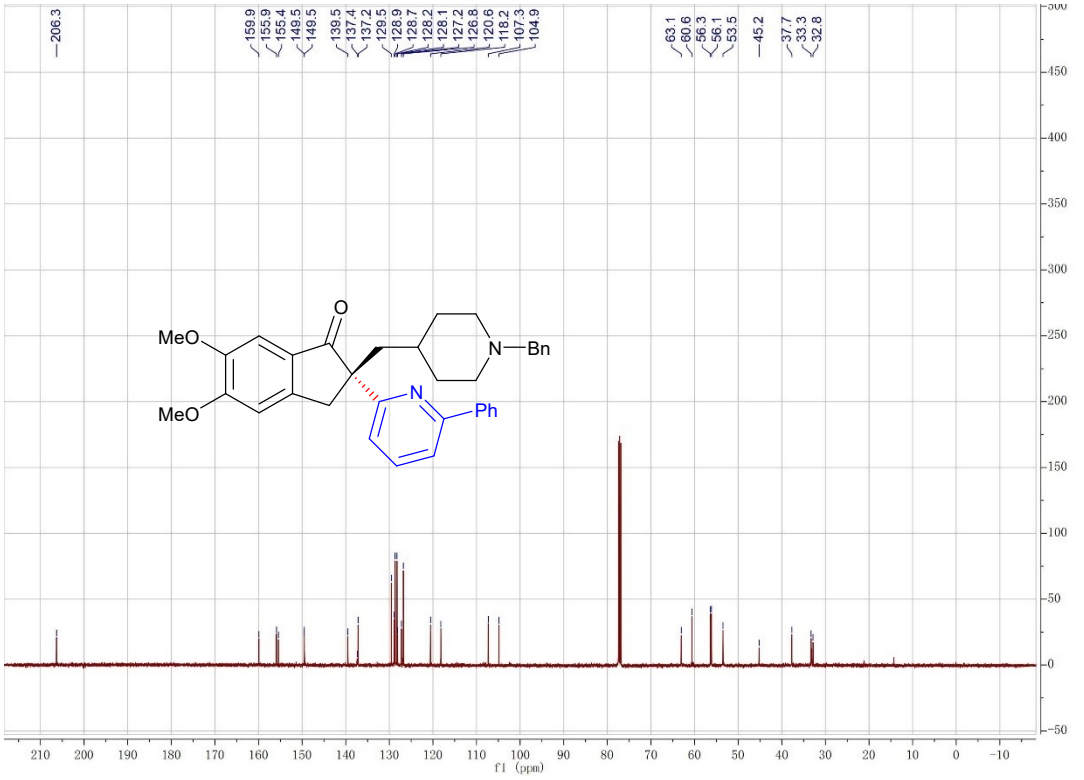
***(S)*-2-(3-Methylbut-2-en-1-yl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3lj)**



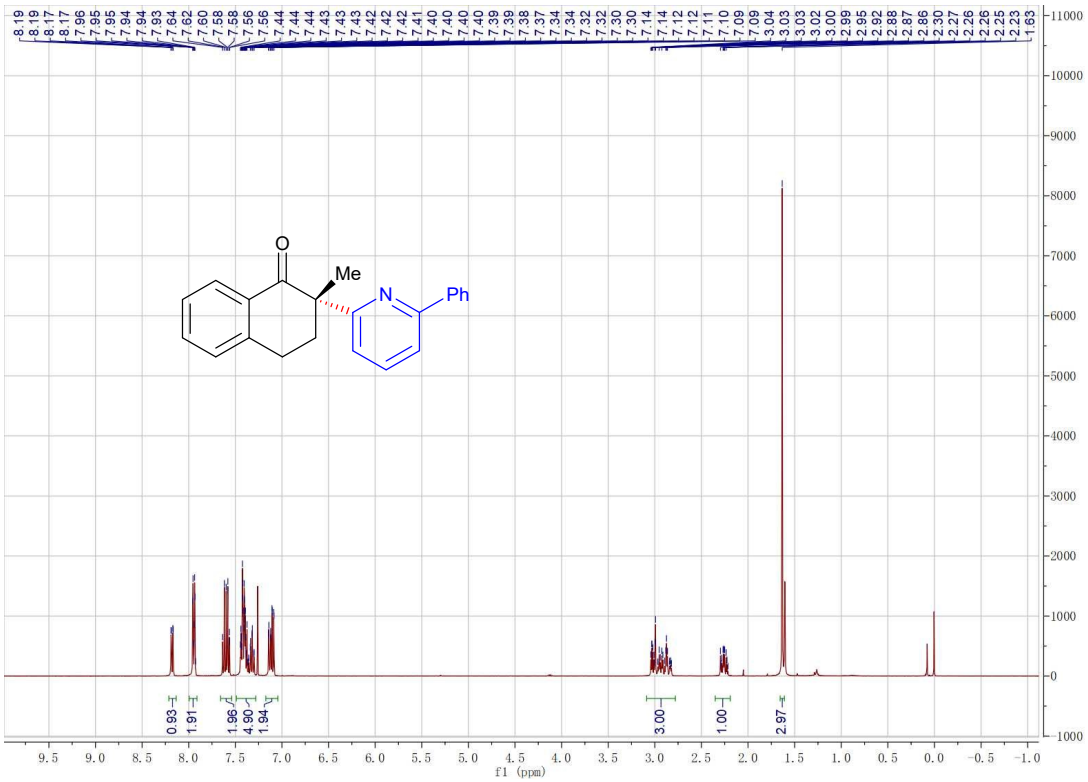


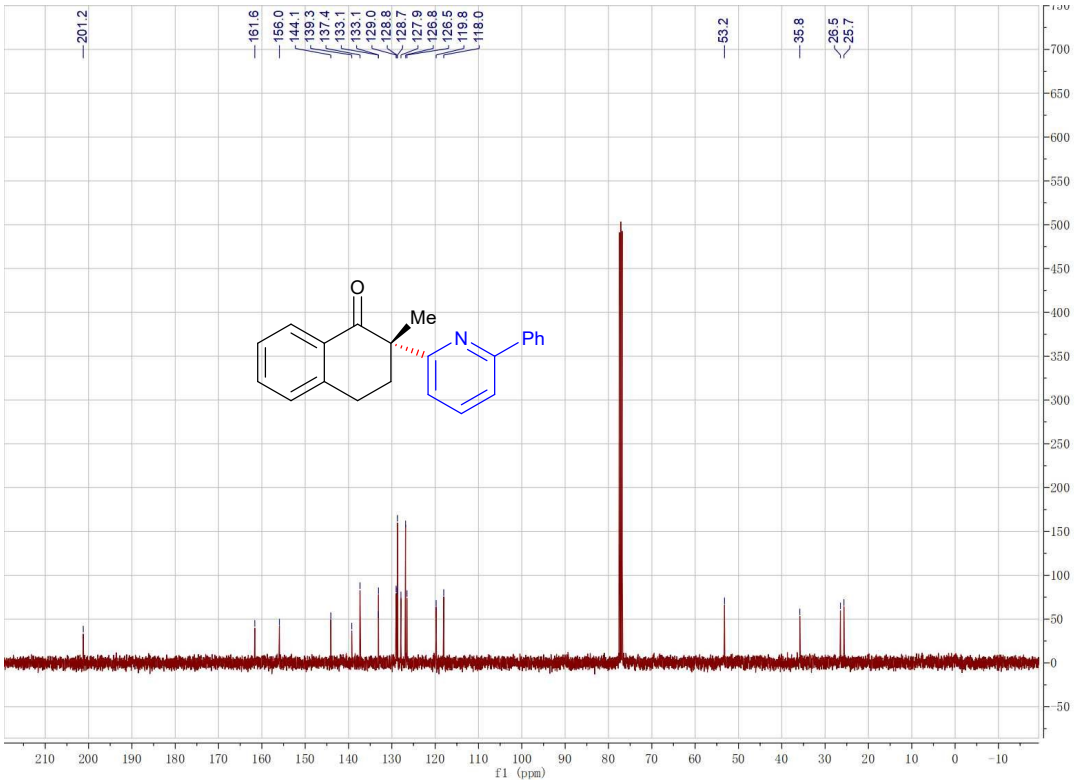
***(S)*-2-(3-Methylbut-2-en-1-yl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3mj)**



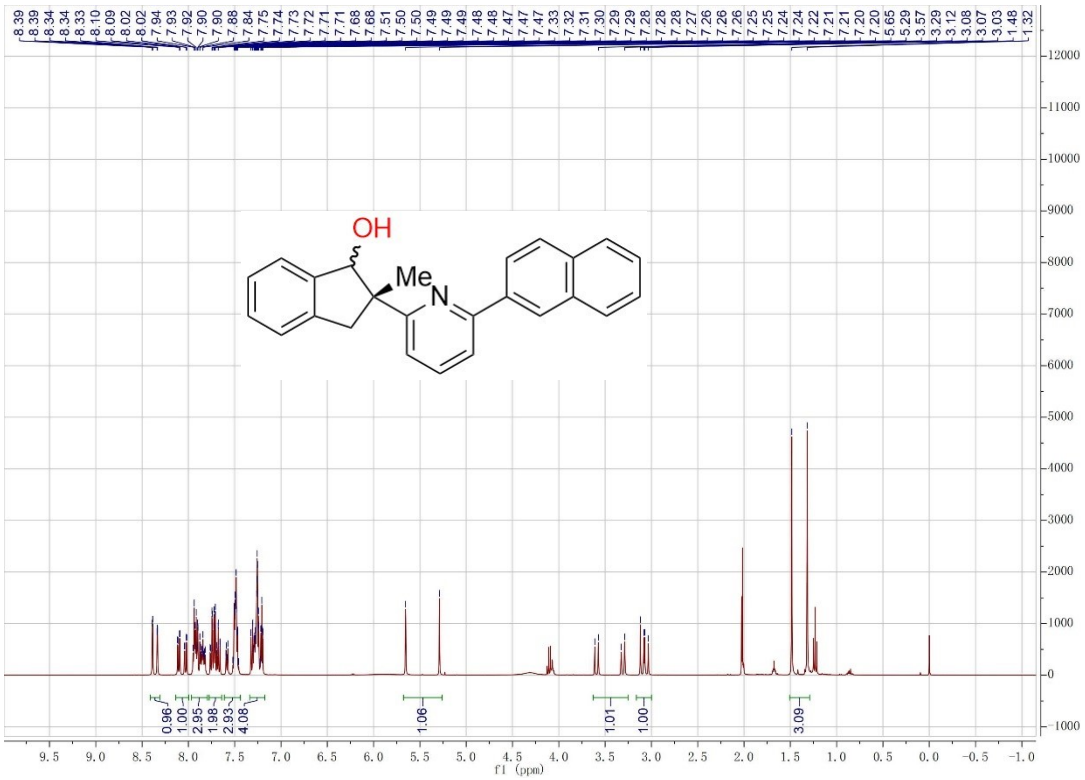


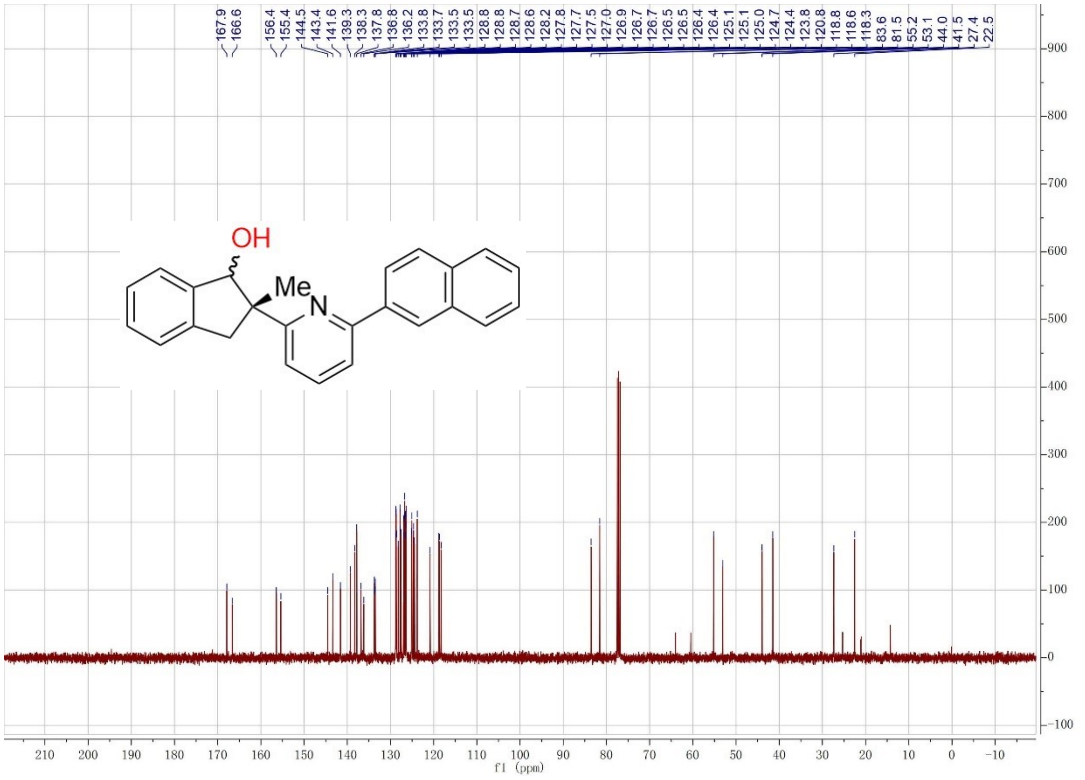
***(S)*-2-methyl-2-(6-phenylpyridin-2-yl)-3,4-dihydronaphthalen-1(2H)-one (3nj)**



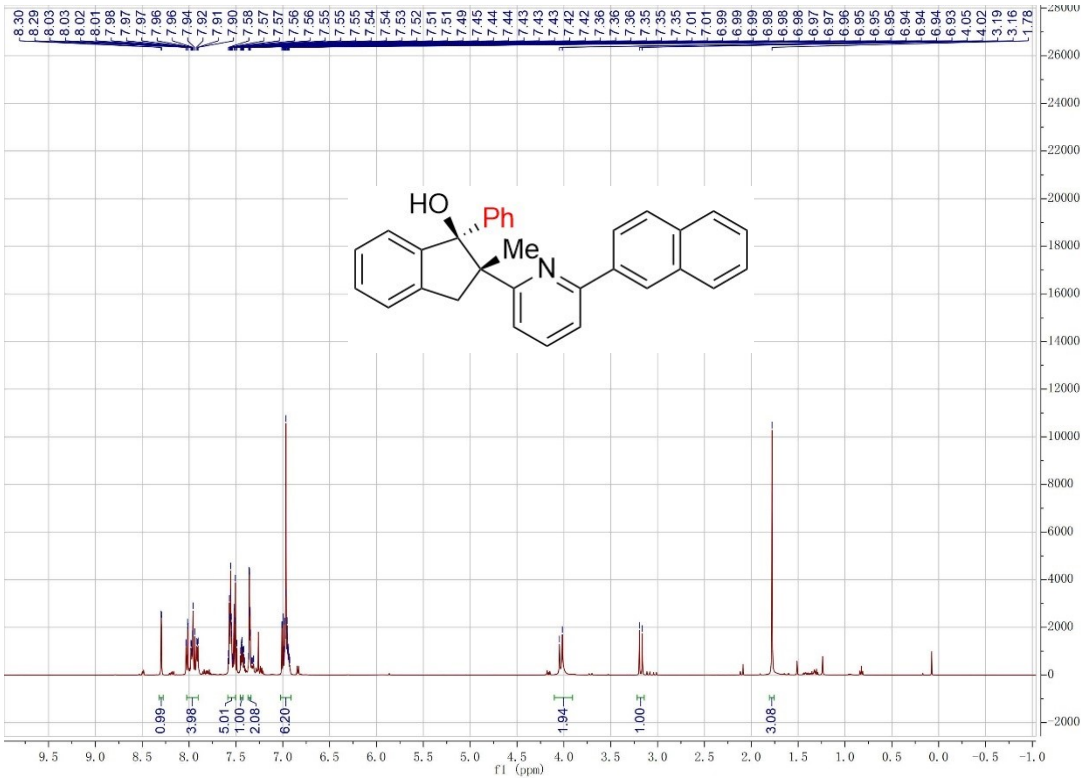


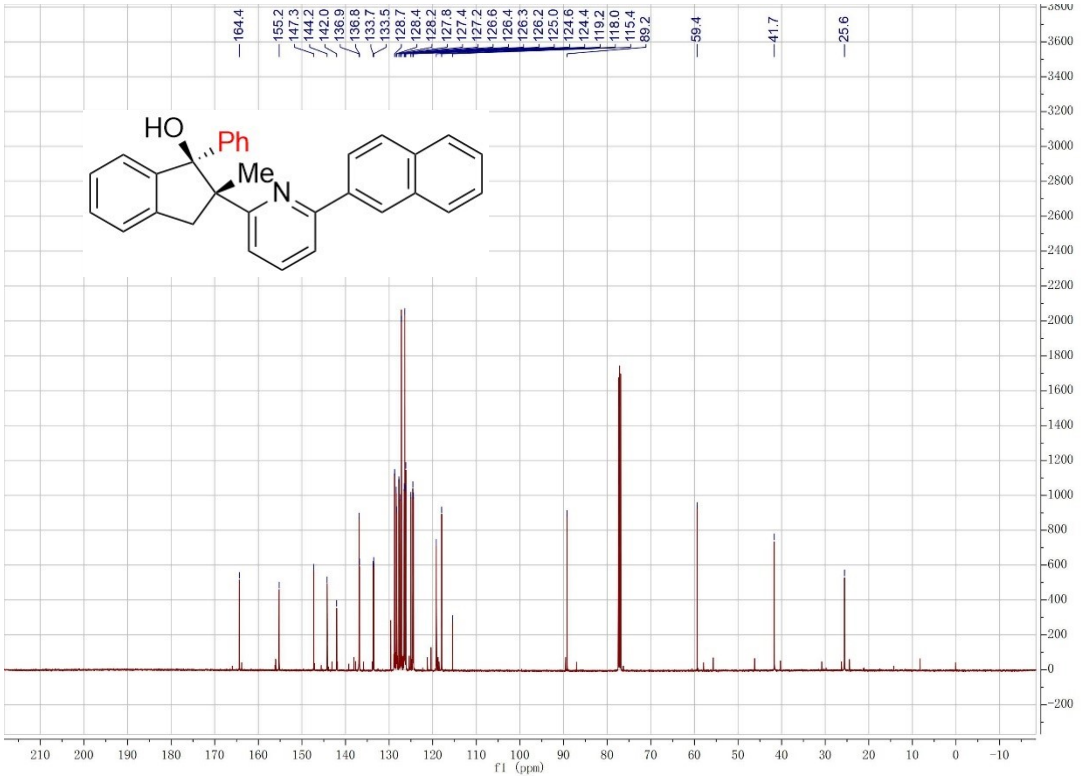
(2*S*)-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-ol (4)



