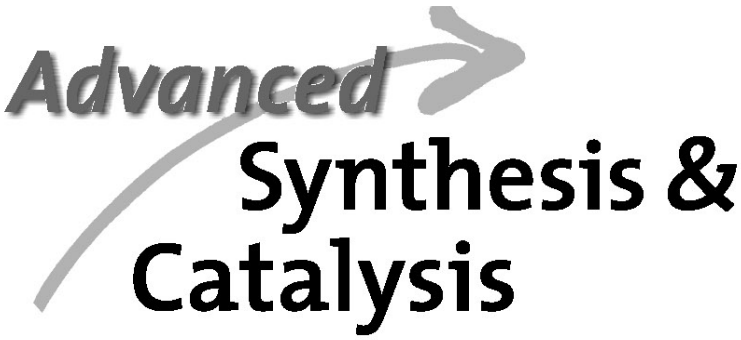

Supporting Information

SUPPORTING INFORMATION

Catalytic enantioselective addition of alkyl Grignard reagents to aliphatic aldehydes

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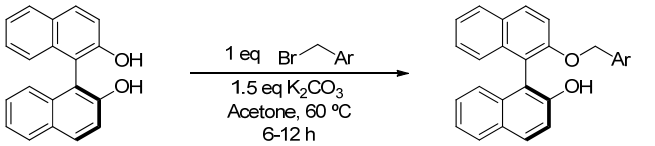
General Procedures: Chromatography: Panreac silica gel 60, 40-63 microns RE, TLC: Machery-Nagel silica gel 60, 0.20 mm. Components were visualized by UV and phosphomolibdic acid staining. Progress of the reaction and conversion were determined by GC analysis (Agilent Technologies 7820A GC System) with a CP-Chiralsil-DEX CB (Varian, 25 m × 0.25 mm) or HP-CHIRAL-20β (Agilent Technologies, 30 m × 0.25 mm) column; injector and detector temperatures: 250 °C. Mass spectra were recorded on a GC-MS spectrometer (Agilent Technologies 6890N Network GC System) with a HP-5MS column (Agilent technologies, 30 m × 0.25 mm), including an Agilent Technologies 5973 Network Mass Selective Detector. ^{1}H- and ^{13}C-NMR were recorded on a *Bruker AC-300* (300 and 75 MHz, respectively) or a *Bruker Avance-400* (400 and 101 MHz, respectively) using $CDCl_3$ as solvent. Chemical shift values are reported in ppm with TMS as internal standard ($CDCl_3$: δ 7.26 for ^{1}H-NMR, δ 77.0 for ^{13}C-NMR). Data are reported as follows: chemical shifts, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, quintuplet = quin, sextuplet = sext, br = broad, m = multiplet), coupling constants (Hz), and integration. Optical rotations were measured on a *Jasco P-1030 Polarimeter* with a 5 cm cell (*c* given in g/100 mL). IR Spectra were recorded on *Jasco FT/IR – 4100* Fourier Transform Infrared Spectrometer. Melting points were measured in a *Reichtert Thermovar* hot plate apparatus and are corrected. Enantioselectivities were determined by HPLC analysis (*Agilent 1100 Series* HPLC) equipped with a G1315B diode array detector and a Quat Pump G1311A or GC analysis (Agilent technologies 7820A GC System) using N_2 as a carrier gas.

All reactions were carried out under argon atmosphere unless noted, using flame dried glassware. $Ti(OPr^{i})_4$ not dry was purchase from Aldrich and was stored under argon atmosphere. MeMgBr (3 M in Et_2O) and EtMgBr (3M in Et_2O), were purchased from Aldrich and were used without further purification. *n*-BuMgBr (3.0 M in Et_2O) was prepared from 1-bromobutane and magnesium turnings in Et_2O following standard procedures. Grignard reagents were titrated using *s*-BuOH and catalytic amounts of 1,10-phenanthroline in THF. Aldehydes were purified by washing with 10% aq. $NaHCO_3$ (3 × 5 mL), dried over hot magnesium sulfate and finally were distilled by Kugelrohr aparatus (*Büchi Glass Oven B-585*) and used immediately. Racemic alcohols were synthesized by reaction of the corresponding aldehyde (1.0 mmol) and RMgX (1.5 mmol) in THF at 0 °C.

1. Synthesis of ligands L1–7

1.1 Step 1: Synthesis of monobenzylated (*S*)-BINOL derivatives (*S*)-P1–7

The intermediates (*S*)-**P1–7** were prepared starting from commercially available (*S*)-BINOL or (*S*)-8H-BINOL according to two different procedures:



Ar = C_6H_5, (*S*)-**P1**
Ar = 4-C_5H_4N, (*S*)-**P2**
Ar = 2-C_5H_4N, (*S*)-**P3**
Ar = *o*-OMe-C_6H_5, (*S*)-**P4**
Ar = *m*-OMe-C_6H_5, (*S*)-**P5**
Ar = *p*-OMe-C_6H_5, (*S*)-**P6**
Ar = 1-Naphtyl, (*S*)-**P7**

Scheme 1

Procedure A:[1] Synthesis of (*S*)-**P1**, (*S*)-**P4**, (*S*)-**P5**, (*S*)-**P6**, (*S*)-**P7** and (*S*)-(*8H*)-**P1**

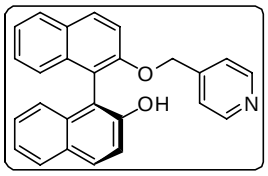
(*S*)-BINOL (2 g, 7 mmol) or (*S*)-8H-BINOL (2.1 g, 7.0 mmol) was dissolved in 50 mL of acetone in a round bottom flask, then K_2CO_3 (1.45 g, 10.5 mmol, 1.5 eq.) and the corresponding benzyl bromide derivative (*Ar*CH_2Br, 7 mmol, 1 eq) were added and the mixture was heated at 60 °C during 6 h. The reaction crude was concentrated under vacuum and was extracted with EtOAc (3 × 15 mL). The combined organic layers were dried over magnesium sulfate and concentrated under vacuum. Synthetic intermediates **P** were used in the next step without further purification, Data of the products were in accordance with the previously reported in literature.[2]

[1] Bremmer, J. B.; Keller, P. A.; Pyne, S. G.; Boyle, T. P.; Brkic, Z.; Morgan, J.; Rhodes, D. I. *Bioorgan. Med. Chem.* **2010**, *18*, 4793–4800.
[2] (a) Fernández-Mateos, E.; Maciá, B.; Ramón, D. J.; Yus, M. *Eur. J. Org. Chem.*, **2011**, *34*, 6851–6855. (b) Gao, G.; Gu, F.-L.; Jiang, J.-X.; Jiang, K.; Sheng, C.-Q.; Lai, G.-Q.; Xu, L.-W. *Chem. Eur. J.*, **2011**, *17*, 2698.

Procedure B: Synthesis of (*S*)-**P2** and (*S*)-**P3**.

(*S*)-BINOL (2 g, 7 mmol) was dissolved in 40 mL of acetone in a round bottom flask and a solution of K_2CO_3 (2.9 g, 21.0 mmol, 3 eq.) in 4 mL of water was added. Next, the corresponding (bromomethyl)pyridinium bromide (7 mmol, 1 eq.) was added and the mixture was heated at 65 °C during 12 h. The reaction crude was filtered under vacuum over celite, washing the cake with EtOAc (3 × 50 mL) and solvent was evaporated under vacuum. The hydroxyether (*S*)-**P2** was purified by flash silica gel chromatography while the synthetic intermediate (*S*)-**P3** was used in the next step without further purification.

1.2 Data of the precursor (*S*)-P2



(*S*)-2'-(pyridin-4-ylmethoxy)-(1,1'-binaphthalen)-2-ol [(*S*)-**P2**]**:** Compound (*S*)-**P2** was obtained after purification on flash silica gel chromatography from 100:0 till 0:100 (Hexane/EtOAc) as a white powder (66% yield) and was recrystallized in Hexane/EtOAc , m.p. 182–184 °C, $[\alpha]_D^{20}$= -17.5 (*c* 1.0, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (br d, *J* = 4.5 Hz, 2H), 7.97 (d, *J* = 9.0 Hz, 1H), 7.91 (d, *J* = 8.9 Hz, 1H), 7.87 (d, *J* = 7.8 Hz, 2H), 7.42 – 7.34 (m, 3H), 7.34 – 7.26 (m, 3H), 7.21 (ddd, *J* = 8.1, 6.8, 1.3 Hz, 1H), 7.06 (d, *J* = 8.4 Hz, 1H), 6.85 (br d, *J* = 5.2 Hz, 2H), 5.08 (d, *J* = 13.9 Hz, 1H), 5.03 (d, *J* = 13.8 Hz, 1H), 3.18 (br s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 154.3, 151.6, 148.9, 146.9, 134.0, 133.8, 130.9, 129.9, 129.1, 128.2, 127.5, 126.5, 125.2, 124.7, 123.3, 121.2, 117.7, 115.4, 114.8, 69.4. IR (ATR): ν (cm^{-1}): 3064, 1610, 1504, 1325, 1264, 1044, 798. LRMS (EI) *m/z*: 379 (M^++2, 5), 378 (M^++1, 28), 377 (M^+, 100), 286 (14), 285 (47), 284 (10), 269 (11), 268 (38), 257 (15), 255 (19), 240 (17), 239 (42), 229 (28), 228 (37), 227 (20), 226 (37), 93 (22), 80 (49). HRMS calculated for $C_{26}H_{19}NO_2$ 377.1416, found 377.1404.

1.3 Step 2: Synthesis of Ar-BINMOLs derivatives L1–7

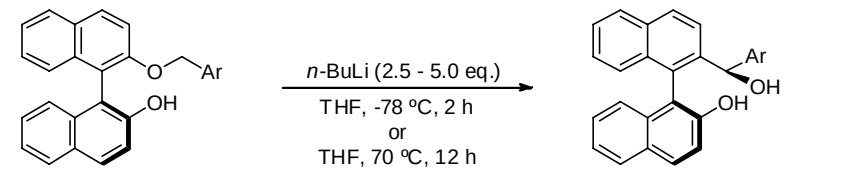
Two different procedures were used to synthesize compounds **L1–7** through a [1,2]-Wittig rearrangement from the corresponding hydroxyethers (*S*)-**P1–7**.

Procedure A: Synthesis of (*S*)-**L1** and (*S*)-**L4–7**

n-BuLi (2.5 M in hexane, 2.5 eq) was slowly added to a solution of the corresponding precursor (*S*)-**P1** or (*S*)-**P4–7** (4 mmol) in dry THF (30 mL) at -78 °C. The mixture was stirred for 2 h at -78 °C and then quenched with water at 0 °C. The resulting mixture was extracted with EtOAc (3 × 10 mL), and the combined organic layers were washed with brine, dried over magnesium sulfate and concentrated under vacuum. The crude product was purified by chromatography on flash silica gel to give the desired products. Data of the products was in accordance with the previously reported in the literature.

Procedure B: Synthesis of (*S*)-**L2–3** and (*S*)-(*8H*)-**L1**

n-BuLi (2.5 M in hexane, 5.0 eq) was slowly added to a solution of the corresponding precursor (*S*)-**P2–3** or (*S*)-(*8H*)-**P1** (4 mmol) in dry THF (40 mL) at room temperature. The mixture was stirred for 12 h at 70 °C and then the reaction was quenched with water at 0 °C. The resulting mixture was extracted with EtOAc (3 × 15 mL) and the combined organic layers were dried over magnesium sulfate and concentrated under vacuum. The crude product was purified by chromatography on flash silica gel to give the desired products (S_a,*R*)-**L2–3** and (S_a,*R*)-(*8H*)-**L1**.

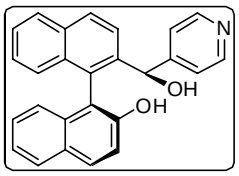


Ar = C_6H_5, (*S*)-**P1**
Ar = 4-C_5H_4N, (*S*)-**P2**
Ar = 2-C_5H_4N, (*S*)-**P3**
Ar = *o*-OMe-C_6H_5, (*S*)-**P4**
Ar = *m*-OMe-C_6H_5, (*S*)-**P5**
Ar = *p*-OMe-C_6H_5, (*S*)-**P6**
Ar = 1-Naphtyl, (*S*)-**P7**

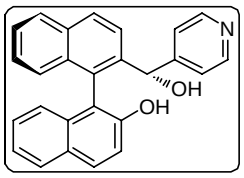
Ar = C_6H_5, (S_a,*R*)-**L1**
Ar = 4-C_5H_4N, (S_a,*R*)-**L2**
Ar = 2-C_5H_4N, (S_a,*S*)-**L3**
Ar = *o*-OMe-C_6H_5, (S_a,*S*)-**L4**
Ar = *m*-OMe-C_6H_5, (S_a,*R*)-**L5**
Ar = *p*-OMe-C_6H_5, (S_a,*R*)-**L6**
Ar = 1-Naphtyl, (S_a,*R*)-**L7**

Scheme 2

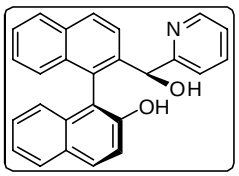
1.4 Data of the ligands L2–3, (S_a,*R*)-**L7** and (S_a,*R*)-(*8H*)-**L1**



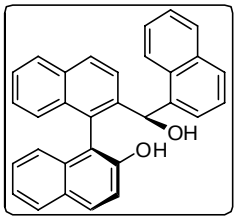
(S_a)-2'-[(*R*)-hydroxy(pyridin-4-yl)methyl]-(1,1'-binaphthalen)-2-ol [(S_a,*R*)-**L2**]**:** Compound (S_a,*R*)-**L2** was obtained after purification on flash silica gel chromatography from 100:0 till 20:80 (Hexane/EtOAc) as a yellow foamy solid (48% yield), m.p. 100–103 °C, $[\alpha]_D^{20}$ = +252 (*c* 1.0, $CHCl_3$). ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.20 (br d, *J* = 6.1 Hz, 2H), 7.93 – 7.78 (m, 4H), 7.44 (ddd, *J* = 8.1, 6.6, 1.4 Hz, 1H), 7.39 – 7.23 (m, 4H), 7.23 – 7.15 (m, 2H), 6.99 (br d, *J* = 5.8 Hz, 2H), 6.89 (d, *J* = 8.4 Hz, 1H), 5.65 (s, 1H), 3.56 (br s, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 152.9, 151.8, 148.3, 139.9, 134.2, 133.5, 132.9, 131.5, 130.3, 129.6, 128.9, 128.2, 128.1, 126.9, 126.7, 126.6, 125.0, 124.7, 123.7, 121.5, 118.2, 117.2, 72.1. IR (ATR): ν (cm^{-1}): 3297, 3055, 1606, 1506, 1342, 813, 747. LRMS (EI) *m/z*: 378 (M^++1, 3), 377 (M^+, 9), 360 (27), 359 (100), 358 (36), 282 (21), 281 (91), 279 (25), 252 (25), 239 (16), 140 (9), 78 (5). HRMS calculated for $C_{26}H_{19}NO_2$ 377.1416, found 377.1386.