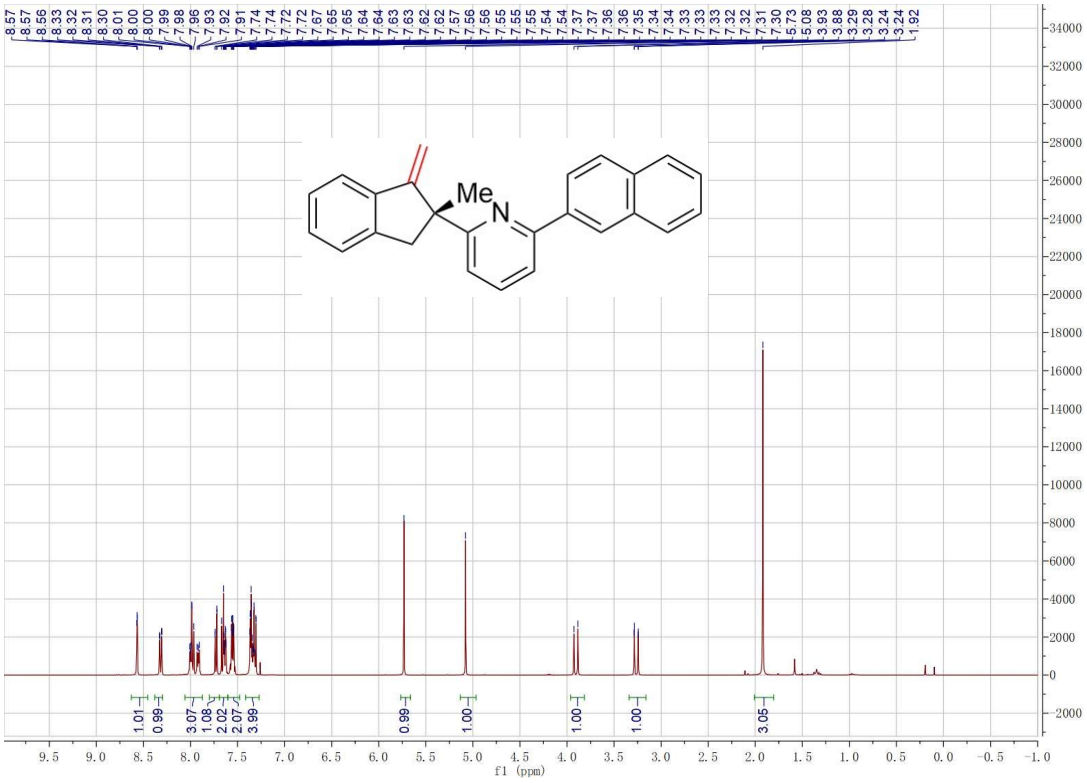


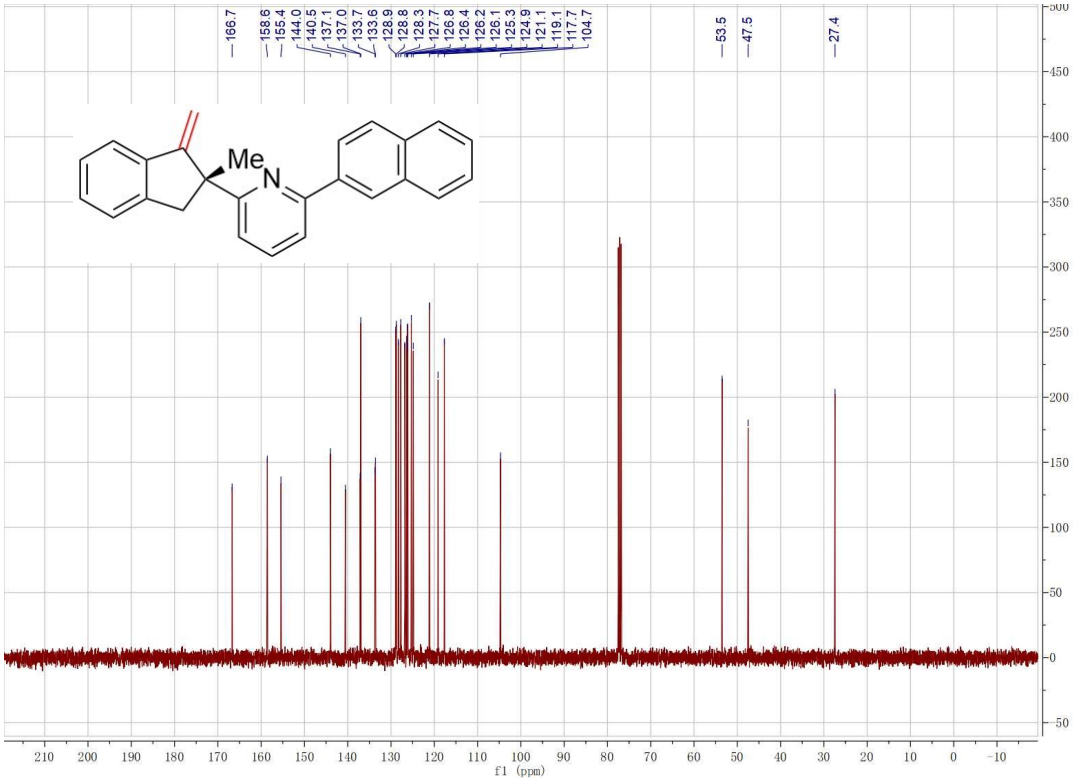
(2*S*)-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-1-phenyl-2,3-dihydro-1*H*-inden-1-ol (5)



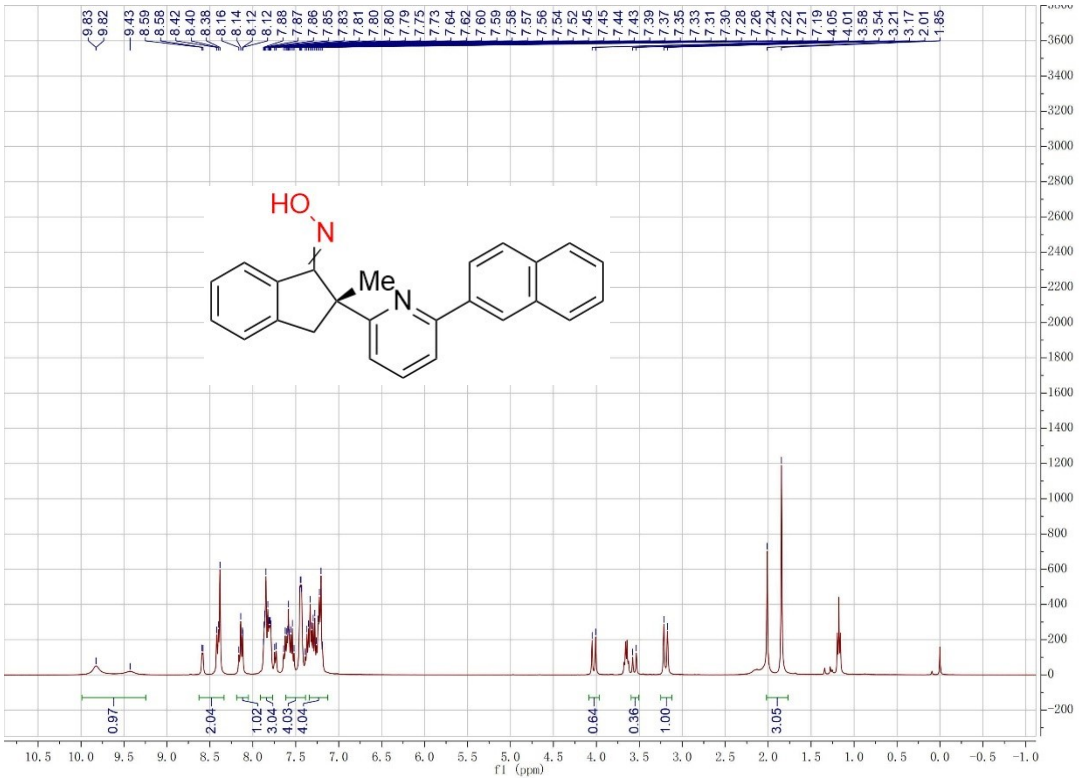


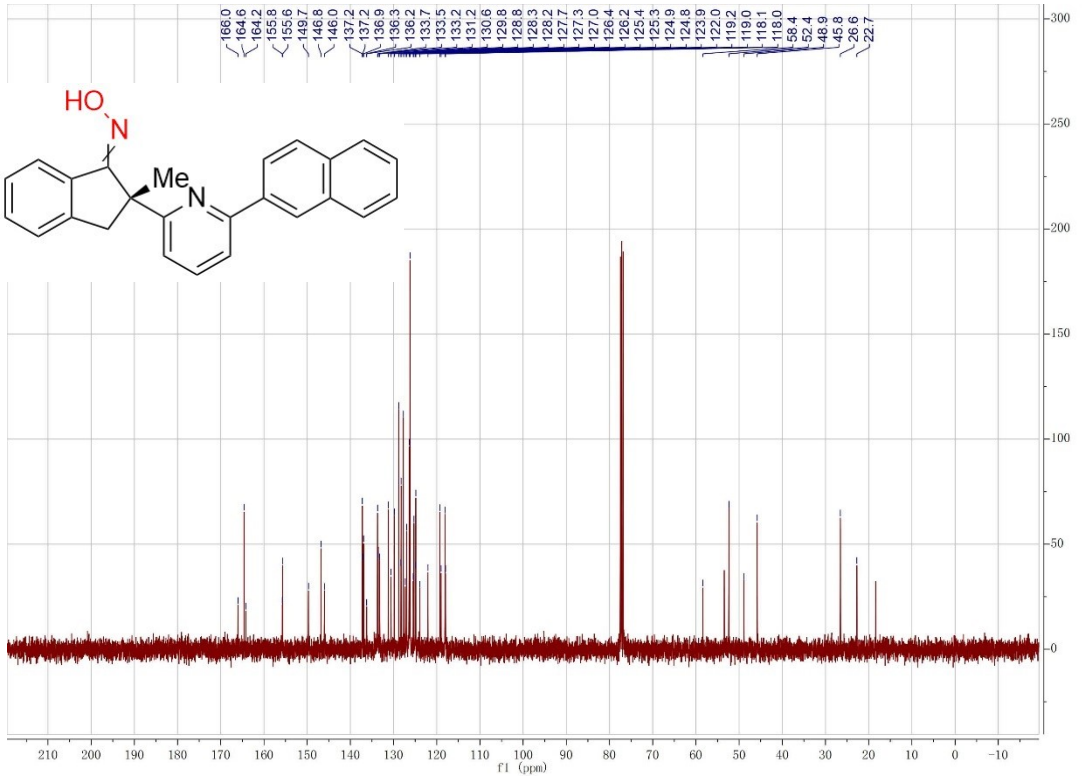
(*R*)-2-(2-Methyl-1-methylene-2,3-dihydro-1*H*-inden-2-yl)-6-(naphthalen-2-yl)pyridine (6)



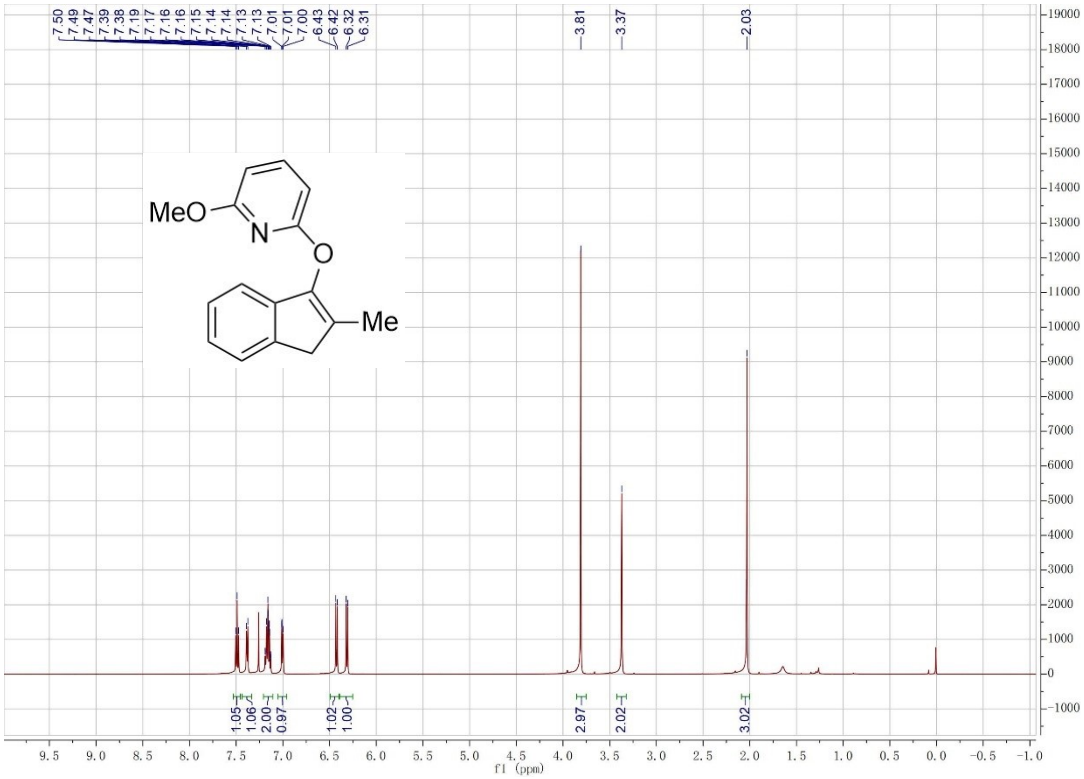


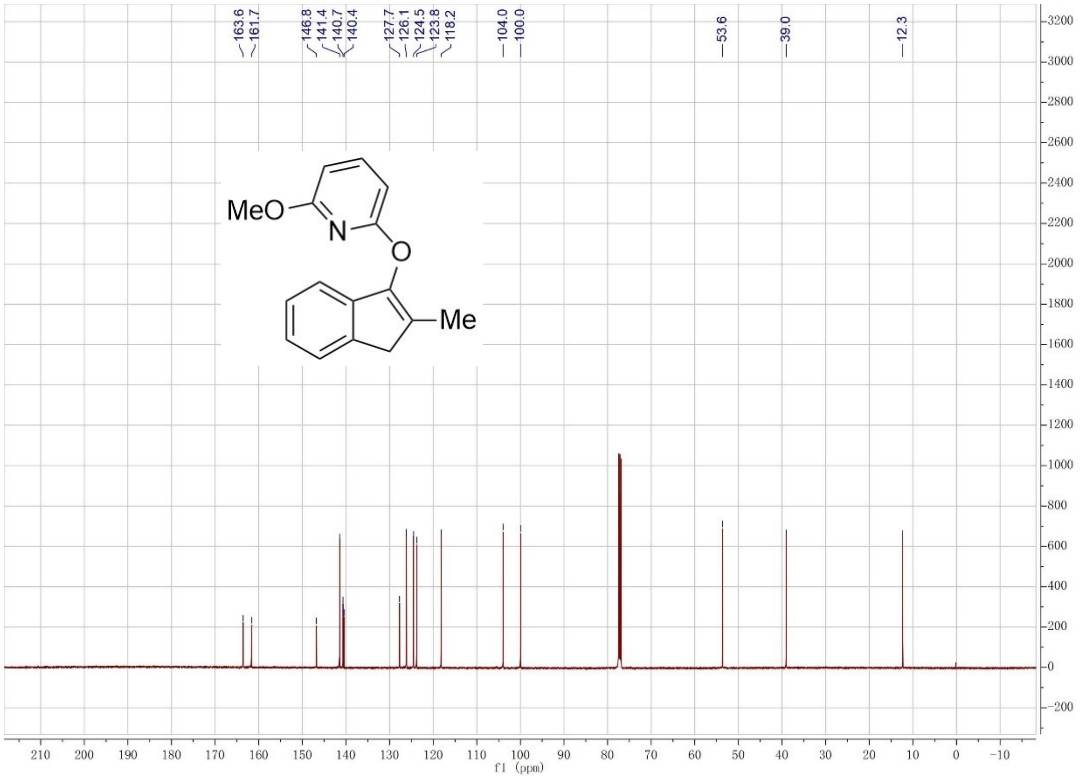
***(S)*-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one oxime (7)**





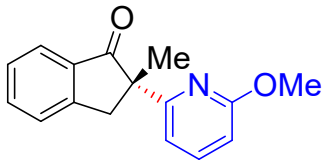
2-Methoxy-6-((2-methyl-1*H*-inden-3-yl)oxy)pyridine (8)

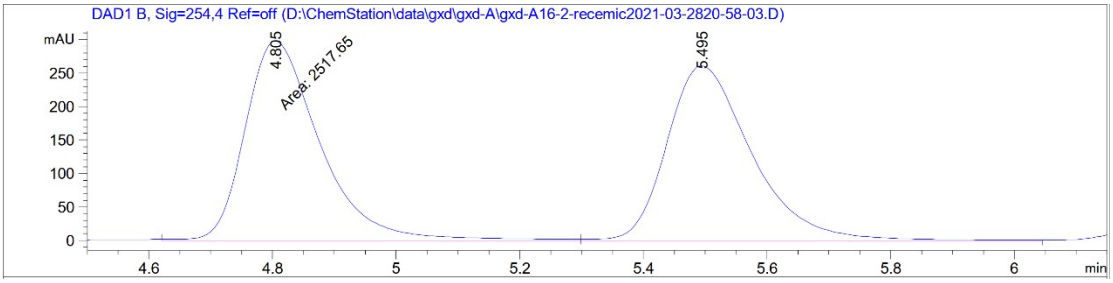




11. HPLC spectrum

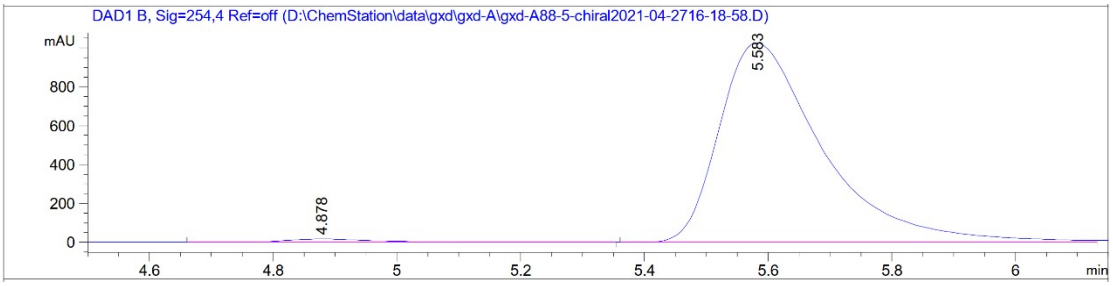
***(S)*-2-(6-Methoxypyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3aa)**





Signal 2: DAD1 B, Sig=254,4 Ref=off

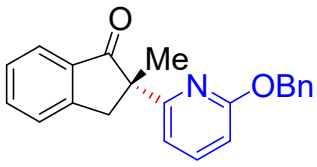
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.805	FM	0.1404	2517.64526	298.83261	50.2620
2	5.495	VV	0.1452	2491.39771	261.41925	49.7380
Totals :				5009.04297	560.25186	