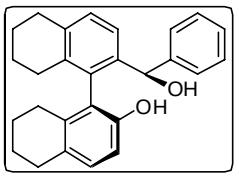
(R_a)-2'-[(*S*)-hydroxy(pyridin-4-yl)methyl]-(1,1'-binaphthalen)-2-ol [(R_a,*S*)-**L2**]**:** Compound (R_a,*S*)-**L2** was obtained after purification on flash silica gel chromatography from 100:0 till 20:80 (Hexane/EtOAc) as a yellow foamy solid (33% yield, two steps), m.p. 100–103 °C, $[\alpha]_D^{20}$ = -273 (*c* 1.0, $CHCl_3$). ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.15 (d, *J* = 6.2 Hz, 2H), 7.95 – 7.73 (m, 4H), 7.42 (ddd, *J* = 8.1, 6.5, 1.6 Hz, 1H), 7.36 – 7.26 (m, 3H), 7.25 – 7.13 (m, 3H), 6.97 (d, *J* = 5.8 Hz, 2H), 6.90 (d, *J* = 8.3 Hz, 1H), 5.64 (s, 1H), 3.56 (br s, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 152.8, 152.0, 148.3, 139.8, 134.2, 133.4, 132.9, 131.8, 130.2, 129.4, 128.9, 128.2, 128.1, 126.8, 126.8, 126.5, 125.0, 124.8, 123.6, 121.5, 118.3, 117.3, 72.1. IR (ATR): ν (cm^{-1}): 3297, 3055, 1606, 1506, 1342, 813, 747. LRMS (EI) *m/z*: 378 (M^++1, 3), 377 (M^+, 9), 360 (27), 359 (100), 358 (36), 282 (21), 281 (90), 279 (26), 252 (25), 239 (16), 140 (9), 78 (4). HRMS calculated for $C_{26}H_{19}NO_2$ 377.1416, found 377.1435.



(S_a)-2'-[(*S*)-hydroxy(pyridin-2-yl)methyl]-(1,1'-binaphthalen)-2-ol [(S_a,*S*)-**L3**]**:** Compound (S_a,*S*)-**L3** was obtained after purification on flash silica gel chromatography from 100:0 till 20:80 (Hexane/EtOAc) as a yellow foamy solid (40% yield), m.p. 83–85 °C, $[\alpha]_D^{20}$ = +251 (*c* 1.0, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (br d, *J* = 4.6 Hz, 1H), 7.96 – 7.84 (m, 4H), 7.45 (m, 3H), 7.39 – 7.30 (m, 2H), 7.29 – 7.16 (m, 3H), 7.15 – 7.09 (m, 1H), 6.99 (d, *J* = 8.4 Hz, 1H), 6.68 (d, *J* = 7.9 Hz, 1H), 5.66 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.5, 152.1, 147.2, 140.7, 137.0, 134.2, 133.5, 133.0, 130.8, 130.2, 129.7, 129.0, 128.3, 128.1, 126.9, 126.7, 126.6, 125.2, 124.9, 123.4, 122.5, 122.0, 118.8, 116.9, 71.7. IR (ATR): ν (cm^{-1}): 3248, 3057, 1594, 1434, 1038, 816, 746. LRMS (EI) *m/z*: 378 (M^+ + 1, 26), 377 (M^+, 90), 360 (16), 359 (54), 358 (11), 332 (22), 331 (96), 330 (100), 329 (11), 328 (16), 282 (19), 281 (79), 280 (11), 279 (30), 268 (15), 254 (14), 253 (45), 252 (53), 250 (19), 240 (11), 239 (36), 237 (11), 164 (10), 109 (14), 80 (24), 79 (12), 78 (19). HRMS calculated for $C_{26}H_{19}NO_2$ 377.1416, found 377.1441.



(S_a)-2'-[(*R*)-hydroxy(naphthalen-1-yl)methyl]-(1,1'-binaphthalen)-2-ol [(S_a,*R*)-**L7**]**:** Compound (S_a,*R*)-**L7** was obtained after purification on flash silica gel chromatography from 100:0 till 80:20 (Hexane/EtOAc) as a yellow foamy solid (72% yield), m.p. 105–108 °C, $[\alpha]_D^{20}$ = +330 (*c* 1.0, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (t, *J* = 6.8 Hz, 2H), 7.81 (t, *J* = 6.9 Hz, 2H), 7.75 (d, *J* = 8.7 Hz, 1H), 7.69 (d, *J* = 8.2 Hz, 2H), 7.48 – 7.41 (m, 2H), 7.37 (ddd, *J* = 8.1, 6.9, 1.1 Hz, 1H), 7.34 – 7.27 (m, 3H), 7.27 – 7.21 (m, 4H), 7.13 (d, *J* = 8.3 Hz, 1H), 6.91 (ddd, *J* = 8.3, 6.9, 1.1 Hz, 1H), 6.40 (s, 1H), 3.45 (br s, 1H), 1.60 (br s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.9, 140.1, 137.5, 133.8, 133.6, 133.4, 133.2, 131.4, 130.4, 129.8, 129.4, 128.4, 128.3, 128.1, 127.9, 126.8, 126.7, 126.5, 126.4, 125.6, 125.4, 125.3, 125.2, 124.9, 123.8, 123.7, 123.4, 118.6, 118.1, 71.6. IR (ATR): ν (cm^{-1}): 3227, 3051, 1621, 1508, 1268, 783, 748. LRMS (EI) *m/z*: 426 (M^+, 2), 409 (33), 408 (100), 407 (15), 380 (27), 379 (14), 282 (18), 281 (80), 280 (10), 279 (18), 252 (19), 239 (16), 127 (14). HRMS calculated for $C_{31}H_{22}O_2$ 426.1620, found 426,1609.



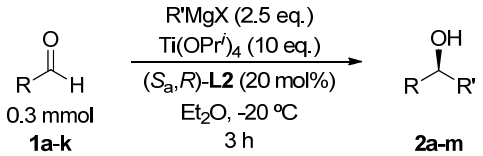
(S_a)-2'-[(*R*)-hydroxy(phenyl)methyl]-5,5',6,6',7,7',8,8'-octahydro-(1,1'-binaphthalen)-2-ol [(S_a,*R*)-(*8H*)-**L1**]**:** Compound (S_a,*R*)-(*8H*)-**L1** was obtained after purification on flash silica gel chromatography from 100:0 till 80:20 (Hexane/EtOAc) as a yellow foamy solid (53% yield), m.p. 74–77 °C, $[\alpha]_D^{20}$ = +90 (*c* 1.0, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.0 Hz, 1H), 7.24 – 7.17 (m, 3H), 7.14 (d, *J* = 8.0 Hz, 1H), 7.11 – 7.06 (m, 2H), 7.01 (d, *J* = 8.3 Hz, 1H), 6.81 (d, *J* = 8.3 Hz, 1H), 5.43 (s, 1H), 4.96 (br s, 1H), 2.80 (t, *J* = 6.0 Hz, 3H), 2.69 (dd, *J* = 13.3, 6.7 Hz, 2H), 2.19 (dd, *J* = 14.2, 6.1 Hz, 2H), 1.99 – 1.89 (m, 1H), 1.80 – 1.50 (m, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 149. 8, 142.7, 139.9, 137.8, 136.5, 136.1, 133.6, 129.8, 129.7, 129.6, 128.1, 127.3, 126.8, 124.7, 124.3, 113.1, 73.5, 29.9, 29.2, 27.4, 27.2, 23.2, 22.9, 22.8, 22.7. IR (ATR): ν (cm^{-1}): 3337, 2927,

1591, 1448, 1018, 808, 698. LRMS (EI) *m/z*: 384 (M^+, <1), 367 (28), 366 (100), 365 (11), 338 (9), 289 (36), 275 (27), 235 (8), 105 (11), 77 (7). HRMS calculated for $C_{27}H_{28}O_2$ 384.2089, found 384, 2057.

2. Synthesis of chiral secondary alcohols 2a–m

2.1 Methodology

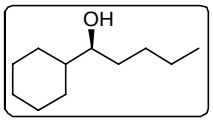
In a flame dried Schlenk tube, (S_a,*R*)-**L2** (22.6 mg, 0.06 mmol) was dissolved in dry Et_2O (2.5 mL) under argon atmosphere. The solution was cooled down to -20 °C and $Ti(OPr^i)_4$ (915 μL, 3.0 mmol, 10 eq.) was added. Five minutes later, RMgBr (0.75 mmol, 2.5 eq.) was added. After stirring the mixture for additional 15 min, the corresponding previously purified aldehyde (0.3 mmol) was added and the reaction mixture was stirred at -20 °C for 3 h. The reaction was quenched with water (5 mL), and $HCl_{(aq)}$ 2M (5 mL). The mixture was extracted with Et_2O (3 × 10 mL), the combined organic layers were neutralized with $NaHCO_{3(aq)}$ solution (15 mL), dried over magnesium sulfate and concentrated under vacuum. The crude product was purified by chromatography on flash silica gel to give the desired products **2a**–**m**.



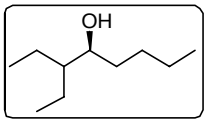
Scheme 3

Ligand (S_a,*R*)-**L2** could be recovered by acid-base extraction (60% yield) and reused in the reaction of MeMgBr with 3-Phenylpropanal (**1g**) to give compound **2g** without any loss of activity (80% yield, 85% *ee*).

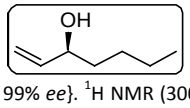
2.2 Data of the products 2a–m



(*S*)-1-cyclohexylpentan-1-ol (2a):[3] Compound **2a** was obtained after purification on flash silica gel chromatography from 100:0 till 92:8 (Hexane/EtOAc) as a yellow oil (97% yield, 90% *ee*); $[\alpha]_D^{20}$ = -15.4 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = +14.3 (*c* 1.9, $CHCl_3$) for 90% *ee* of *R* enantiomer}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.41 – 3.29 (m, 1H), 1.86 – 1.71 (m, 3H), 1.71 – 1.57 (m, 3H), 1.55 – 0.96 (m, 12H), 0.91 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 76.2, 43.5, 33.8, 29.3, 28.1, 27.7, 26.6, 26.4, 26.2, 22.8, 14.1. LRMS (EI) *m/z*: 170 (M^+, <1), 152 (8), 113 (44), 95 (100), 87 (45), 82 (17), 69 (90), 67 (19), 57 (13), 55 (22). *Ee* determination by chiral GC analysis, CP-Chiralsil-DEX CB column, T = 120 °C, P = 14.3 psi, retention times: t_r(*S*) = 21.6 min (major enantiomer), t_r(*R*) = 23.3 min.



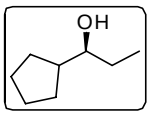
(-)-3-ethyloctan-4-ol (2b):[3] Compound **2b** was obtained after purification on flash silica gel chromatography from 100:0 till 94:6 (Hexane/EtOAc) as a colorless oil (97% yield, 80% *ee*); $[\alpha]_D^{20}$ = -10.6 (*c* 1.0, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.61 (dt, *J* = 8.1, 4.0 Hz, 1H), 1.44 (m, 6H), 1.38 – 1.24 (m, 5H), 1.23 – 1.14 (m, 1H), 0.96 – 0.86 (m, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 73.2, 46.8, 33.7, 28.5, 22.8, 22.1, 21.1, 14.1, 11.9, 11.8. LRMS (EI) *m/z*: 158 (M^+, <1), 101 (17), 87 (47), 86 (15), 83 (11), 70 (17), 69 (100), 59 (18), 57 (15), 55 (15). *Ee* was determined by chiral GC analysis on the derivative **3b**.



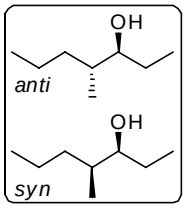
(*S*)-hept-1-en-3-ol (2c):[4] Compound **2c** was obtained after purification on flash silica gel chromatography from 100:0 till 90:10 (Pentane/Et_2O) as a colorless oil (53% yield, 96% *ee*); $[\alpha]_D^{20}$ = +14.2 (*c* 0.9, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = +9.0 (*c* 1.0, $CHCl_3$) for 99% *ee*}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.94 – 5.80 (ddd, *J* = 16.7, 10.4, 6.3 Hz, 1H), 5.21 (dd, *J* = 17.2, 1.5 Hz, 1H), 5.13 – 5.06 (dd, *J* = 10.4, 1.4 Hz, 1H), 4.14 – 4.04 (qt, *J* = 6.3, 1.1 Hz, 1H), 1.90 (br s, 1H), 1.65 – 1.43 (m, 2H), 1.43 – 1.24 (m, 4H), 0.98 – 0.83 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 141.3, 114.5, 73.2, 36.7, 27.5, 22.6, 14.0. LRMS (EI) *m/z*: 114 (M^+, <1), 85 (9), 81 (7), 72 (21), 58 (6), 57 (100), 55 (8). *Ee* determination by chiral GC analysis, CP-Chiralsil-DEX CB column, T = 70 °C, P = 14.3 psi, retention times: t_r(*S*) = 18.1 min (major enantiomer), t_r(*R*) = 19.7 min.

[3] Seebach, D.; Kalinowski, H. O.; Bastani, B.; Crass, G.; Daum, H.; Doerr, H.; DuPreez, N. P.; Ehrig, V.; Langer, W. *Helv. Chim.* Acta **1977**, *60*, 301–325.

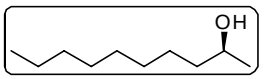
[4] Gawas, D.; Kazmaier, U. *Org. Biomol. Chem.* **2010**, 8, 457–462.



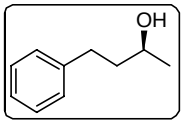
(+)-1-cyclopentylpropan-1-ol (2d):[5] Compound **2d** was obtained after purification on flash silica gel chromatography from 100:0 till 90:10 (Pentane/Et_2O) as a colorless oil (80% yield, 86% *ee*); $[\alpha]_D^{20}$ = +3.7 (*c* 1.2, $CHCl_3$). ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.40 – 3.30 (td, *J* = 8.0, 3.5 Hz, 1H), 1.99 – 1.75 (m, 2H), 1.73 – 1.49 (m, 8H), 1.48 – 1.32 (m, 2H), 0.98 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 77.4, 45.9, 29.1, 28.9, 28.5, 25.7, 25.6, 10.0. LRMS (EI) *m/z*: 128 (M^+, <1), 99 (42), 82 (8), 81 (100), 79 (10), 69 (10), 68 (20), 67 (14), 59 (81), 58 (21), 57 (13), 55 (9). *Ee* was determined by chiral GC analysis on the derivative **3d**.



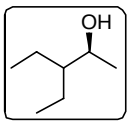
(3*S*,4*R*)-4-methylheptan-3-ol (2ea) and **(3*S*,4*S*)-4-methylheptan-3-ol (2eb):**[6] Compounds **2ea** and **2eb** were obtained as a diastereomeric mixture 43/57 after purification on flash silica gel chromatography from 100:0 till 90:10 (Pentane/Et_2O) as a colorless oil (78% yield, 77% *ee* and 87% *ee*, respectively). ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.42 (m, 1H), 3.35 (m, 1H), 1.05 – 1.60 (m, 16H), 0.87– 0.97 (m, 18H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 78.3, 77.6, 38.5, 35.5, 35.6, 34.1, 27.2, 26.2, 20.4, 20.3, 14.4, 14.3, 13.9, 13.5, 10.6, 10.4. LRMS (EI) *m/z*: 130 (M^+, <1), 101 (16), 83 (22), 70 (8), 59 (100), 58 (21), 57 (11), 55 (18). *Ee* was determined by chiral GC analysis on the derivatives **3ea** and **3eb**.



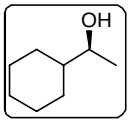
(*S*)-decan-2-ol (2f):[7] Compound **2f** was obtained after purification on flash silica gel chromatography from 100:0 till 94:6 (Hexane/EtOAc) as a colorless oil (98% yield, 88% *ee*); $[\alpha]_D^{20}$ = +6.2 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = +6.1 (*c* 1.0, $CHCl_3$) for 99% *ee*}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.86 – 3.73 (sext, *J* = 6.2 Hz, 1H), 1.72 (s, 1H), 1.53 – 1.37 (m, 3H), 1.36 – 1.22 (m, 11H), 1.19 (d, *J* = 6.2 Hz, 3H), 0.88 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 68.2, 39.3, 31.9, 29.6, 29.5, 29.3, 25.8, 23.4, 22.6, 14.1. LRMS (EI) *m/z*: 158 (M^+, <1), 143 (24), 140 (23), 112 (47), 111 (31), 98 (22), 97 (41), 85 (26), 84 (35), 83 (72), 82 (15), 71 (28), 70 (51), 69 (100), 67 (10), 57 (58), 56 (45), 55 (80). *Ee* was determined by chiral GC analysis on the derivative **3f**.