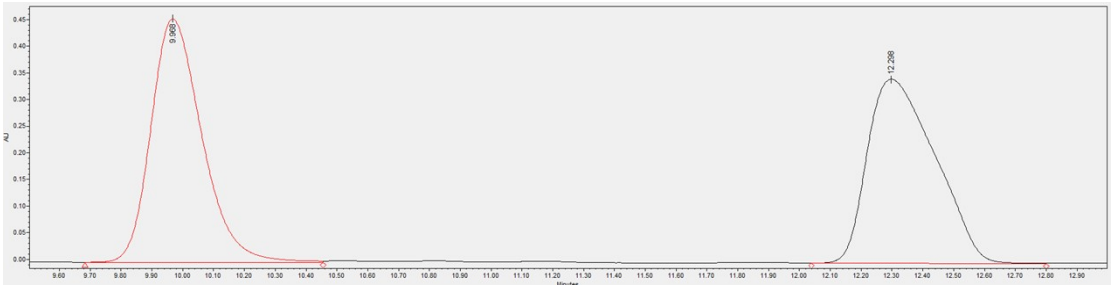


Signal 2: DAD1 B, Sig=254,4 Ref=off

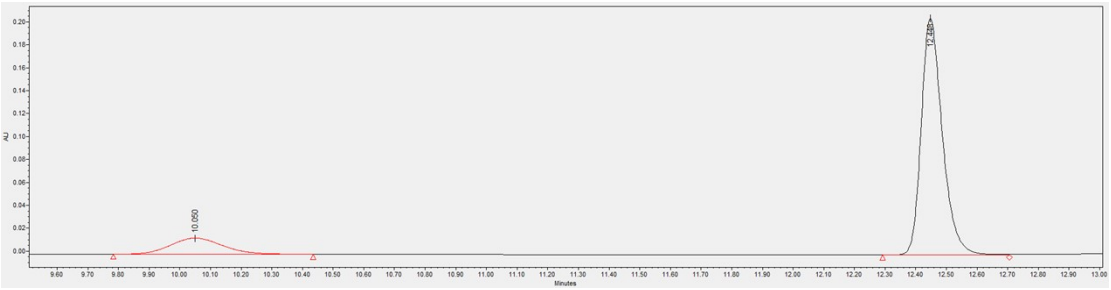
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.878	BB	0.1458	157.89738	16.18967	1.3085
2	5.583	BV	0.1752	1.19094e4	1027.44360	98.6915
Totals :				1.20673e4	1043.63327	

***(S)*-2-(6-(Benzyloxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ab)**



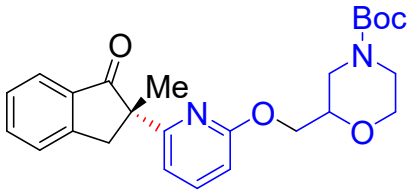


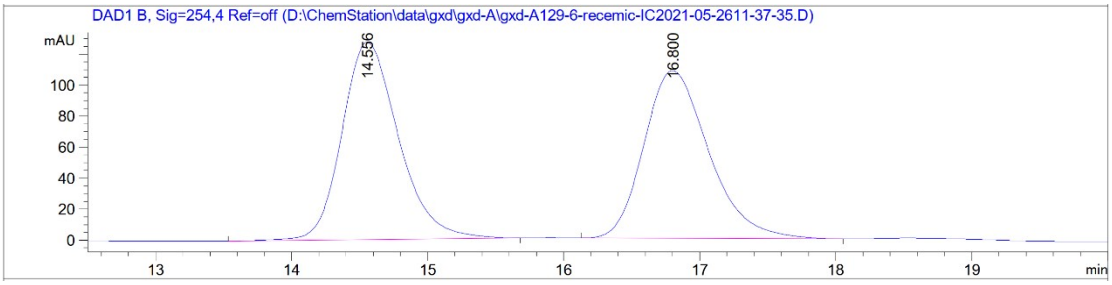
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		9.968	5254973	49.90	456757	BV			Unknown	
2		12.298	5275359	50.10	345404	VV			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		10.050	167714	14.54	14052	BB			Unknown	
2		12.448	985787	85.46	206306	BV			Unknown	

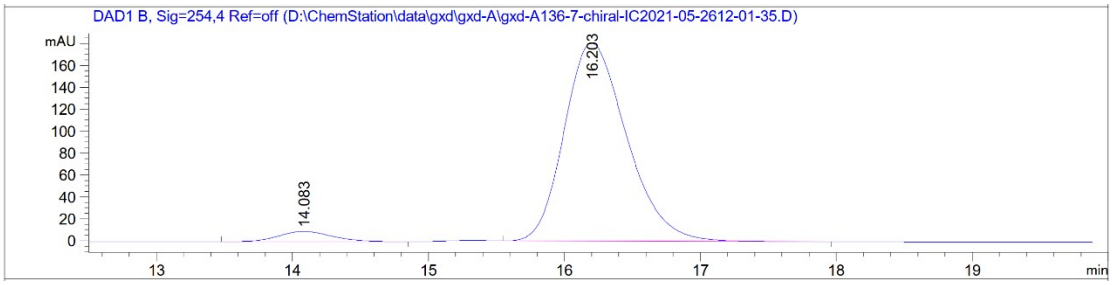
_t_-butyl (_R_)-2-(((6-((_S_)-2-Methyl-1-oxo-2,3-dihydro-1_H_-inden-2-yl)pyridin-2-yl)oxy)methyl) morpholine-4-carboxylate (3ac)





Signal 2: DAD1 B, Sig=254,4 Ref=off

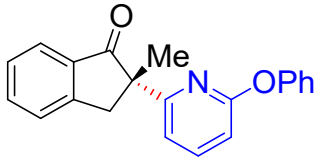
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.556	BB	0.4435	3685.80127	127.42435	50.6690
2	16.800	BB	0.5106	3588.46924	108.29905	49.3310
Totals :				7274.27051	235.72340	

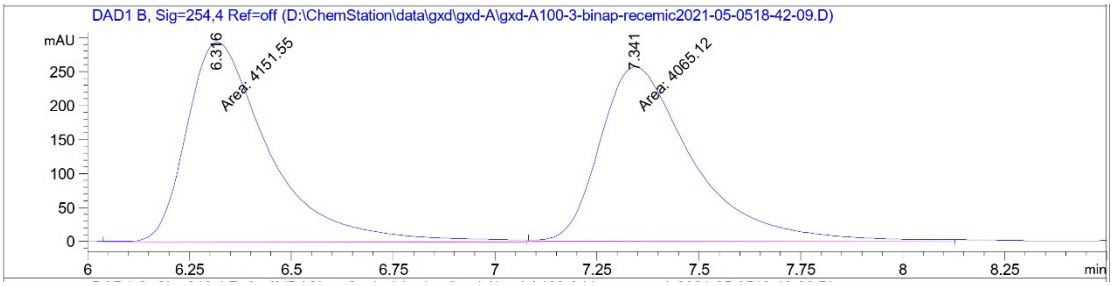


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.083	BB	0.4232	254.85649	9.31612	4.2366
2	16.203	BB	0.4918	5760.76367	180.78888	95.7634
Totals :				6015.62016	190.10500	

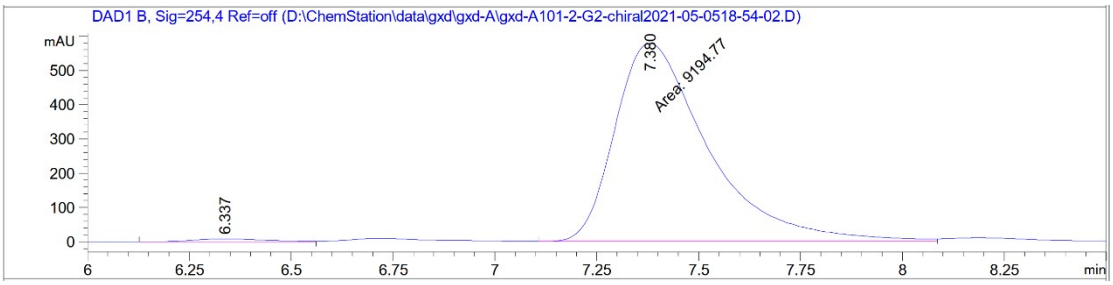
(*S*)-2-Methyl-2-(6-phenoxypyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ad)





Signal 2: DAD1 B, Sig=254,4 Ref=off

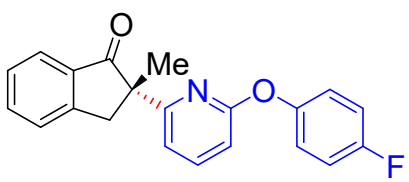
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.316	FM	0.2353	4151.55420	294.12201	50.5260
2	7.341	MM	0.2639	4065.11816	256.75818	49.4740
Totals :				8216.67236	550.88019	

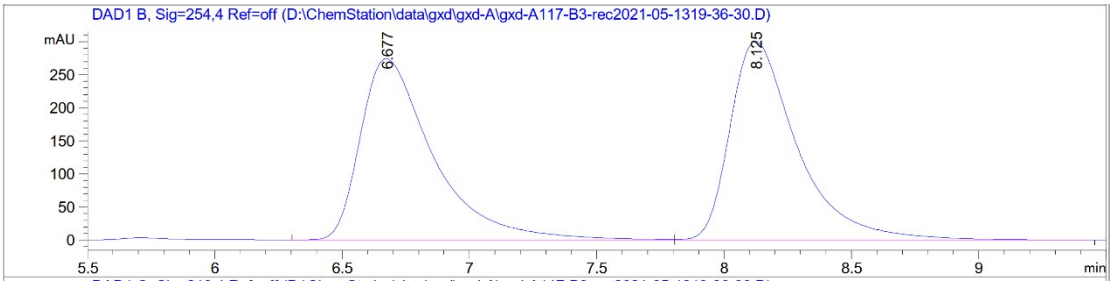


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.337	BV	0.1849	105.94891	8.77116	1.1391
2	7.380	MF	0.2648	9194.77344	578.81982	98.8609
Totals :				9300.72235	587.59099	

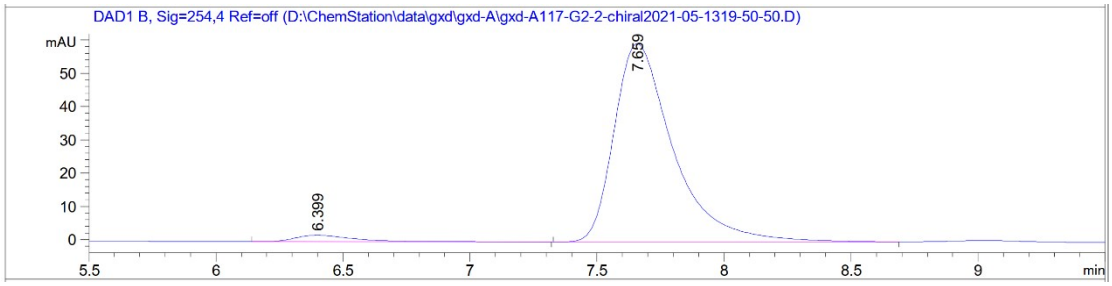
***(S)*-2-(6-(4-Fluorophenoxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ae)**





Signal 2: DAD1 B, Sig=254,4 Ref=off

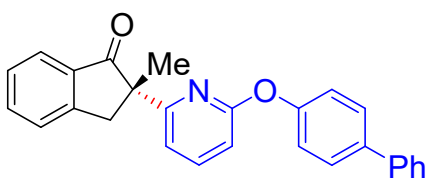
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.677	BV	0.2984	5462.82178	274.22858	49.6989
2	8.125	VB	0.2744	5529.01318	300.85895	50.3011
Totals :				1.09918e4	575.08752	

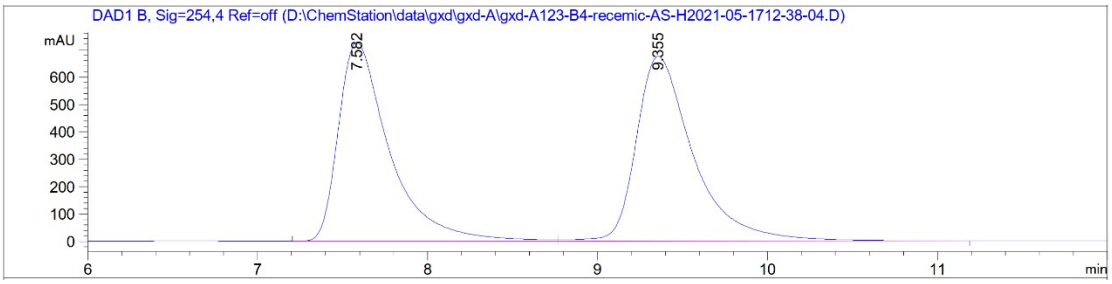


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.399	BB	0.2354	31.49223	1.96058	3.1636
2	7.659	BB	0.2426	963.95435	59.62250	96.8364
Totals :				995.44658	61.58308	

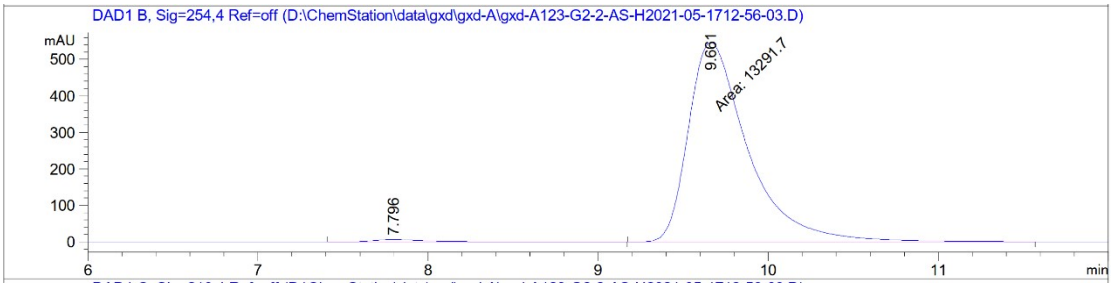
_(S)_-2-(6-([1,1'-Biphenyl]-4-yloxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1_H_-inden-1-one (3af)





Signal 2: DAD1 B, Sig=254,4 Ref=off

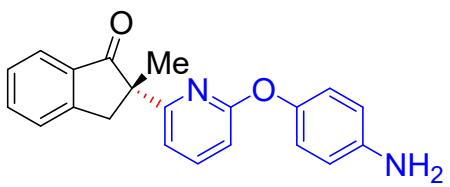
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.582	BV	0.3095	1.51630e4	726.57629	49.0767
2	9.355	VB	0.3483	1.57335e4	674.10547	50.9233
Totals :				3.08965e4	1400.68176	

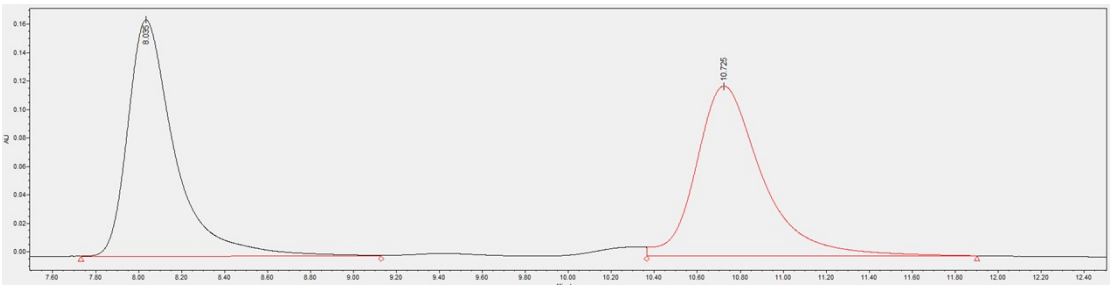


Signal 2: DAD1 B, Sig=254,4 Ref=off

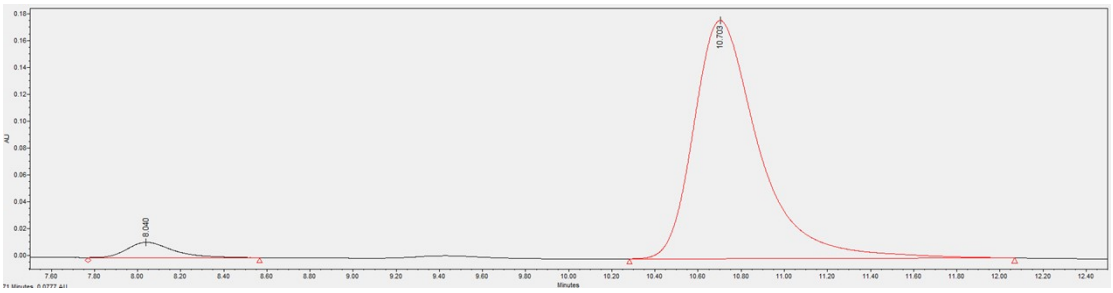
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.796	BB	0.3290	141.28993	6.36536	1.0518
2	9.661	MF	0.4051	1.32917e4	546.84534	98.9482
Totals :				1.34330e4	553.21070	

***(S)*-2-(6-(4-Aminophenoxy)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ag)**



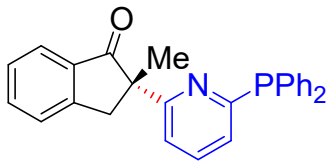


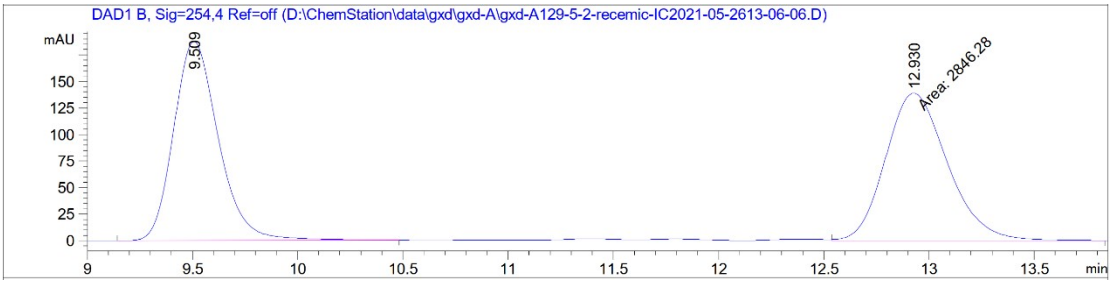
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.035	2527834	49.79	166201	BV			Unknown	
2		10.725	2549189	50.21	119534	VB			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.040	170798	4.37	11495	VB			Unknown	
2		10.703	3733175	95.63	177367	BB			Unknown	

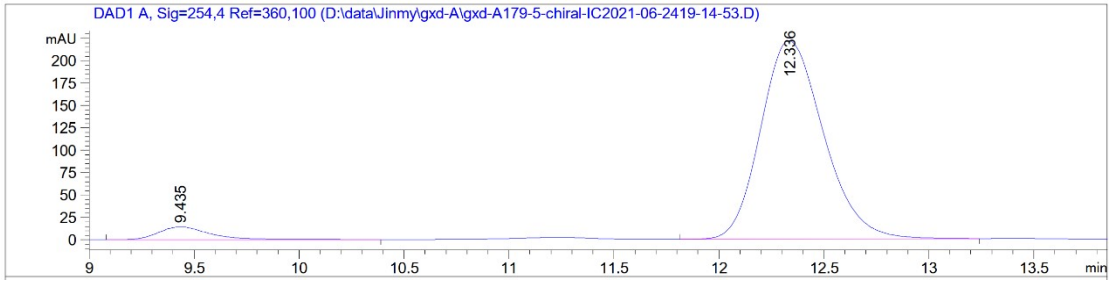
_(S)_-2-(6-(Diphenylphosphaneyl)pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3ah)