(*S*)-4-phenylbut-2-ol (2g):[8] Compound **2g** was obtained after purification on flash silica gel chromatography from 100:0 till 90:10 (Hexane/EtOAc) as a colorless oil (81% yield, 86% *ee*); $[\alpha]_D^{20}$ = +13.5 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = +13.8 (*c* 1.7, $CHCl_3$) for 79% *ee*}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.33 – 7.13 (m, 5H), 3.88 – 3.75 (sext, *J* = 6.2 Hz, 1H), 2.83 – 2.59 (m, 2H), 1.83 – 1.72 (m, 2H), 1.70 (s, 1H), 1.22 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 142.0, 128.4, 125.8, 67.4, 40.8, 32.1, 23.6. LRMS (EI) *m/z*: 151 (M^++1, 1), 150 (M^+, 10), 132 (52), 131 (9), 118 (10), 117 (100), 115 (9), 105 (10), 92 (34), 91 (75), 78 (20), 77 (13), 65 (12), 51 (7). *Ee* determination by chiral GC analysis, CP-Chiralsil-DEX CB column, T = 110 °C, P = 14.3 psi, retention times: t_r(*S*) = 27.0 min (major enantiomer), t_r(*R*) = 29.7 min.



(+)-3-ethylpentan-2-ol (2h):[9] Compound **2h** was obtained after purification on flash silica gel chromatography from 100:0 till 90:10 (Pentane/Et_2O) as a colorless oil (99% yield, 83% *ee*); $[\alpha]_D^{20}$ = +2.6 (*c* 1.0, $CHCl_3$). ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.84 (qd, *J* = 6.4, 5.1 Hz, 1H), 1.93 (br s, 1H), 1.48 – 1.19 (m, 5H), 1.15 (d, *J* = 6.4 Hz, 3H), 0.91 (t, *J* = 7.4 Hz, 6H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 69.3, 48.1, 21.6, 21.5, 20.0, 11.7, 11.6. LRMS (EI) *m/z*: 116 (M^+, <1), 101 (10), 83 (9), 71 (16), 70 (100), 69 (14), 59 (17), 57 (13), 55 (42), 53 (6). *Ee* determination by chiral GC analysis, CP-Chiralsil-DEX CB column, T = 70 °C, P = 14.3 psi, retention times: t_r(*R*) = 20.4 min, t_r(*S*) = 21.0 min (major enantiomer).



(*S*)-1-cyclohexylethanol (2i):[10] Compound **2i** was obtained after purification on flash silica gel chromatography from 100:0 till 94:6 (Hexane/EtOAc) as a yellow oil (61% yield, 92% *ee*); $[\alpha]_D^{20}$ = +2.8 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = +3.5 (*c* 3.1, $CHCl_3$) for 95% *ee*}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.54 (quin, *J* = 6.2 Hz, 1H), 1.92 – 1.59 (m, 6H), 1.34 – 1.09 (m, 7H), 1.09 – 0.87 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 72.2, 45.1, 28.6, 28.3, 26.5, 26.2, 26.1, 20.3. LRMS (EI) *m/z*: 128 (M^+, <1), 113 (16), 110 (37), 95 (42), 84 (24), 83 (35), 82 (100), 81 (18), 69 (16), 67 (61), 56 (25), 55 (76), 54 (14), 53 (9). *Ee* was determined by chiral GC analysis on the derivative **3i**.

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5 Xin, S.; Harrod, J. F. *Can. J. Chemistry* **1995**, *73*, 999–1002.

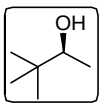
6 Zada, A.; Ben-Yehuda, S.; Dunkelblum, E.; Harel, M.; Assael, F.; Mendel, Z. *J. Chem. Ecol.* **2004**, *30*, 631–641.

7 Keinan, E.; Hafeli, E. K.; Seth, K. K.; Lamed, R. *J. Am. Chem. Soc.* **1986**, *108*, 162–169.

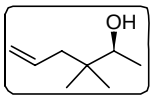
8 Li, D. R.; He, A.; Falck, J.R. *Org. Lett.* **2010**, *12*, 1756–1759.

9 Rawson. D.; Meyers, A. I. *J. Chem. Soc., Chem. Commun.* **1992**, *6*, 494–496.

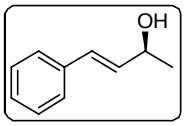
10 Li, G.; Kabalka, G. W. *J. Organomet. Chem.,* **1999**, 581, 66–69.



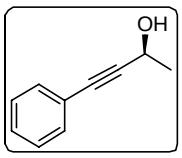
(*S*)-3,3-dimethylbutan-2-ol (2j):[11] Compound **2j** was obtained after purification on flash silica gel chromatography from 100:0 till 90:10 (Pentane/Et_2O) as a colorless oil (58% yield, 99% *ee*); $[\alpha]_D^{20}$ = -8.0 (*c* 1.7, EtOAc) {$^{Lit}[\alpha]_D^{20}$ = +31.0 (*c* 1.0, $CHCl_3$) for 60% *ee*}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.47 (q, *J* = 6.4 Hz, 1H), 1.76 (br s, 1H), 1.12 (d, *J* = 6.4 Hz, 3H), 0.89 (s, 9H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 75.6, 34.8, 25.4, 17.8. LRMS (EI) *m/z*: 136 (M^+, 1), 118 (23), 117 (35), 115 (15), 92 (100), 91 (94), 65 (19), 51 (9). *Ee* determination by chiral GC analysis, HP-CHIRAL-20β column, T = 60 °C, P = 6.0 psi, retention time: t_r(*S*) = 29.8 min (major enantiomer), t_r(*R*) = 31.9 min.



(*S*)-3,3-dimethylhex-5-en-2-ol (2k):[12] Compound **2k** was obtained after purification on flash silica gel chromatography from 100:0 till 92:8 (Pentane/Et_2O) as a colorless oil (60% yield, 98% *ee*); $[\alpha]_D^{20}$ = +2.8 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = -7.2 (*c* 1.1, $CHCl_3$) for 76% *ee* of *R* enantiomer}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.95 – 5.79 (dddd, *J* = 15, 12.6, 9.4, 7.5 Hz, 1H), 5.10 – 5.05 (m, 1H), 5.05 – 5.01 (m, 1H), 3.55 (q, *J* = 6.1 Hz, 1H), 2.11 (ddt, *J* = 13.6, 7.6, 1.1 Hz, 1H), 1.99 (ddt, *J* = 13.6, 7.4, 1.1 Hz, 1H)., 1.70 (br s, 1H), 1.13 (d, *J* = 6.4 Hz, 3H), 0.88 (s, 3H), 0.86 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 135.5, 117.0, 74.2, 43.5, 37.8, 22.9, 22.1, 17.6. LRMS (EI) *m/z*: 128 (M^+, <1), 110 (16), 95 (16), 87 (70), 86 (10), 84 (44), 83 (22), 82 (14), 71 (12), 69 (100), 67 (28), 56 (11), 55 (79), 53 (9). *Ee* was determined by chiral GC analysis on the derivative **3k**.



(*S,E*)-4-phenylbut-3-en-2-ol (2l):[13] Compound **2l** was obtained after purification on flash silica gel chromatography from 100:0 till 85:15 (Hexane/EtOAc) as a yellow oil (>99% yield, 82% *ee*); $[\alpha]_D^{20}$ = -25.4 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = -14.6 (*c* 1.0, $CHCl_3$) for 60% *ee*}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (dd, *J* = 5.3, 3.2 Hz, 2H), 7.34 – 7.27 (m, 2H), 7.27 – 7.20 (m, 1H), 6.55 (d, *J* = 15.9 Hz, 1H), 6.25 (dd, *J* = 15.9, 6.4 Hz, 1H), 4.47 (p, *J* = 6.3 Hz, 1H), 1.99 (br s, 1H), 1.36 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 136.6, 133.5, 129.3, 128.5, 127.6, 126.4, 68.8, 23.3. LRMS (EI) *m/z*: 149 (M^++1, 1), 148 (M^+, 9), 131 (11), 130 (87), 129 (100), 128 (63), 127 (25), 115 (63), 105 (14), 91 (11), 77 (15), 51 (13). Ee determination by chiral GC analysis, CP-Chiralsil-DEX CB column, T = 110 °C, P = 10.0 psi, retention times: t_r(R) = 60.8 min, t_r(S) = 61.8 min (major enantiomer).



(*S*)-4-phenylbut-3-yn-2-ol (2m):[14] Compound **2m** was obtained after purification on a flash silica gel chromatography from 100:0 till 90:10 (Hexane/EtOAc) as a colorless oil (80% yield, 60% *ee*); $[\alpha]_D^{20}$ = −21.5 (*c* 1.0, $CHCl_3$) {$^{Lit}[\alpha]_D^{20}$ = −33.0 (*c* 0.9, $CHCl_3$) for 98% *ee*}. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.43 (m, 2H), 7.31 (m, 3H), 4.76 (m, 1H), 2.14 (br s, 1H), 1.56 (d, *J* = 6.6 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 131.6, 128.3, 128.2, 122.5, 90.9, 84.0, 58.8, 24.4. LRMS (EI) *m/z*: 147 (M^++1, 3), 146 (M^+, 33), 145 (50), 132 (10), 131 (100), 129 (11), 128 (12), 127 (10), 103 (65), 102 (14), 77 (32), 51 (11). *Ee* determination by chiral HPLC analysis, Chiralcel OJ column, Hexane/Pr^{i}OH 97:3, flow rate = 1.0 mL/min, λ=210 nm, retention times: t_r(*R*) = 15.6 min, t_r(*S*) = 18.0 min (major enantiomer).

2.3 Derivatization of chiral alcohols

Two different procedures were used to derivatize chiral aliphatic alcohols into the corresponding *p*-nitrobenzoate (Procedure A) and acetate (Procedure B) products.

Procedure A:

The corresponding aliphatic alcohol **2b** (31.7 mg, 0.2 mmol) was dissolved in dry DCM (1 mL) at 0 °C and Et_3N (56 μL, 0.4 mmol, 2 eq), DMAP (2.5 mg, 0.02 mmols, 0.1 eq) and *p*-nitrobenzoyl chloride (55.7 mg, 0.3 mmol, 1.5 eq) were added. The reaction mixture was stirred at room temperature for 12 h. The reaction was quenched with water (1 mL), extracted with Et_2O (3 × 5 mL) and the combined organic layers were dried over magnesium sulfate and concentrated under vacuum. The crude product was purified by chromatography on flash silica gel to give the desired product **3b**.

[11] Gilmore, N. J.; Jones, S.; Muldowney, M. P. *Org. Lett.* **2004**, *6*, 2805–2808.

[12] Cozzi, P. G.; Kotrusz, P. *J. Am. Chem. Soc.* **2006**, *128*, 4940–4941.

[13] Inagaki, T.; Ito, A.; Ito, J.; Nishiyama, H. *Angew. Chem., Int. Ed. Engl*. **2010**, *49*, 9384–9387.

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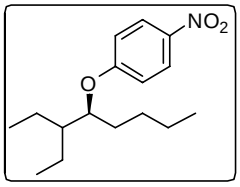
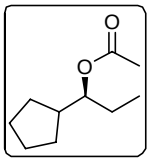
Procedure B:

The corresponding aliphatic alcohol [**2d**, **2e**, **2f**, **2i** or **2k** (0.1 mmol)] was dissolved in dry DCM (1 mL) at 0 °C and Et_3N (28 μL, 0.2 mmol, 2 eq), DMAP (1.3 mg, 0.01 mmol, 0.1 eq) and acetic anhydride (22 μL, 0.2 mmol, 2 eq) were added. The reaction mixture was stirred at room temperature for 12 h. The reaction was quenched with water (1 mL), extracted with Et_2O (3 × 5 mL) and the combined organic layers were dried over magnesium sulfate and concentrated under vacuum. The crude product was purified by Kugelrohr distillation to give the desired products **3d**, **3e**, **3f**, **3i** and **3k**.

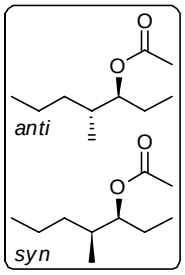
2.4 Data of the products 3b, 3d, 3e, 3f, 3i, and 3k



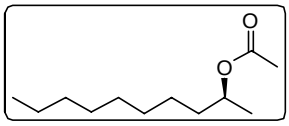
(*S*)-1-[(3-ethyloctan-4-yl)oxy]-4-nitrobenzene (3b): Compound **3b** was obtained after purification on flash silica gel chromatography from 100:0 till 98:2 (Hexane/EtOAc) as a yellow viscous oil (>99% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, *J* = 9.0 Hz, 2H), 8.21 (d, *J* = 9.0 Hz, 2H), 5.27 (dt, *J* = 8.5, 4.2 Hz, 1H), 1.80 – 1.58 (m, 2H), 1.58 – 1.46 (m, 2H), 1.45 – 1.21 (m, 7H), 0.97 (t, *J* = 7.0 Hz, 3H), 0.94 (t, *J* = 7.4 Hz, 3H), 0.89 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.4, 150.4, 136.2, 130.6, 123.5, 77.8, 44.5, 30.7, 28.0, 22.6, 22.2, 21.93, 14.0, 11.8, 11.7. IR (ATR): ν (cm^{-1}): 2960, 1719, 1527, 1271, 1101, 718. LRMS (EI) *m/z*: 307 (M^+, <1), 236 (9), 151 (13), 150 (100), 140 (7), 104 (13), 92 (5), 76 (6), 55 (4). HRMS calculated for $C_{16}H_{25}NO_3$ 307.1784, found 250.1119 (M^+-Bu·). *Ee* determination by chiral HPLC analysis, Chiralcel ASH column, Hexane/Pr^iOH 99:1, flow rate = 0.8 mL/min, λ=254 nm, retention times: t_r(*R*) = 7.5 min, t_r(*S*) = 8.7 min (major enantiomer).



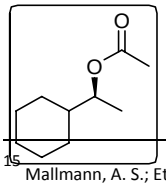
(*S*)-1-cyclopentylpropyl acetate (3d): Compound **3d** was obtained after purification by Kugelrohr distillation as a colorless oil (>99% yield). ^{1}H NMR (300 MHz, $CDCl_3$) δ 4.77 (td, *J* = 7.8, 4.1 Hz, 1H), 2.06 (s, 3H), 1.76 – 1.41 (m, 9H), 1.36 – 1.11 (m, 2H), 0.88 (t, *J* = 7.4 Hz, 4H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.1, 78.8, 43.3, 29.0, 28.6, 26.2, 25.5, 25.2, 21.2, 9.6. LRMS (EI) *m/z*: 170 (M^+, <1), 141 (17), 112 (33), 110 (35), 101 (69), 97 (11), 95 (14), 82 (17), 81 (100), 71 (16), 68 (16), 67 (39), 55 (11). *Ee* determination by chiral GC analysis, CP-Chiralsil-DEX CB column, T = 110 °C, P = 14.3 psi, retention time: t_r(*S*) = 6.6 min (major enantiomer), t_r(*R*) = 7.3 min.