Signal 2: DAD1 B, Sig=254,4 Ref=off

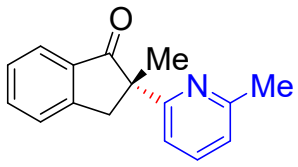
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.509	BB	0.2261	2765.91748	187.55046	49.2840
2	12.930	MF	0.3416	2846.28003	138.86888	50.7160
Totals :				5612.19751	326.41934	

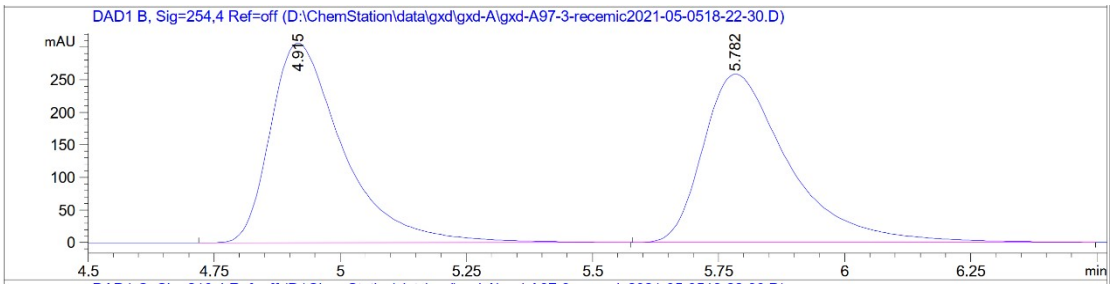


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.435	BB	0.2616	249.65086	14.30693	5.1451
2	12.336	BB	0.3223	4602.56738	221.61607	94.8549
Totals :				4852.21825	235.92301	

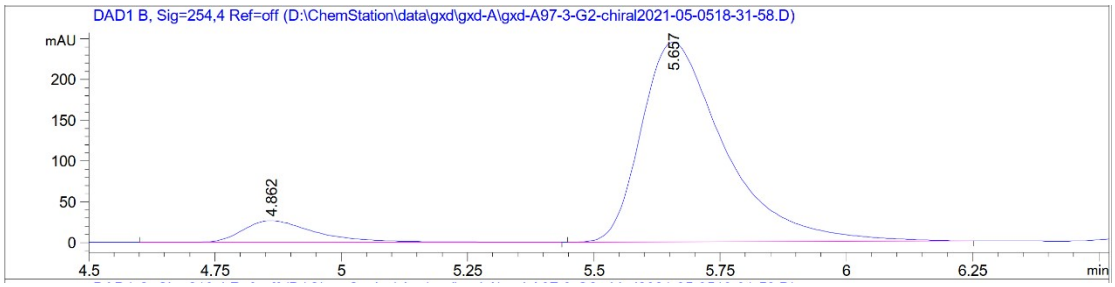
_(S)_-2-Methyl-2-(6-methylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3ai)





Signal 2: DAD1 B, Sig=254,4 Ref=off

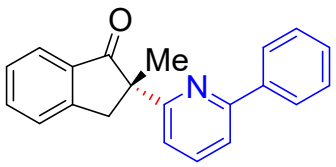
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.915	BB	0.1488	3071.43213	306.85233	50.2167
2	5.782	BB	0.1774	3044.92480	258.53867	49.7833
Totals :				6116.35693	565.39099	

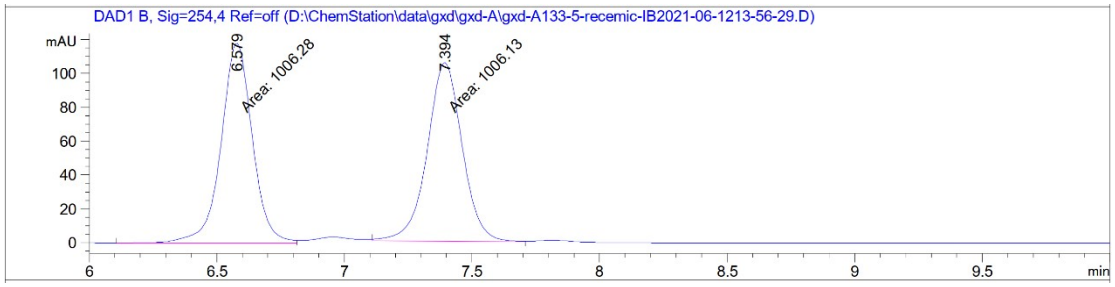


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.862	BB	0.1497	263.85211	26.60425	8.6070
2	5.657	BB	0.1735	2801.69580	244.92673	91.3930
Totals :				3065.54791	271.53097	

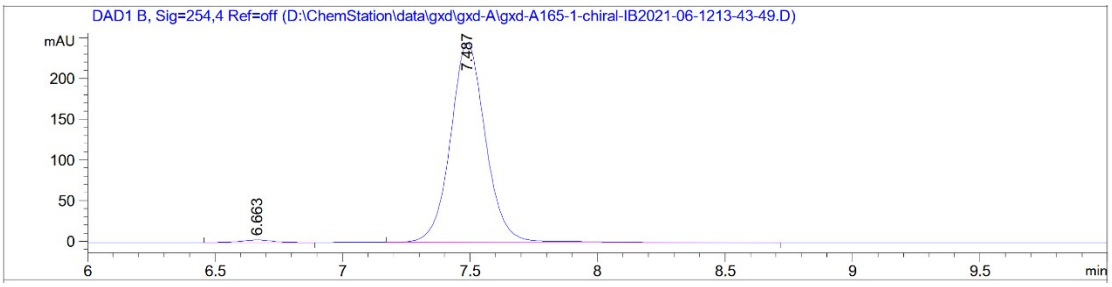
***(S)*-2-Methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3aj)**





Signal 2: DAD1 B, Sig=254,4 Ref=off

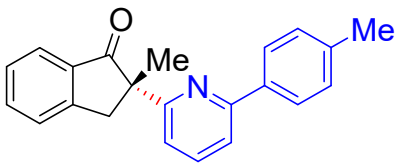
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.579	MF	0.1419	1006.28082	118.17661	50.0037
2	7.394	MM	0.1589	1006.13074	105.52702	49.9963
Totals :				2012.41156	223.70362	

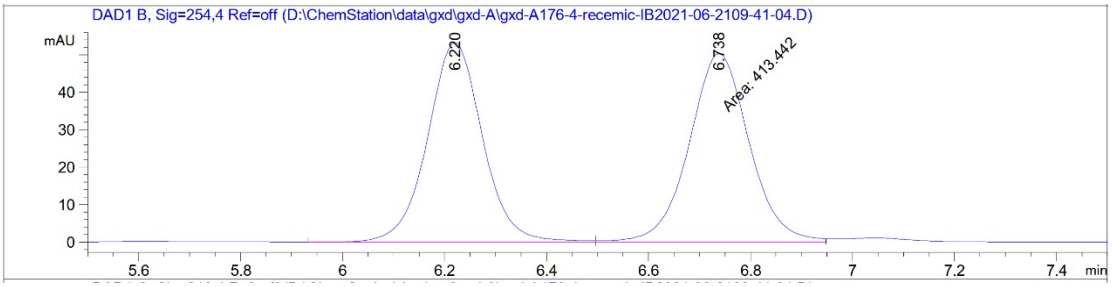


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.663	BB	0.1280	26.46866	3.14948	1.1149
2	7.487	BB	0.1456	2347.71362	245.46957	98.8851
Totals :				2374.18228	248.61906	

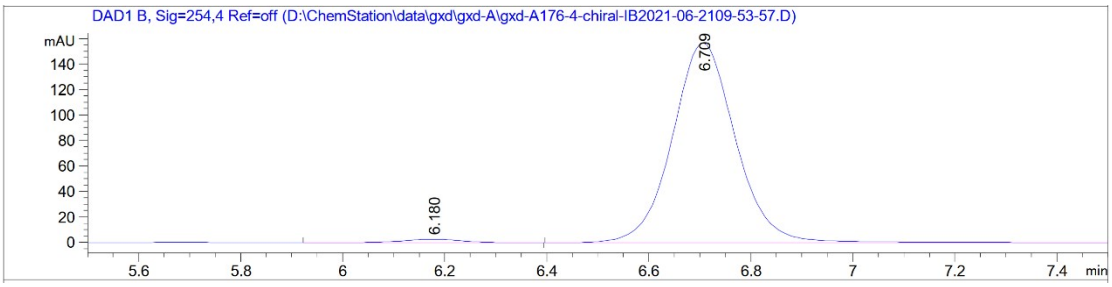
***(S)*-2-Methyl-2-(6-(p-tolyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ak)**





Signal 2: DAD1 B, Sig=254,4 Ref=off

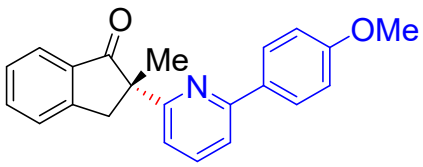
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.220	BV	0.1135	400.89880	53.46898	49.2298
2	6.738	MF	0.1364	413.44223	50.51876	50.7702
Totals :				814.34103	103.98774	

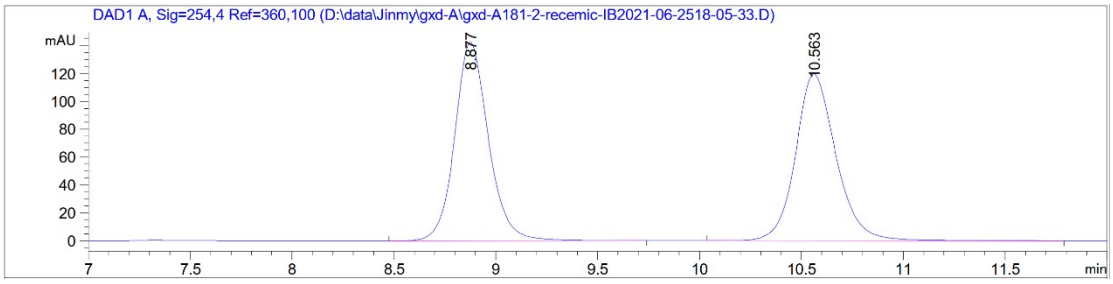


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.180	BB	0.1218	22.52283	2.80266	1.6324
2	6.709	BB	0.1309	1357.23352	156.88248	98.3676
Totals :				1379.75635	159.68514	

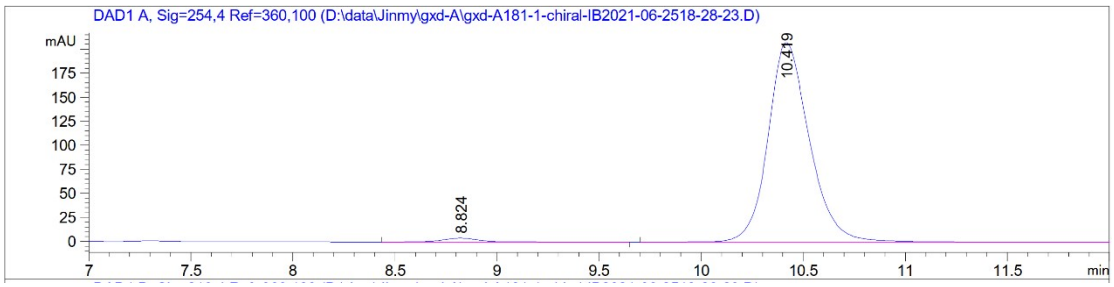
(*S*)-2-(6-(4-Methoxyphenyl) pyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3al)





Signal 1: DAD1 A, Sig=254,4 Ref=360,100

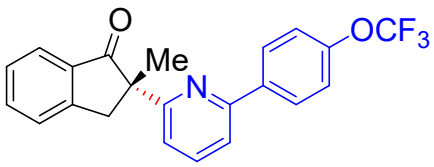
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.877	BB	0.1745	1642.98352	142.49730	49.8866
2	10.563	BB	0.2091	1650.45435	119.52814	50.1134
Totals :				3293.43787	262.02544	

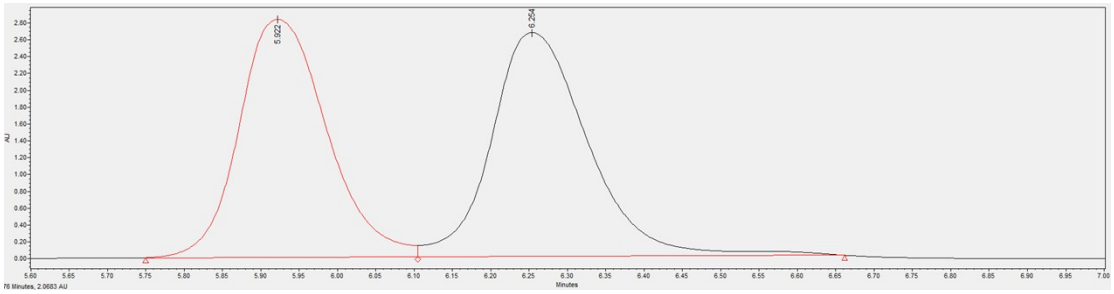


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

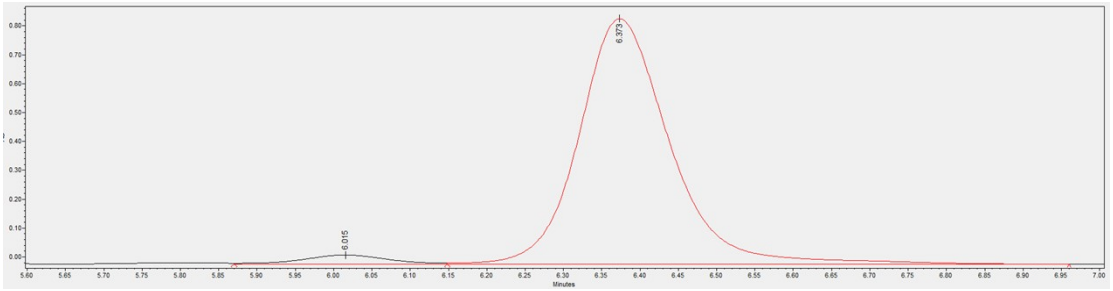
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.824	BB	0.1965	53.68452	4.05393	1.7951
2	10.419	BB	0.2151	2936.87476	207.49667	98.2049
Totals :				2990.55928	211.55060	

_(S)_-2-Methyl-2-(6-(4-(trifluoromethoxy)phenyl)pyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3am)



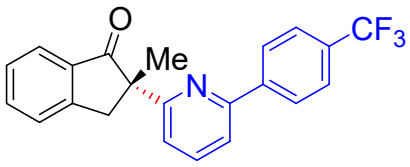


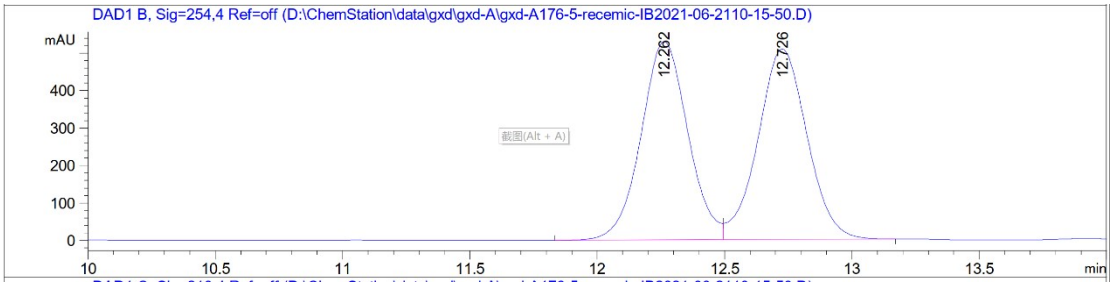
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.922	22435454	49.09	2824431	bV			Unknown	
2		6.254	23271823	50.91	2656748	Vb			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		6.015	235392	3.25	30950	VV			Unknown	
2		6.373	7009857	96.75	849010	Vb			Unknown	

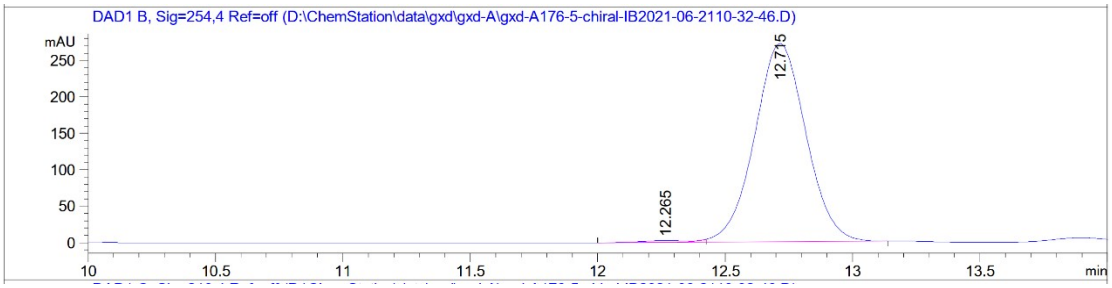
(*S*)-2-Methyl-2-(6-(4-(trifluoromethyl)phenyl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3an)





Signal 2: DAD1 B, Sig=254,4 Ref=off

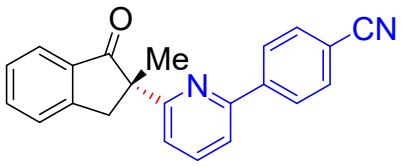
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.262	BV	0.1968	6763.39551	530.22046	49.8155
2	12.726	VB	0.2061	6813.49268	509.13394	50.1845
Totals :				1.35769e4	1039.35440	