(3*S*,4*R*)-4-methylheptan-3-yl acetate (3ea) and **(3*S*,4*S*)-4-methylheptan-3-yl acetate (3eb):** **¡Error! Marcador no definido.** Compounds **3ea** and **3eb** were obtained after Kugelrohr distillation as a colorless oil (>99% yield). LRMS (EI) *m/z*: 172 (M^+, <1), 143 (9), 130 (9), 112 (22), 101 (100), 83 (47), 72 (50), 71 (14), 70 (26), 69 (25), 57 (13), 55 (29). *Ee* determination by chiral GC analysis, HP-CHIRAL-20β column, T = 70 °C, P = 14.3 psi, retention time for *anti* diastereoisomers: t_r(3*S*,*4R*) = 27.9 min (major enantiomer), t_r(3*R*,*4S*) = 31.2 min, and for *syn* diastereoisomers: t_r(3*S*,*4S*) = 29.4 min (major enantiomer), t_r(3*R*,*4R*) = 32.3 min.



(*S*)-decan-2-yl acetate (3f):[15] Compound **3f** was obtained after purification by Kugelrohr distillation as a colorless oil (>99% yield). ^{1}H NMR (300 MHz, $CDCl_3$) δ 4.95 – 4.79 (sext, *J* = 6.3 Hz, 1H), 2.04 – 1.95 (s, 3H), 1.66 – 1.36 (m, 2H), 1.35 – 1.21 (m, 11H), 1.18 (d, *J* = 6.3 Hz, 3H), 0.86 (t, *J* = 6.7 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.8, 71.1, 35.9, 31.8, 29.5, 29.4, 29.2, 25.4, 22.6, 21.3, 19.9, 14.0. LRMS (EI) *m/z*: 200 (M^+, <1), 140 (43), 112 (16), 111 (26), 102 (12), 98 (22), 97 (34), 96 (11), 87 (100), 85 (11), 84 (21), 83 (24), 82 (10), 71 (16), 70 (36), 69 (37), 58 (16), 57 (24), 56 (37), 55 (42). *Ee* determination by chiral GC analysis, Chiralsil-DEX CB column, T = 130 °C, P = 14.3 psi, retention time: t_r(*S*) = 6.5 min (major enantiomer), t_r(*R*) = 7.4 min.

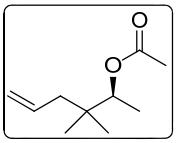


(*S*)-1-cyclohexylethyl acetate (3i):[16] Compound **3i** was obtained after purification by Kugelrohr distillation as a colorless oil (>99% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.72 (quin, *J* = 6.4 Hz, 1H), 2.04 (s, 3H), 1.80 – 1.61 (m, 5H), 1.43 (m, 1H), 1.27 – 1.09 (m, 3H), 1.16 (d, *J* = 6.4 Hz, 3H), 1.07 – 0.90 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.0, 74.7, 42.5, 28.4, 26.3, 26.0, 25.9,

[15] Mallmann, A. S.; Ethur, E. M.; da Silva, U. F.; Dalcol, I. I.; Morel, A. F. *J. Brazil. Chem. Soc.* **2010**, *21*, 2005–2011.

[16] Taglieber, A.; Hobenreich, H.; Carballeira, J. D.; Mondiere, R. J. G.; Reetz, M. T. *Angew. Chem., Int. Ed. Engl*. **2007**, *46*, 8597–8600.

20.92, 17.0. LRMS (EI) *m/z*: 128 (M^+, <1), 113 (16), 110 (37), 95 (42), 84 (24), 83 (35), 82 (100), 81 (18), 69 (16), 67 (61), 56 (25), 55 (76), 54 (14), 53 (9). *Ee* determination by chiral GC analysis, HP-CHIRAL-20β column, T = 130 °C, P = 14.3 psi, retention time: t_r(*S*) = 8.1 min (major enantiomer), t_r(*R*) = 8.5 min.



(*S*)-3,3-dimethylhex-5-en-2-yl acetate (3k):[17] Compound **3k** was obtained after purification by Kugelrohr distillation as a colorless oil (>99% yield). ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.80 (ddt, *J* = 17.6, 10.2, 7.5 Hz, 1H), 5.10 – 4.95 (m, 2H), 4.72 (q, *J* = 6.4 Hz, 1H), 2.04 (s, 3H), 1.14 (d, *J* = 6.4 Hz, 3H), 0.88 (d, *J* = 7.9 Hz, 6H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.7, 134.6, 117.4, 76.4, 43.3, 36.8, 22.8, 22.5, 21.2, 14.5. LRMS (EI) *m/z*: 170 (M^+, <1), 129 (27), 110 (17), 95 (19), 87 (100), 83 (20), 69 (29), 67 (13), 55 (29). *Ee* determination by chiral GC analysis, Chiralsil-DEX CB column, T = 90 °C, P = 14.3 psi, retention time: t_r(*S*) = 7.2 min (major enantiomer), t_r(*R*) = 8.5 min.

3. Additional data - Mechanistic studies

3.1 Non-Linear effect study (NLE)

In a flame dried Schlenk tube, (S_a,*R*)-**L2** (x mmol) and (R_a,*S*)-**L2** (y mmol) were dissolved in dry Et_2O (1.5 mL) under argon atmosphere. The solution was cooled down to −20 °C and $Ti(OPr^i)_4$ (305 μL, 1.0 mmol, 10 eq.) was added. Five minutes later, MeMgBr (3.0 M in Et_2O, 83 μL, 0.25 mmol, 2.5 eq.) was added. After stirring the mixture for additional 15 min, freshly distilled 3-phenylpropanal (0.1 mmol) was added and the reaction mixture was stirred at −20 °C for 3 h. The reaction was quenched with water (2 mL), and 2 M $HCl_{(aq)}$ (2 mL). The mixture was diluted with Et_2O (2 mL) and dried over magnesium sulfate. Ee and conversions were determined by chiral GC analysis (see reported data of **2g** for further details). Results are summarized in Table S1:

Table S1. Study of the non-linear effect with **2g** and **L2**

mg (S_a,*R*)-**L2**	mg (R_a,*S*)-**L2**	*ee* **L2 (%)**	*ee* **2g (%)**	**Conversion (%)**
3.77	3.77	0	0	82
4.53	3.02	20	19	85
5.28	2.26	40	39	75
6.04	1.51	60	60	78
6.79	0.75	80	76	72
7.55	0	100	88	81

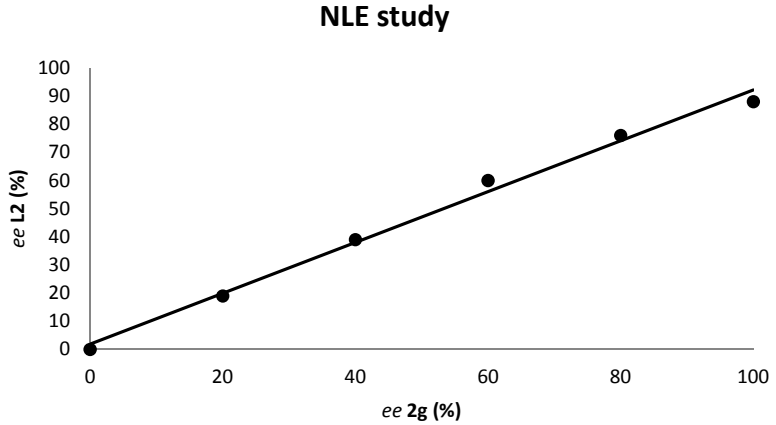


Figure 1. Linear plot of *ee* values of **L2** *vs ee* values of **2g**

[17] Dillenberger, Z.; Schmid, H.; Hansen, H. *Helv. Chim.* Acta **1978**, *61*, 1856–18902.