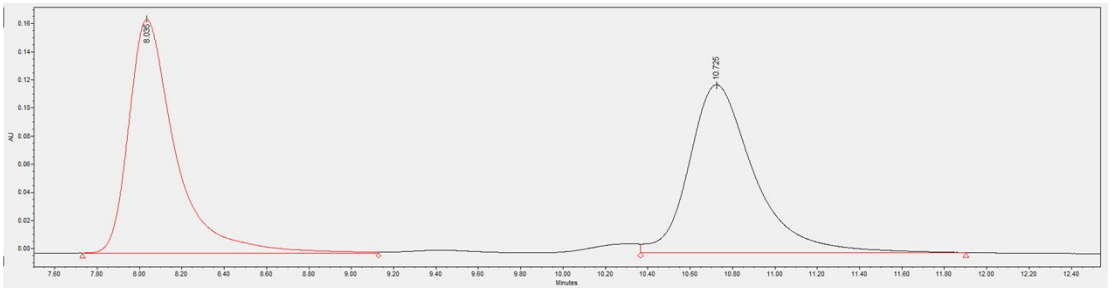


Signal 2: DAD1 B, Sig=254,4 Ref=off

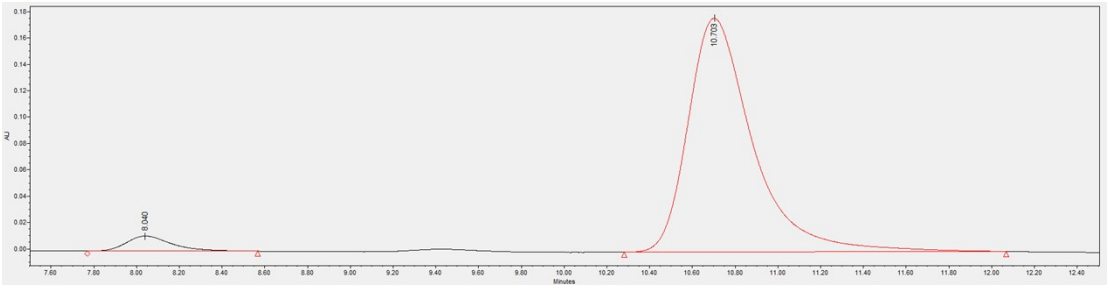
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.265	BV E	0.1719	29.12238	2.57535	0.7564
2	12.715	VB R	0.2158	3820.89111	272.20615	99.2436
Totals :				3850.01349	274.78150	

***(S)*-4-(6-(2-Methyl-1-oxo-2,3-dihydro-1*H*-inden-2-yl)pyridin-2-yl)benzonitrile (3ao)**



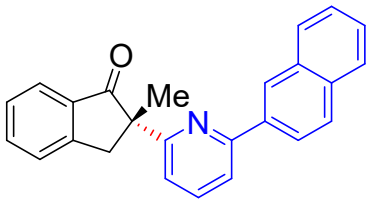


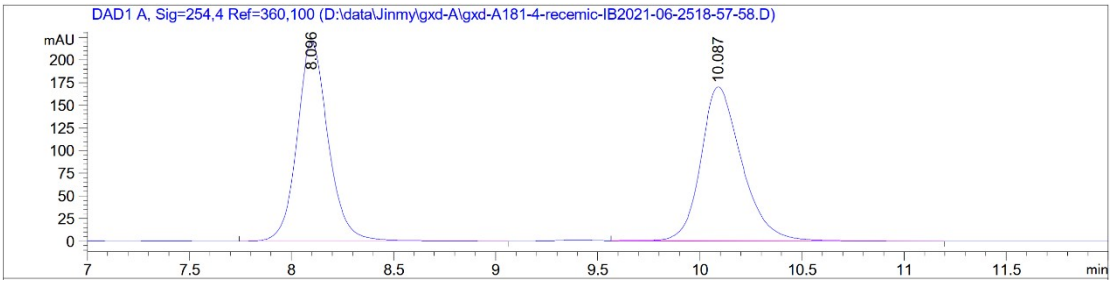
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.035	2527834	49.79	166201	BV			Unknown	
2		10.725	2549189	50.21	119534	VB			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.040	170798	4.37	11495	VB			Unknown	
2		10.703	3733175	95.63	177367	BB			Unknown	

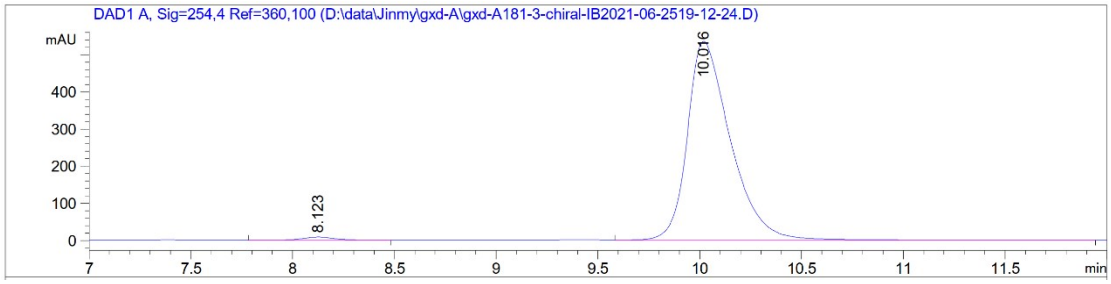
***(S)*-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ap)**





Signal 1: DAD1 A, Sig=254,4 Ref=360,100

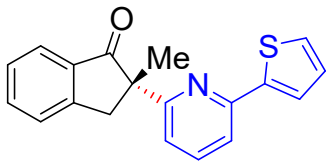
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.096	BB	0.1615	2331.03271	220.28400	49.4676
2	10.087	BB	0.2094	2381.20703	170.02510	50.5324
Totals :				4712.23975	390.30910	

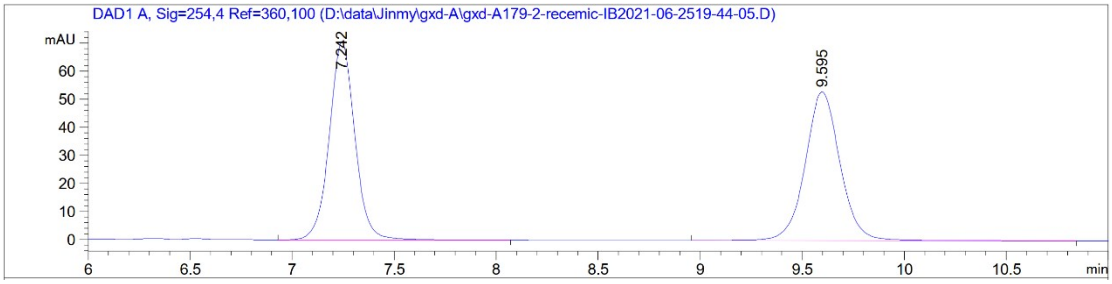


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.123	BB	0.1658	90.89558	8.29588	1.1410
2	10.016	BB	0.2194	7875.12012	535.91010	98.8590
Totals :				7966.01570	544.20597	

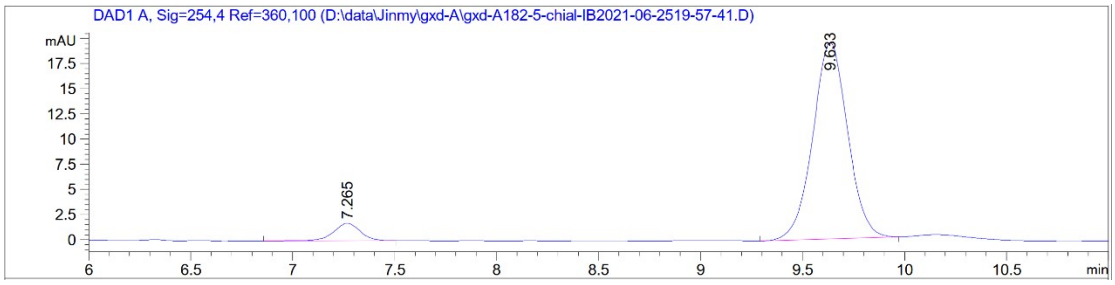
_(S)_-2-Methyl-2-(6-(thiophen-2-yl)pyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3aq)





Signal 1: DAD1 A, Sig=254,4 Ref=360,100

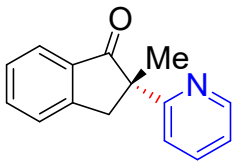
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.242	BB	0.1336	618.66748	71.05457	49.5403
2	9.595	BB	0.1805	630.14813	53.06929	50.4597
Totals :				1248.81561	124.12386	

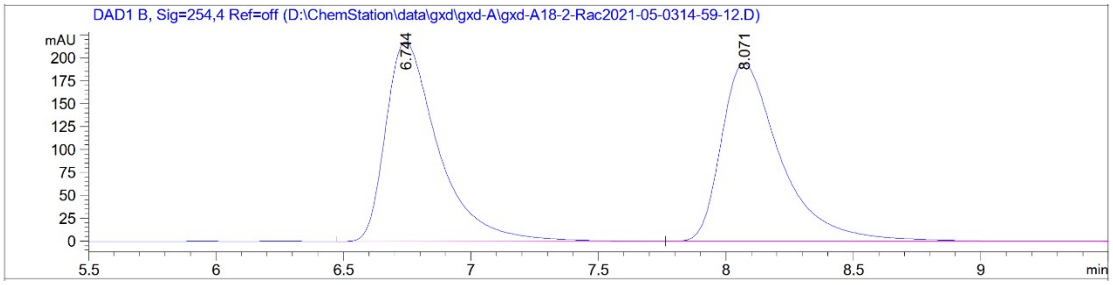


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.265	BB	0.1409	15.91391	1.73604	6.4336
2	9.633	BB	0.1823	231.44313	19.52280	93.5664
Totals :				247.35704	21.25884	

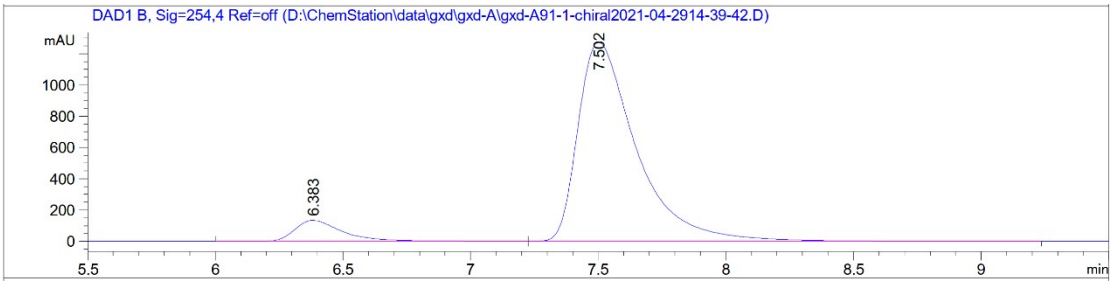
***(S)*-2-Methyl-2-(pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ar)**





Signal 2: DAD1 B, Sig=254,4 Ref=off

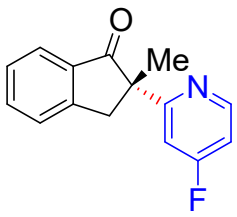
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.744	BB	0.2151	3123.30957	218.08815	49.7657
2	8.071	BBA	0.2435	3152.71924	194.11169	50.2343
Totals :				6276.02881	412.19984	

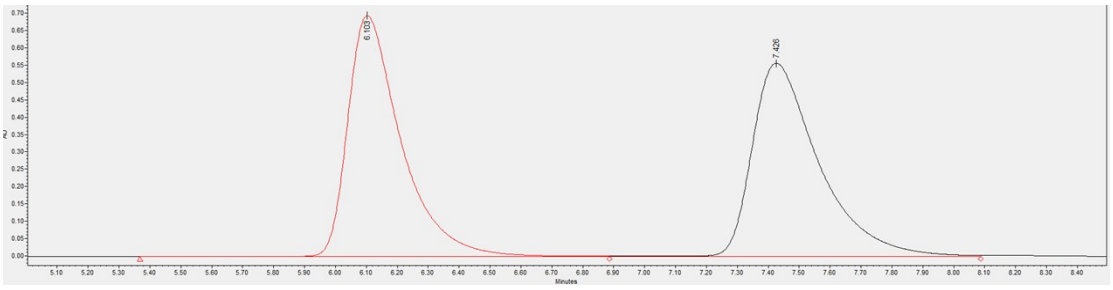


Signal 2: DAD1 B, Sig=254,4 Ref=off

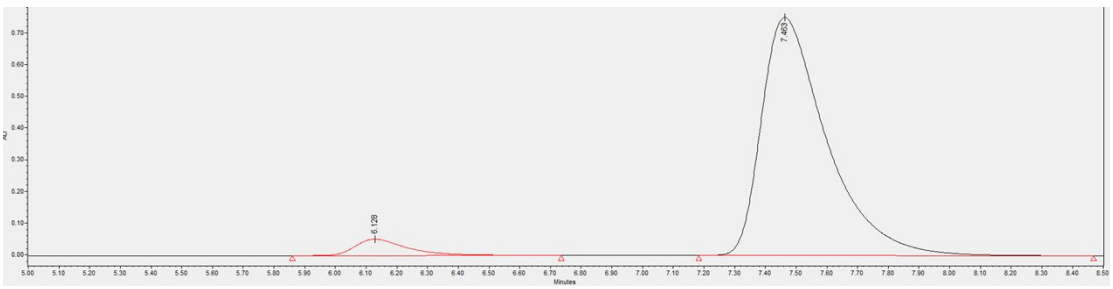
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.383	BV	0.1974	1766.98157	134.42104	8.0165
2	7.502	VB	0.2375	2.02747e4	1275.17188	91.9835
Totals :				2.20417e4	1409.59291	

(*S*)-2-(4-Fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1*H*-inden-1-one (3as)



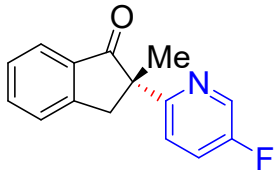


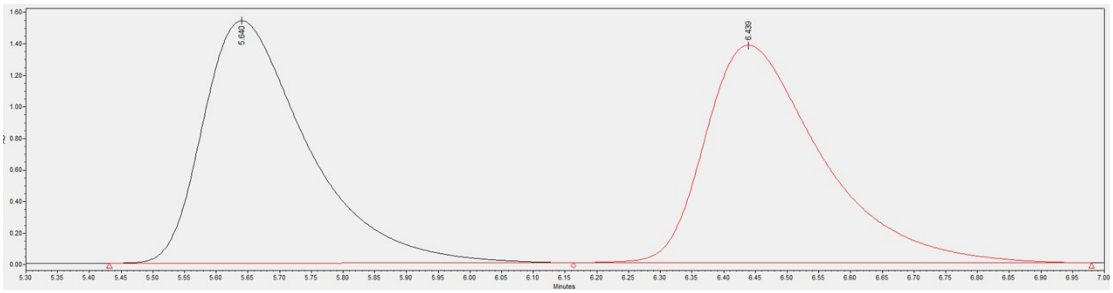
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		6.103	8284699	49.85	693741	BV			Unknown	
2		7.426	8333306	50.15	556684	VV			Unknown	



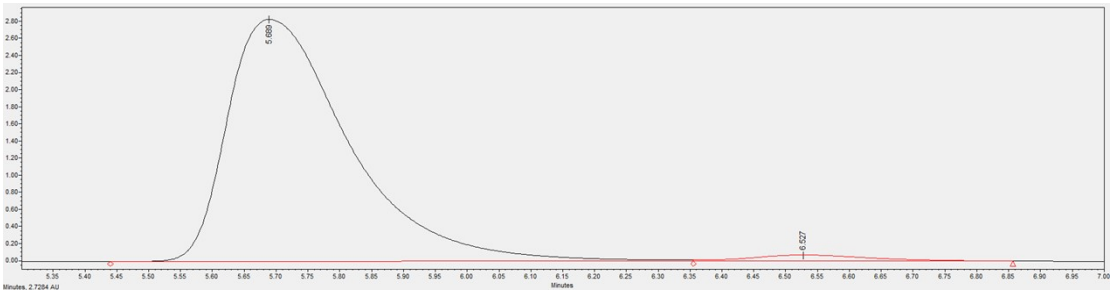
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		6.128	604285	5.19	51561	BB			Unknown	
2		7.463	11047472	94.81	749678	BB			Unknown	

***(S)*-2-(5-fluoropyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3at)**



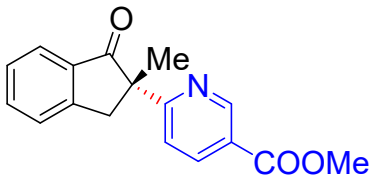


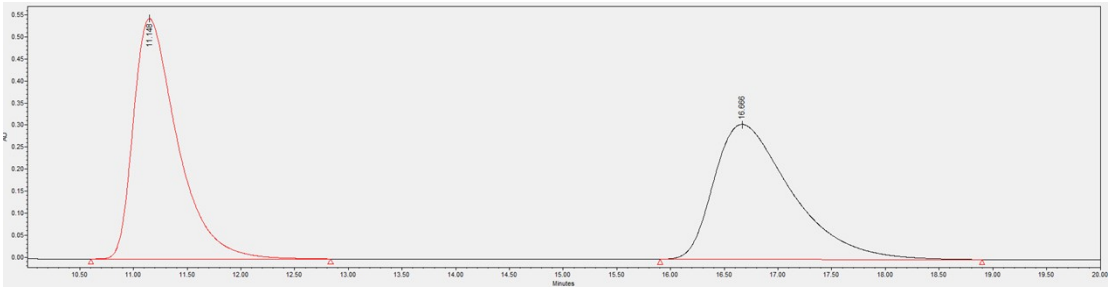
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.640	17597486	49.95	1536086	bV			Unknown	
2		6.439	17636041	50.05	1379708	Vb			Unknown	



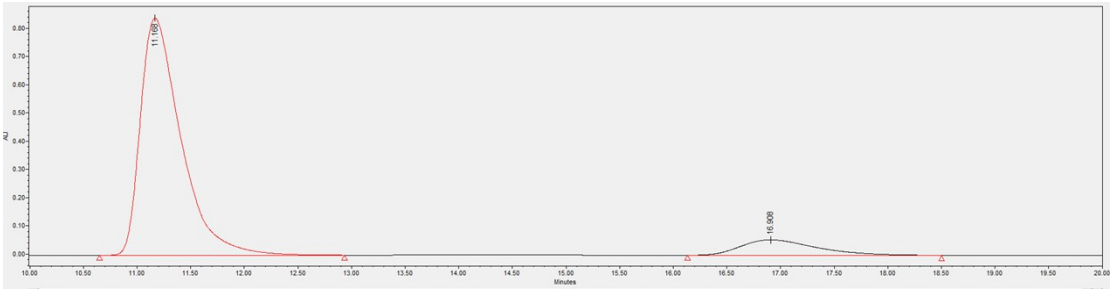
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.689	37420715	97.56	2825802	VV			Unknown	
2		6.527	935240	2.44	71806	Vb			Unknown	

Methyl *(S)*-6-(2-methyl-1-oxo-2,3-dihydro-1H-inden-2-yl)nicotinate (3au)



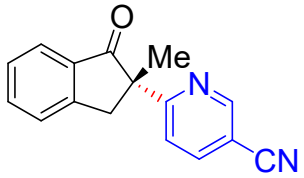


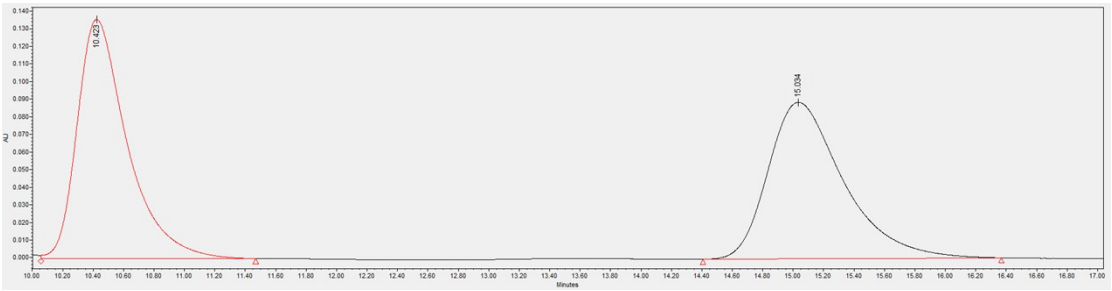
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		11.148	15512364	50.27	545392	BB			Unknown	
2		16.666	15348029	49.73	306122	BB			Unknown	



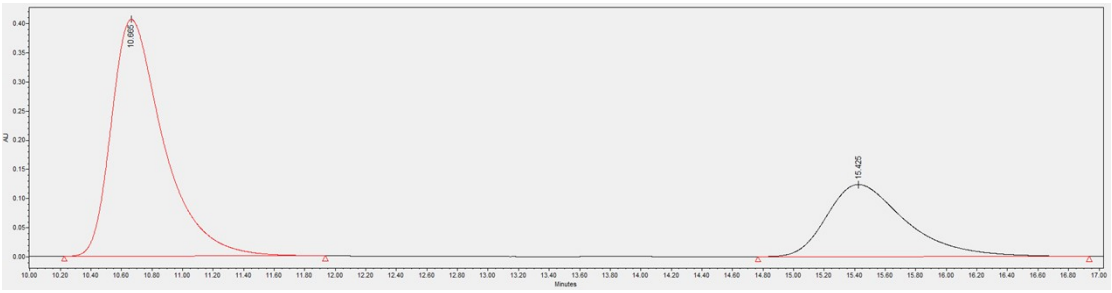
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		11.168	22061123	89.19	839851	BB			Unknown	
2		16.908	2674873	10.81	54795	BB			Unknown	

***(S)*-6-(2-methyl-1-oxo-2,3-dihydro-1H-inden-2-yl)nicotinonitrile (3av)**



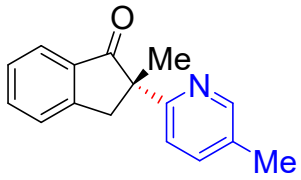


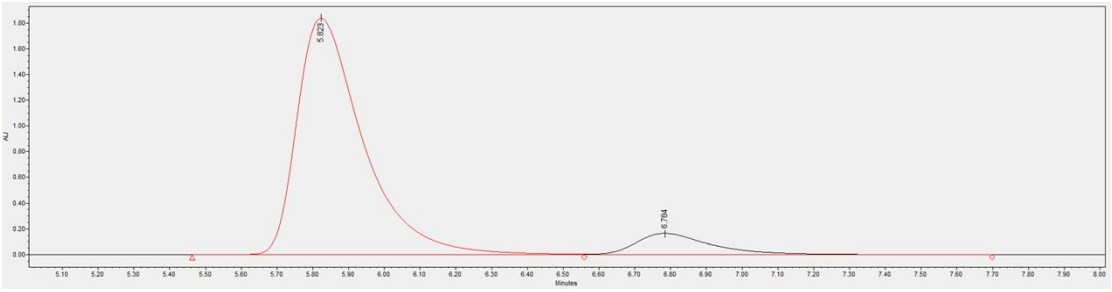
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		10.423	3101456	50.39	135766	VB			Unknown	
2		15.034	3053991	49.61	88858	BB			Unknown	



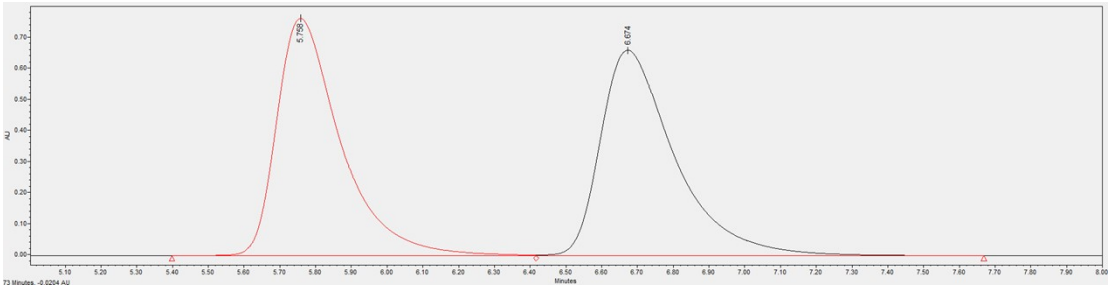
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		10.665	9590536	68.36	405355	BB			Unknown	
2		15.425	4438476	31.64	123608	BB			Unknown	

***(S)* 2-methyl-2-(5-methylpyridin-2-yl)-2,3-dihydro-1H-inden-1-one (3aw)**



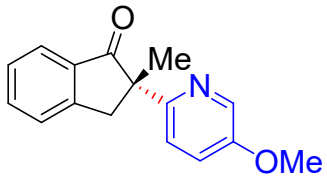


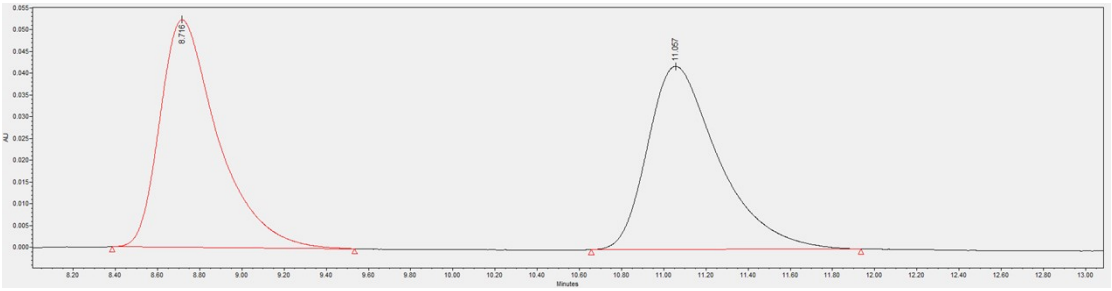
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.823	23628477	90.68	1837718	BV			Unknown	
2		6.784	2429867	9.32	165934	VV			Unknown	



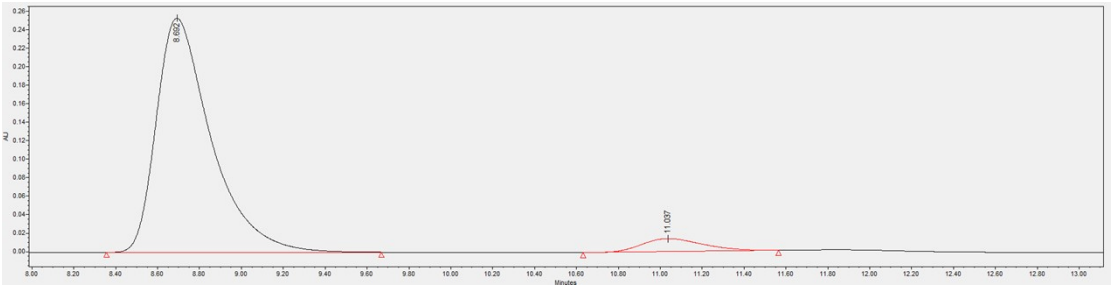
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.758	9547475	50.01	763217	BV			Unknown	
2		6.674	9543423	49.99	660852	VB			Unknown	

***(S)*- 2-(5-methoxypyridin-2-yl)-2-methyl-2,3-dihydro-1H-inden-1-one (3ax)**



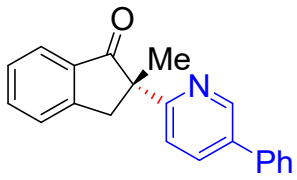


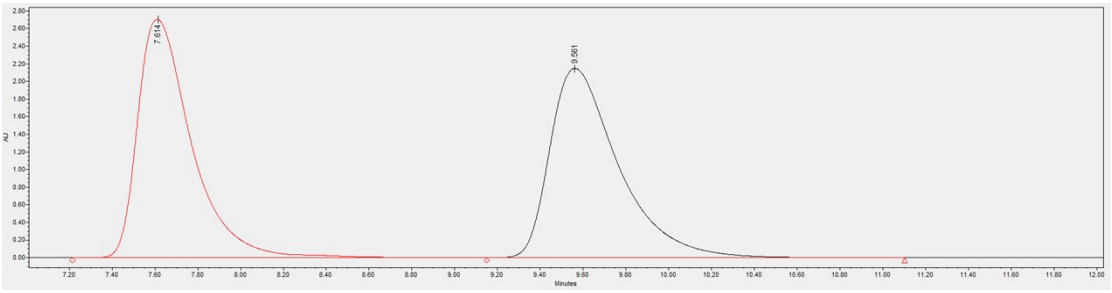
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.716	999160	50.39	52282	BB			Unknown	
2		11.057	983760	49.61	42080	BB			Unknown	



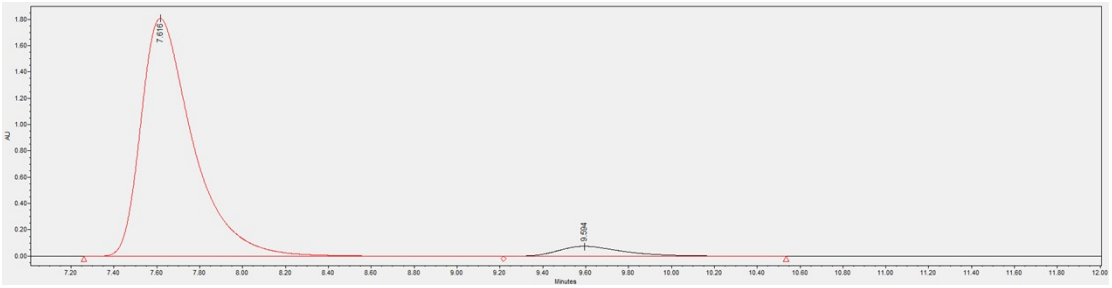
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.692	4602836	94.15	252957	BB			Unknown	
2		11.037	286250	5.85	14095	Bb			Unknown	

***(S)*-2-methyl-2-(5-phenylpyridin-2-yl)-2,3-dihydro-1H-inden-1-one (3ay)**



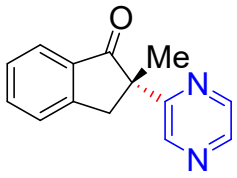


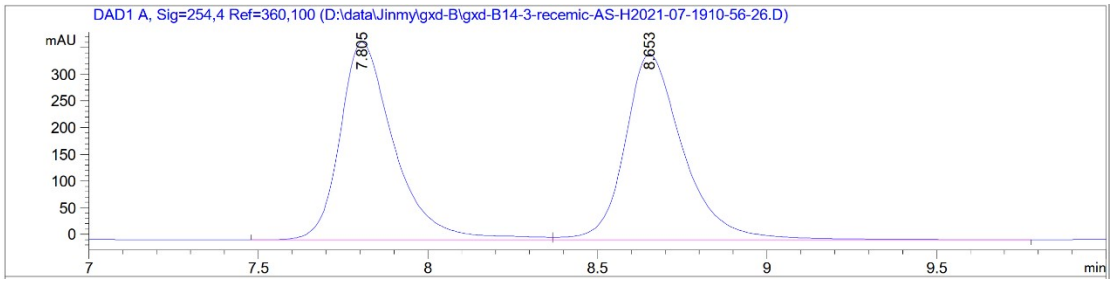
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		7.614	47228781	49.71	2705078	VV			Unknown	
2		9.561	47781406	50.29	2149407	VB			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		7.616	30396682	94.98	1808292	BV			Unknown	
2		9.594	1608069	5.02	75849	VB			Unknown	

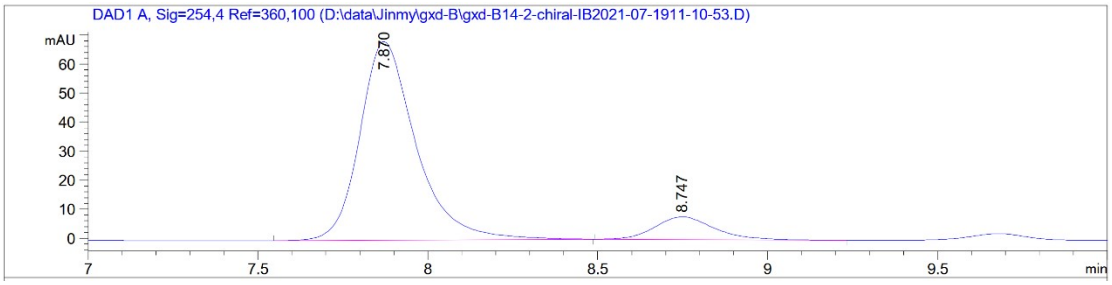
***(S)*-2-Methyl-2-(pyrazin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3az)**





Signal 1: DAD1 A, Sig=254,4 Ref=360,100

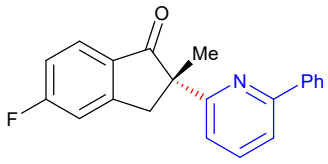
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.805	BV	0.1654	4119.54395	371.37781	49.7867
2	8.653	VB	0.1771	4154.84131	348.49011	50.2133
Totals :				8274.38525	719.86792	

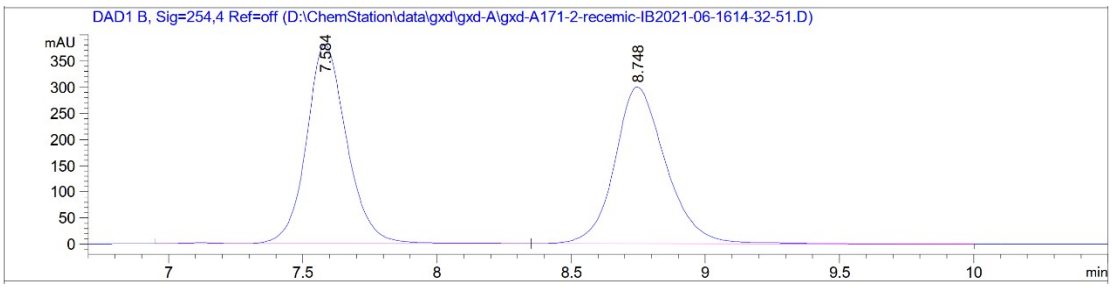


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.870	BB	0.1720	785.12885	68.38147	89.1686
2	8.747	BB	0.1839	95.37012	7.84107	10.8314
Totals :				880.49896	76.22254	

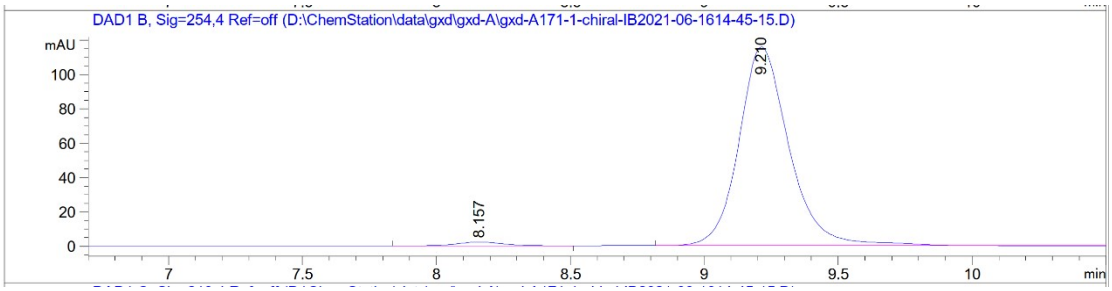
_(S)_-5-Fluoro-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3bj)





Signal 2: DAD1 B, Sig=254,4 Ref=off

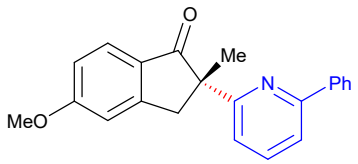
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.584	VB R	0.1576	3993.69653	381.55051	50.1625
2	8.748	BBA	0.1985	3967.81982	299.54883	49.8375
Totals :				7961.51636	681.09933	

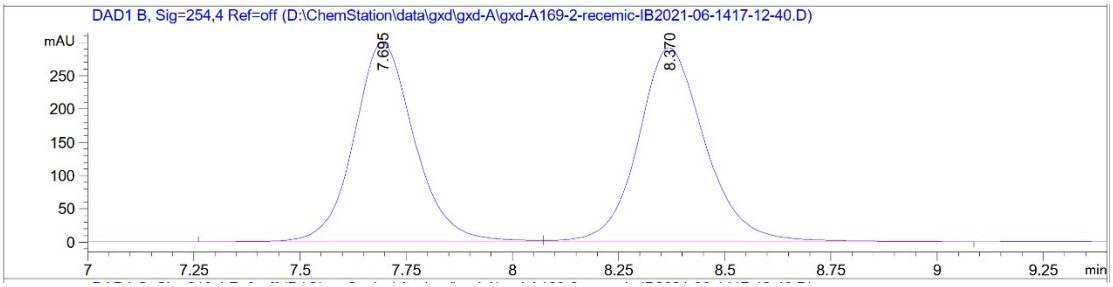


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.157	BB	0.1794	26.43185	2.24362	1.7122
2	9.210	BB	0.1967	1517.28845	115.89758	98.2878
Totals :				1543.72030	118.14120	

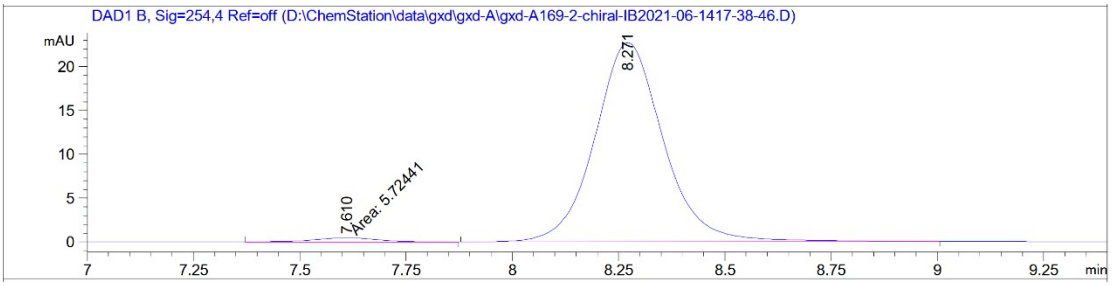
_(S)_-5-Methoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3cj)





Signal 2: DAD1 B, Sig=254,4 Ref=off

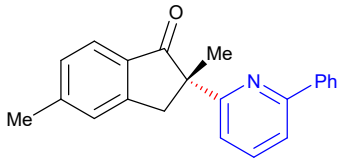
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.695	BV	0.1497	2966.65015	299.22369	48.1542
2	8.370	VB	0.1638	3194.08325	291.59235	51.8458
Totals :				6160.73340	590.81604	

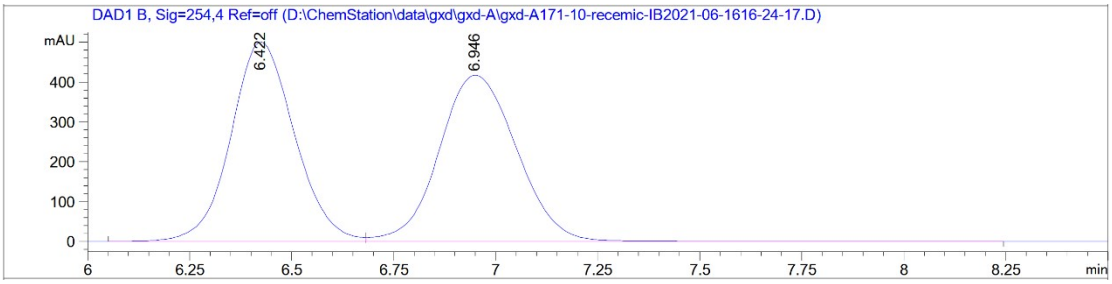


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.610	MM	0.1938	5.72441	4.92230e-1	2.1961
2	8.271	BB	0.1689	254.93965	22.71818	97.8039
Totals :				260.66407	23.21041	

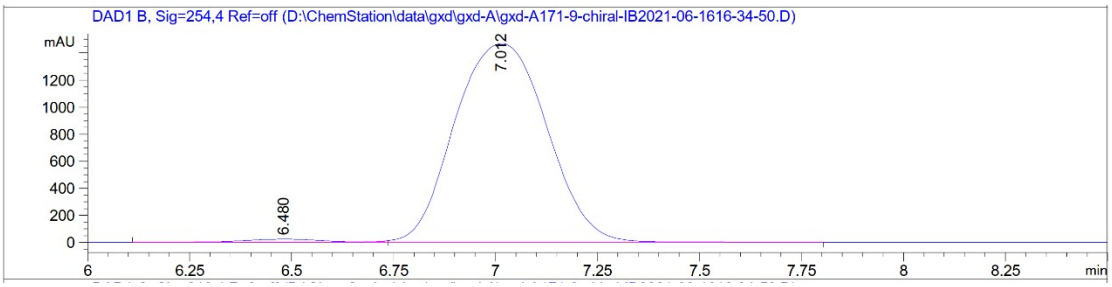
_(S)_-2,5-Dimethyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3dj)





Signal 2: DAD1 B, Sig=254,4 Ref=off

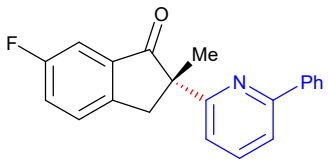
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.422	BV	0.1664	5417.37744	499.92279	49.6194
2	6.946	VB	0.2080	5500.47949	416.57761	50.3806
Totals :				1.09179e4	916.50040	

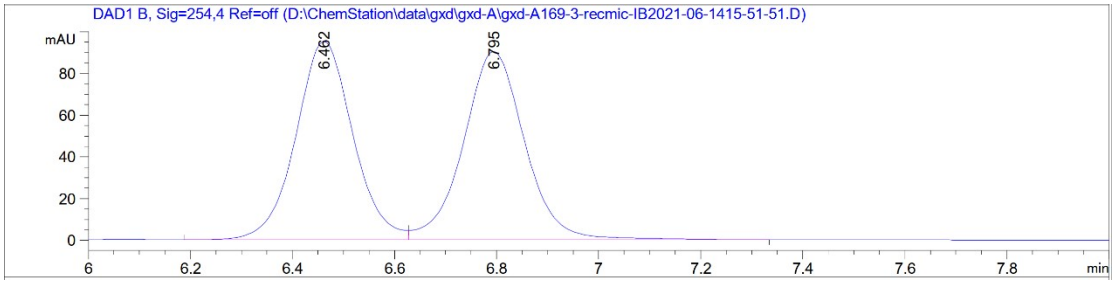


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.480	BV E	0.2079	308.00690	23.04514	1.3176
2	7.012	VB R	0.2572	2.30680e4	1469.01599	98.6824
Totals :				2.33760e4	1492.06113	

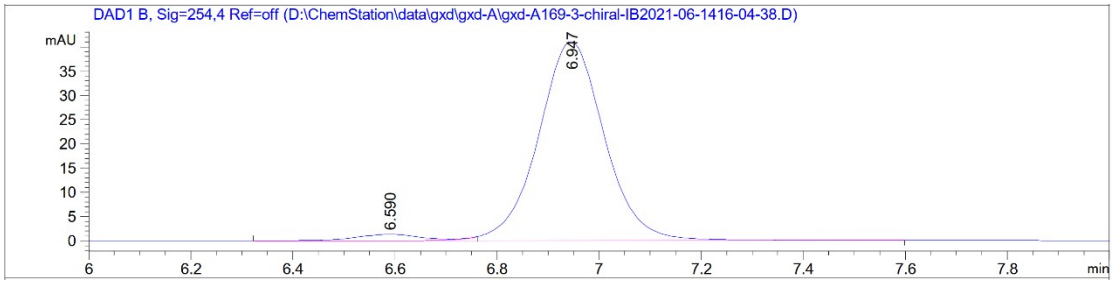
_(S)_-6-Fluoro-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3ej)





Signal 2: DAD1 B, Sig=254,4 Ref=off

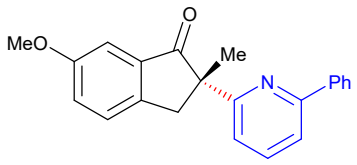
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.462	BV	0.1185	739.16156	95.31671	49.4419
2	6.795	VB	0.1276	755.84796	90.36465	50.5581
Totals :				1495.00952	185.68136	

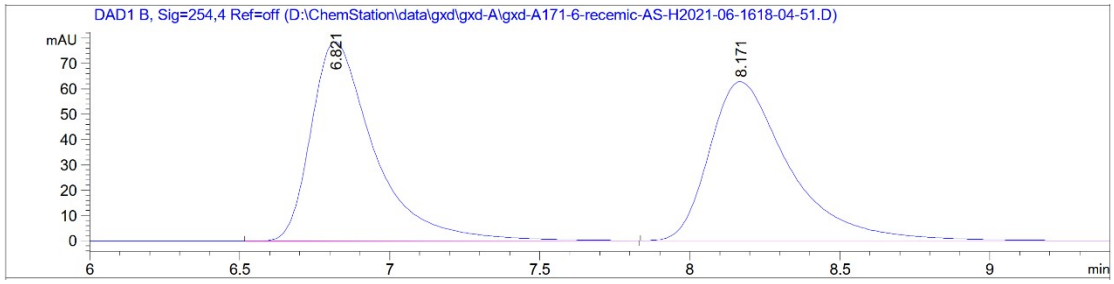


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.590	BV E	0.1333	11.57730	1.33330	3.0295
2	6.947	VB R	0.1371	370.57101	41.12797	96.9705
Totals :				382.14832	42.46127	

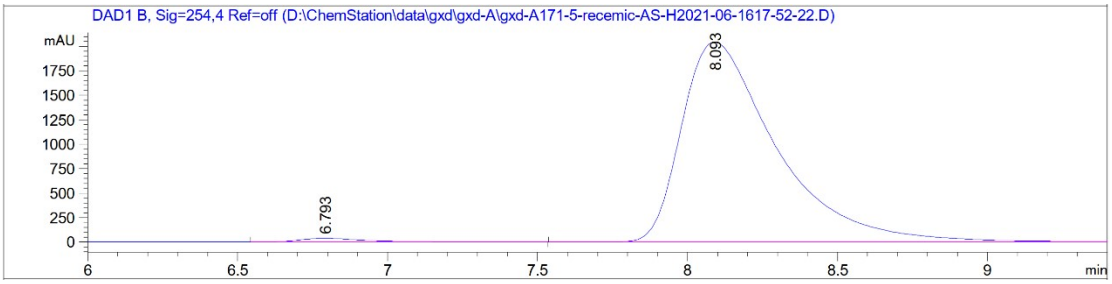
_(S)_-6-Methoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3fj)





Signal 2: DAD1 B, Sig=254,4 Ref=off

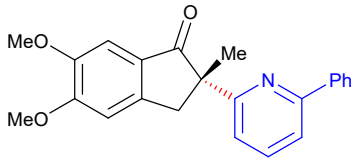
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.821	BB	0.2187	1151.40369	78.69646	49.7414
2	8.171	BBA	0.2783	1163.37805	62.74682	50.2586
Totals :				2314.78174	141.44328	

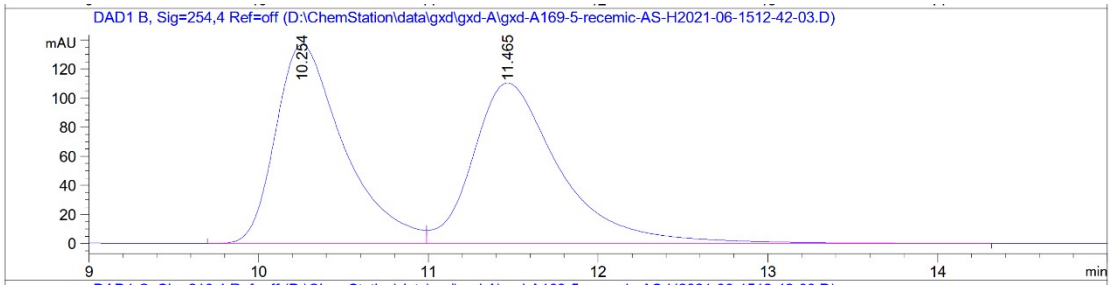


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.793	BB	0.2238	578.56732	38.39893	1.2694
2	8.093	BBA	0.3292	4.49993e4	2041.42151	98.7306
Totals :				4.55778e4	2079.82043	

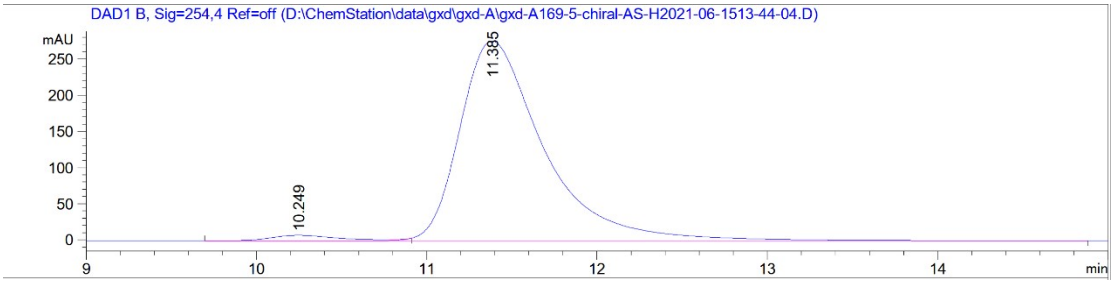
(*S*)-5,6-Dimethoxy-2-methyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3gj)





Signal 2: DAD1 B, Sig=254,4 Ref=off

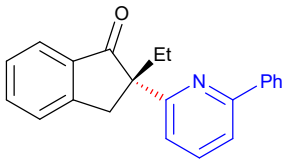
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.254	BV	0.4136	3818.44409	136.83629	49.2807
2	11.465	VB	0.5292	3929.90967	110.41638	50.7193
Totals :				7748.35376	247.25267	

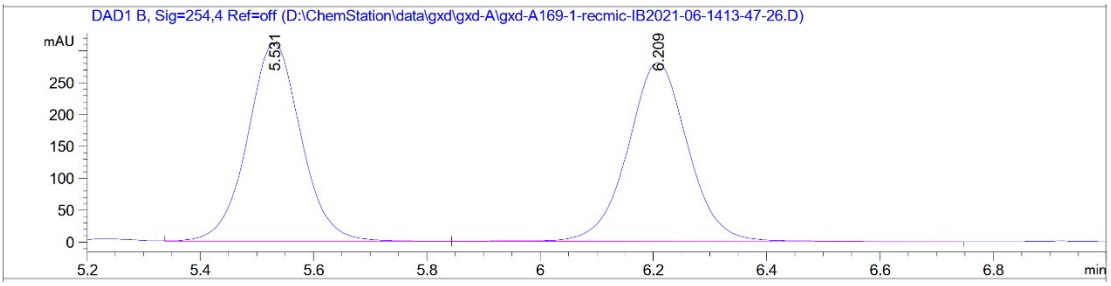


Signal 2: DAD1 B, Sig=254,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.249	BV E	0.4030	206.90015	7.61542	2.1337
2	11.385	VB R	0.5129	9490.00586	276.14899	97.8663
Totals :				9696.90601	283.76441	

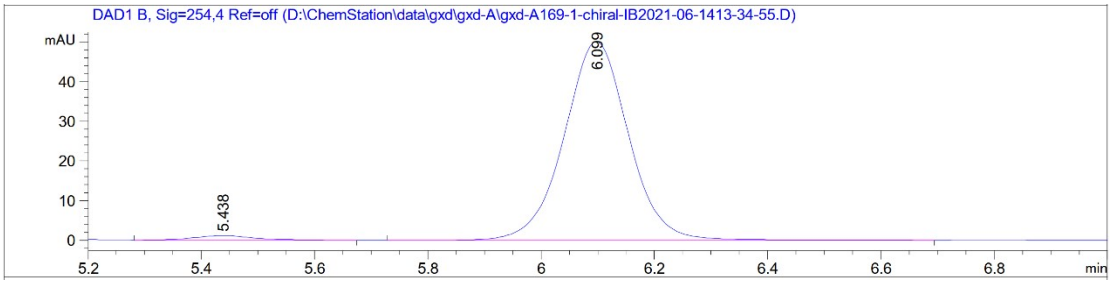
_(S)_-2-Ethyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1_H_-inden-1-one (3hj)





Signal 2: DAD1 B, Sig=254,4 Ref=off

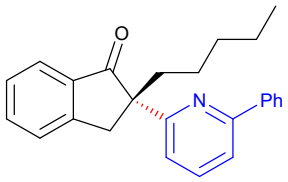
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.531	VB	0.1004	2043.91663	312.20636	49.6049
2	6.209	BB	0.1123	2076.47192	280.77417	50.3951
Totals :				4120.38855	592.98053	

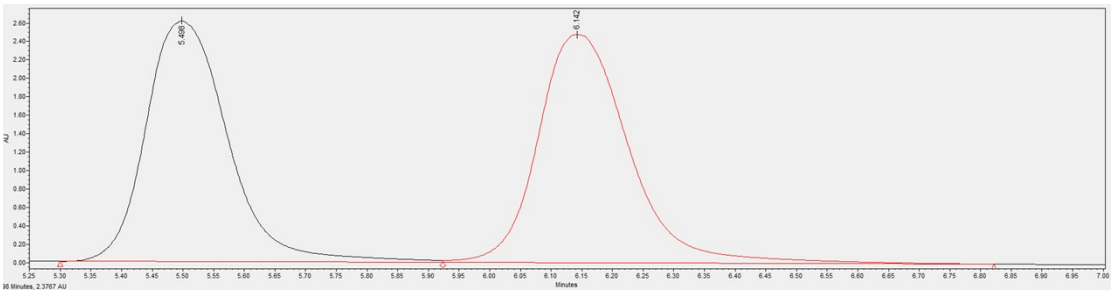


Signal 2: DAD1 B, Sig=254,4 Ref=off

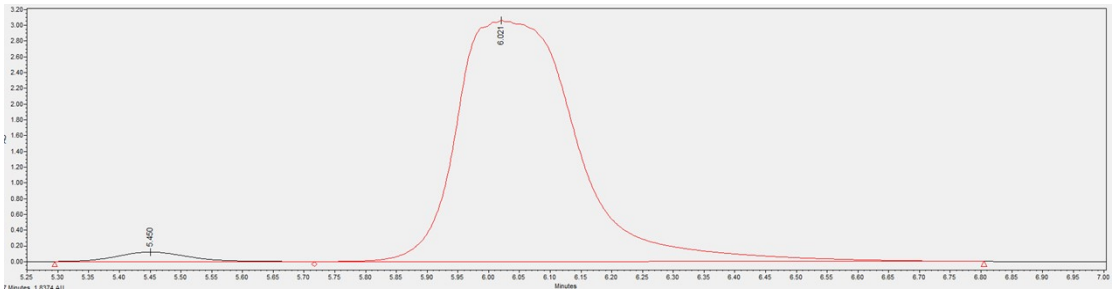
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.438	BB	0.1110	8.62617	1.15735	2.1237
2	6.099	BB	0.1203	397.56201	50.24480	97.8763
Totals :				406.18819	51.40214	

(*S*)-2-Pentyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3ij)



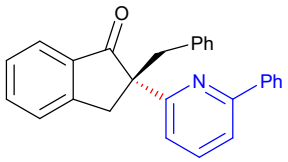


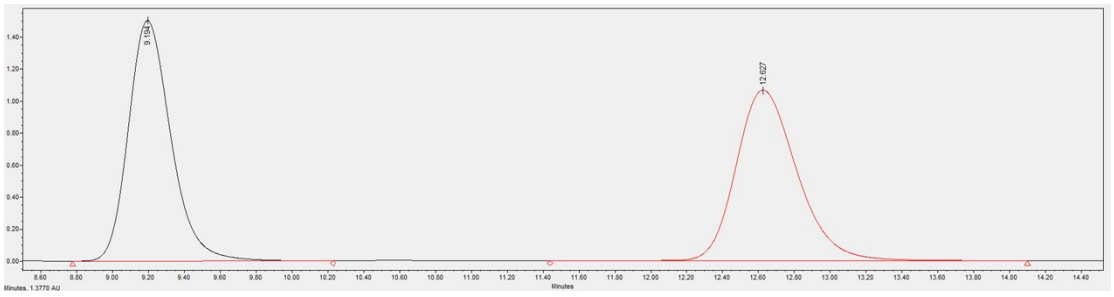
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.498	24329177	48.77	2615356	bV			Unknown	
2		6.142	25560858	51.23	2478961	Vb			Unknown	



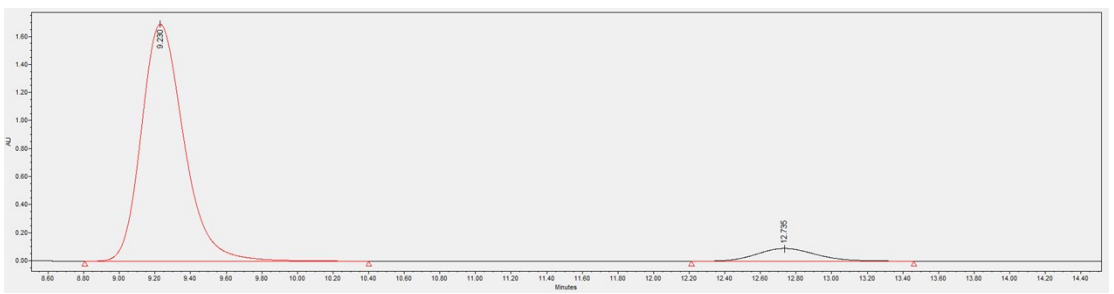
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.450	936206	2.22	119622	bV			Unknown	
2		6.021	41177537	97.78	3056543	Vb			Unknown	

(*S*)-2-Benzyl-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3jj)



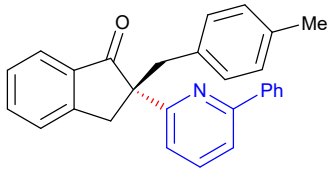


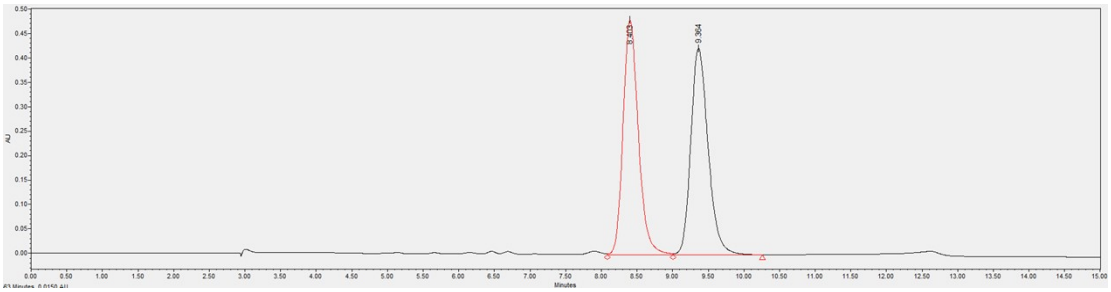
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		9.194	24719124	49.61	1502577	BV			Unknown	
2		12.627	25106996	50.39	1065585	VB			Unknown	



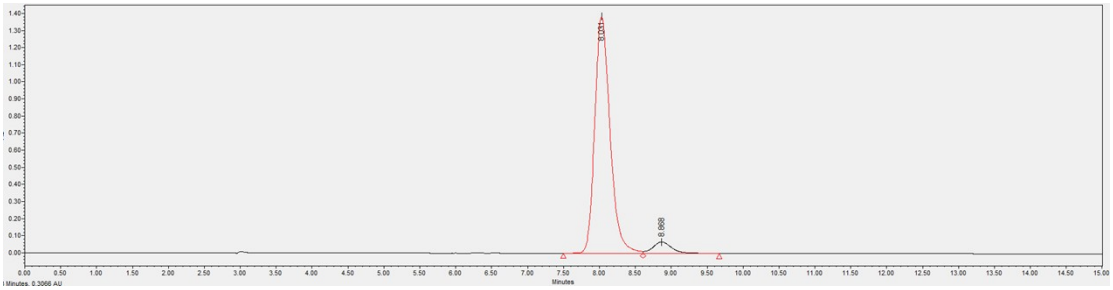
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		9.230	27958613	93.08	1689639	BB			Unknown	
2		12.735	2078262	6.92	90609	BB			Unknown	

***(S)*-2-(4-Methylbenzyl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3kj)**



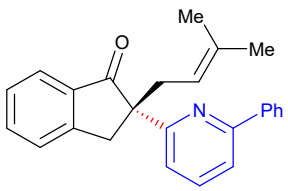


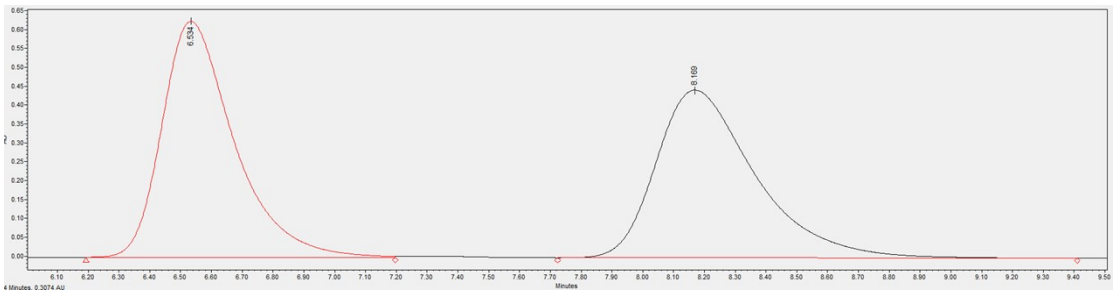
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.403	7143940	50.05	479441	VV			Unknown	
2		9.364	7130833	49.95	422598	VB			Unknown	



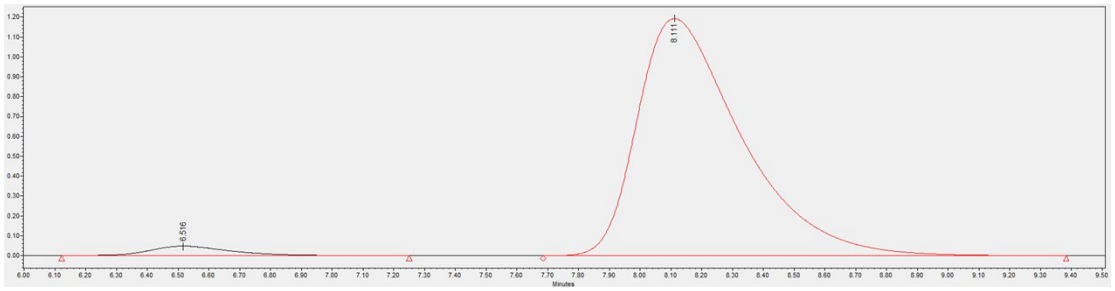
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.031	20506961	94.37	1382537	BV			Unknown	
2		8.868	1222570	5.63	67203	VB			Unknown	

***(S)*-2-(3-Methylbut-2-en-1-yl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3lj)**



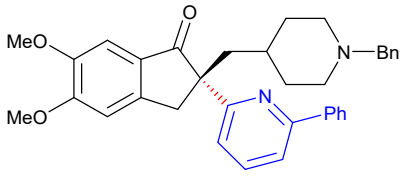


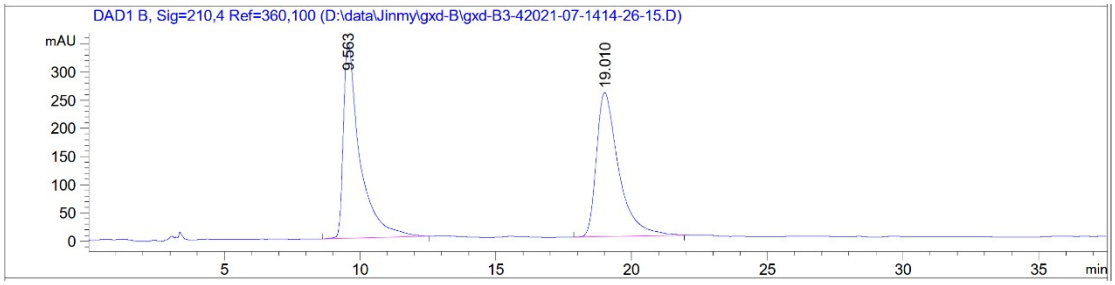
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		6.534	10201643	50.65	625024	bv			Unknown	
2		8.169	9939222	49.35	444309	VV			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		6.516	874052	3.02	47924	bB			Unknown	
2		8.111	28102742	96.98	1193638	Vb			Unknown	

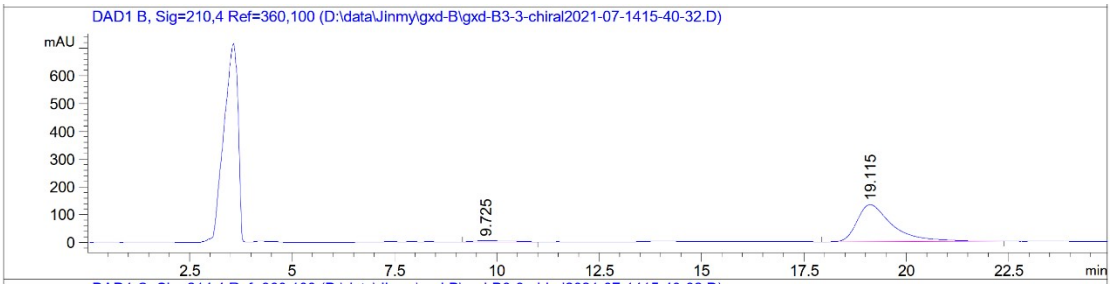
***(S)*-2-(3-Methylbut-2-en-1-yl)-2-(6-phenylpyridin-2-yl)-2,3-dihydro-1*H*-inden-1-one (3mj)**





Signal 2: DAD1 B, Sig=210,4 Ref=360,100

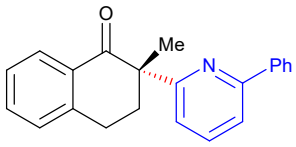
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.563	BB	0.5967	1.45413e4	347.10962	50.0761
2	19.010	BB	0.8443	1.44971e4	255.37648	49.9239
Totals :				2.90383e4	602.48610	

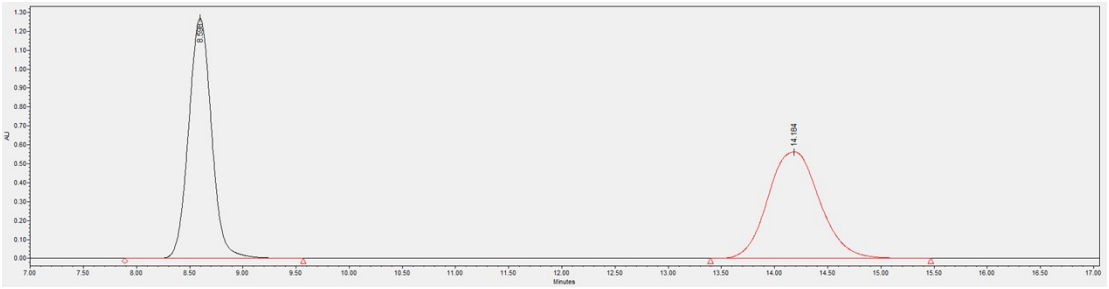


Signal 2: DAD1 B, Sig=210,4 Ref=360,100

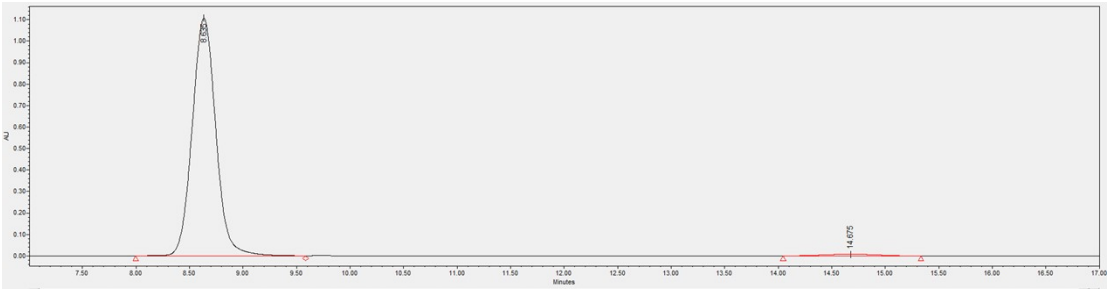
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.725	BB	0.7460	277.43982	4.99529	3.3527
2	19.115	BB	0.8877	7997.72998	133.35741	96.6473
Totals :				8275.16980	138.35270	

(*S*)-2-methyl-2-(6-phenylpyridin-2-yl)-3,4-dihydronaphthalen-1(2H)-one (3nj)



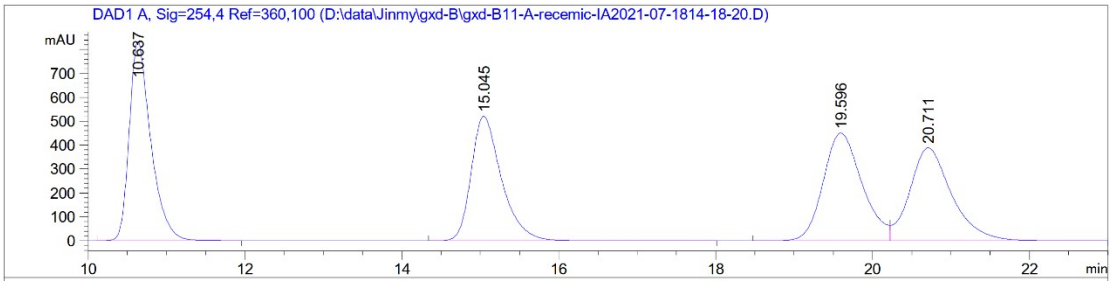


	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.598	18988496	49.95	1267747	VB			Unknown	
2		14.184	19026794	50.05	562907	BB			Unknown	



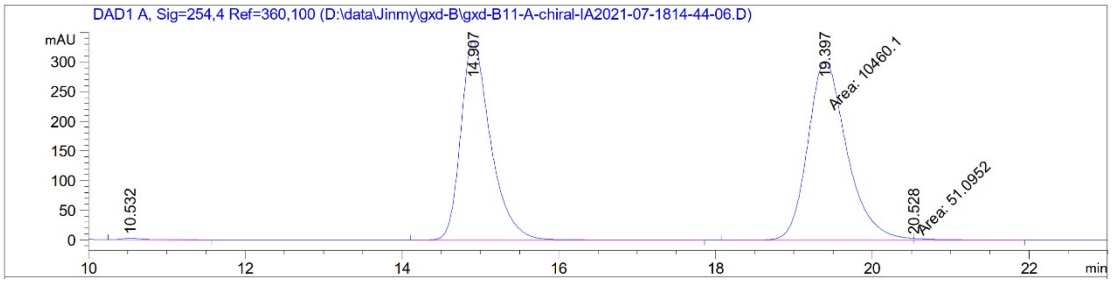
	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		8.635	16948574	98.46	1105794	BV			Unknown	
2		14.675	265572	1.54	7718	BB			Unknown	

(2*S*)-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-2,3-dihydro-1*H*-inden-1-ol (4)



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

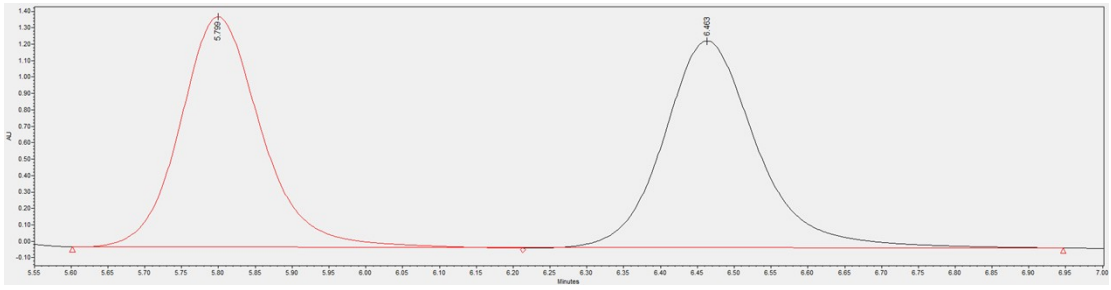
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.637	BB	0.2843	1.58784e4	833.23743	26.5509
2	15.045	BB	0.4036	1.39944e4	520.69348	23.4006
3	19.596	BV	0.5234	1.55026e4	450.58401	25.9225
4	20.711	VB	0.5533	1.44283e4	388.51685	24.1260
Totals :				5.98037e4	2193.03177	



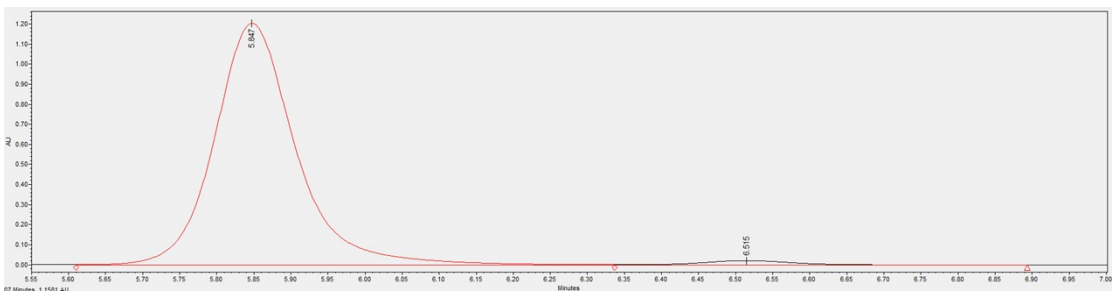
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.532	BB	0.2751	47.65583	2.58524	0.2454
2	14.907	BB	0.3984	8859.19629	335.13831	45.6234
3	19.397	MF	0.5765	1.04601e4	302.42783	53.8680
4	20.528	FM	0.2973	51.09517	2.86405	0.2631
Totals :				1.94181e4	643.01542	

(2*S*)-2-Methyl-2-(6-(naphthalen-2-yl)pyridin-2-yl)-1-phenyl-2,3-dihydro-1*H*-inden-1-ol (5)

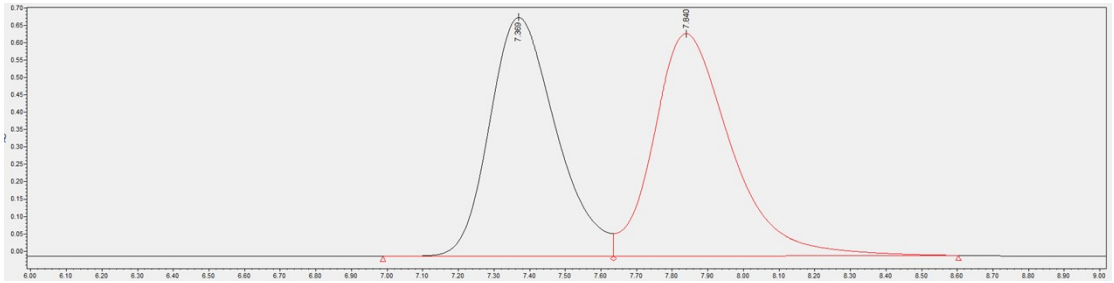


	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.799	10755429	49.24	1401545	bV			Unknown	
2		6.463	11085257	50.76	1258041	Vb			Unknown	

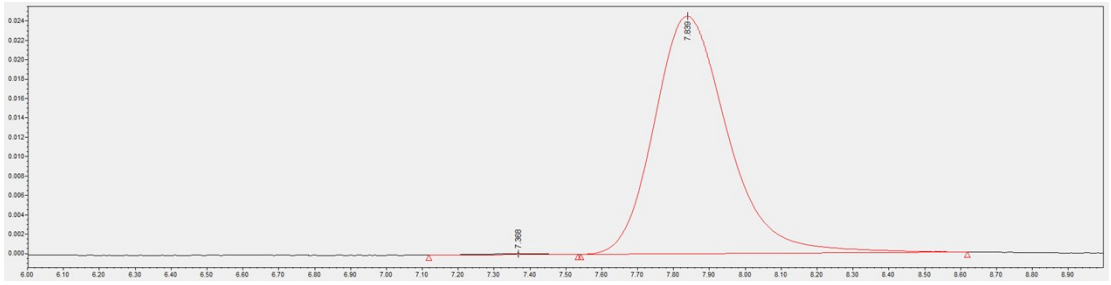


	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		5.847	9205800	97.98	1202844	VV			Unknown	
2		6.515	189746	2.02	21723	VB			Unknown	

(*R*)-2-(2-Methyl-1-methylene-2,3-dihydro-1*H*-inden-2-yl)-6-(naphthalen-2-yl)pyridine (6)



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		7.369	8912264	48.17	685849	BV			Unknown	
2		7.840	9591017	51.83	639017	Vb			Unknown	



	Name	Retention Time (min)	Area (μV*sec)	% Area	Height (μV)	Int Type	Amount	Units	Peak Type	Peak Codes
1		7.368	1216	0.35	129	bb			Unknown	
2		7.839	347750	99.65	24532	Bb			Unknown	