3.2 Kinetic study

(A): In a flame dried Schlenk tube, (S_a,*R*)-**L2** (22.6 mg, 0.06 mmol) was dissolved in dry Et_2O (2.5 mL) under argon atmosphere. The solution was cooled down to −20 °C and $Ti(OPr^i)_4$ (915 μL, 3.0 mmol, 10 eq.) was added. Five minutes later, MeMgBr (3.0 M in Et_2O, 250 μL, 0.75 mmol, 2.5 eq.) was added. After stirring the mixture for additional 15 min, freshly distilled 3-phenylpropanal (0.3 mmol) was added and the reaction mixture was stirred at −20 °C. Samples were taken at different times during 3h and analyzed by chiral GC. Results are shown in Table S2:

Table S2. Conversion and ee of **2g** *vs* time with (S_a,*R*)-**L2**

Time (min)	Conversion (%)	*ee* **2g** (%)
0.5	32	88
1	32	88
3	36	88
5	42	88
10	50	88
15	58	88
25	66	88
45	75	88
60	77	88
180	85	88

(B): In a flame dried Schlenk tube, (*S*)-BINOL (17.2 mg, 0.06 mmol) was dissolved in dry Et_2O (2.5 mL) under argon atmosphere. The solution was cooled down to −20 °C and $Ti(OPr^i)_4$ (915 μL, 3.0 mmol, 10 eq.) was added. Five minutes later, MeMgBr (3.0 M in Et_2O, 250 μL, 0.75 mmol, 2.5 eq.) was added. After stirring the mixture for additional 15 min, freshly distilled 3-phenylpropanal (0.3 mmol) was added and the reaction mixture was stirred at −20 °C. Samples were taken at different times during 3h and analyzed by chiral GC. Results are shown in Table S3:

Table S3. Conversion and ee of **2g** *vs* time with (*S*)-BINOL

Time (min)	Conversion (%)	*ee* **2g** (%)
0.5	14	7
1	17	7
3	21	7
5	23	7
10	27	7
15	29	7
45	41	7
180	48	7

(C): In a flame dried Schlenk tube, $Ti(OPr^i)_4$ (915 μL, 3.0 mmol, 10 eq.) was dissolved in dry Et_2O (2.5 mL) under argon atmosphere at −20 °C . Then, MeMgBr (3.0 M in Et_2O, 250 μL, 0.75 mmol, 2.5 eq.) was added. After stirring the mixture for additional 15 min, freshly distilled 3-phenylpropanal (0.3 mmol) was added and the reaction mixture was stirred at −20 °C. Samples were taken at different times during 3h and analyzed by chiral GC. Results are shown in Table S4:

Table S4. Conversion and ee of **2g** *vs* time without ligand

Time (min)	Conversion (%)	*ee* **2g** (%)
0.5	22	0
1	25	0
3	27	0
5	30	0

10	32	0
15	35	0
25	39	0
45	46	0
60	51	0
180	64	0

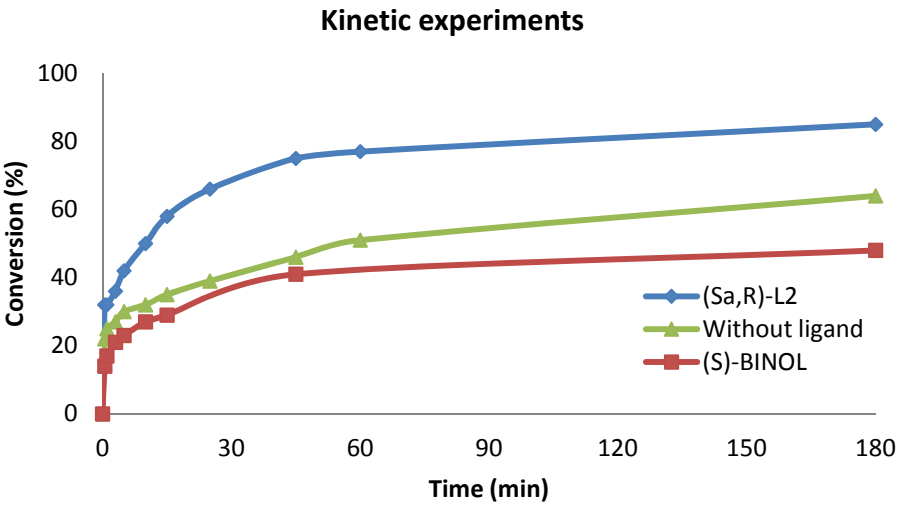
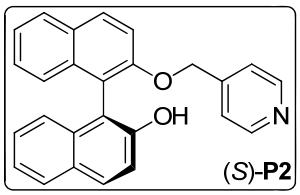
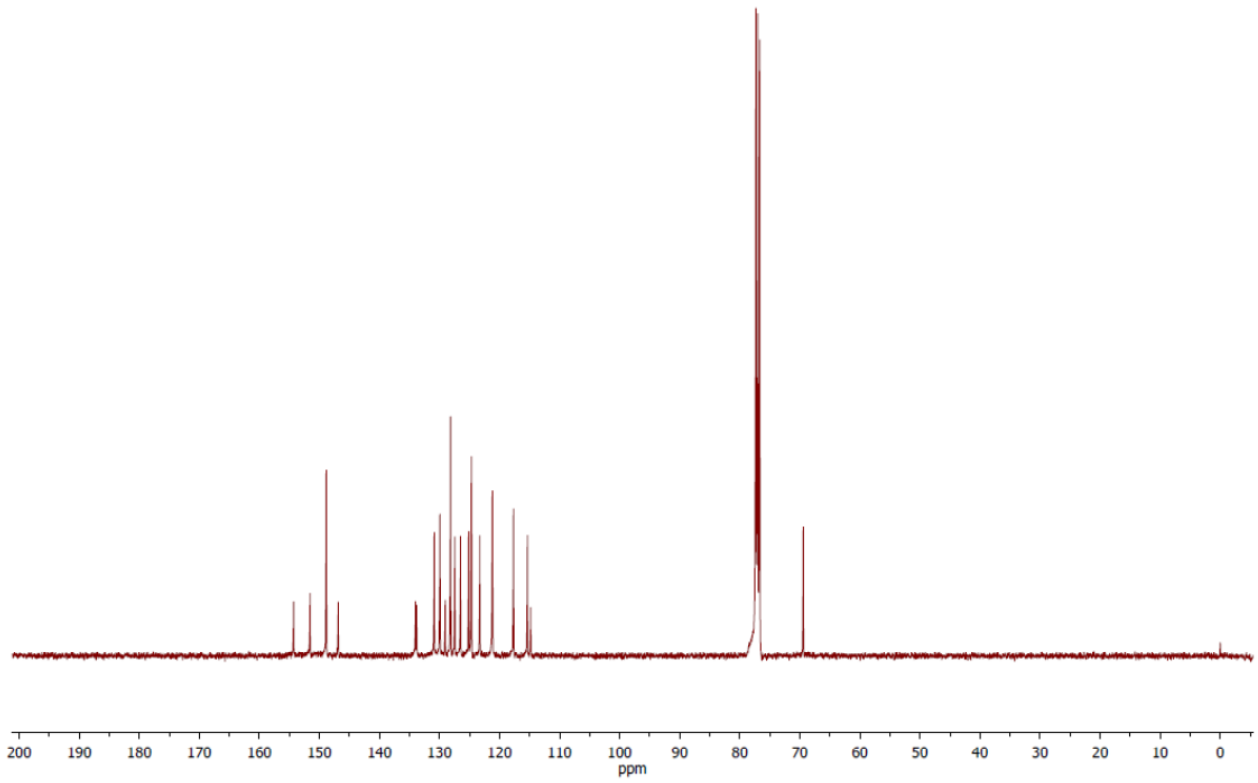


Figure 2. Comparative graphs on the rate of the reaction with (S_a,*R*)-**L2**, (*S*)-BINOL and without ligand.

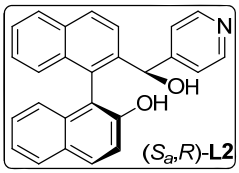
4. Spectra of compounds (^{1}H NMR, ^{13}C NMR)

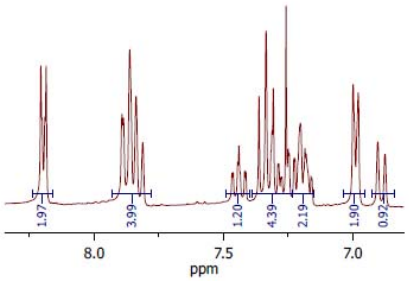
(*S*)-**P2: (*S*)-2'-(pyridin-4-ylmethoxy)-(1,1'-binaphthalen)-2-ol**

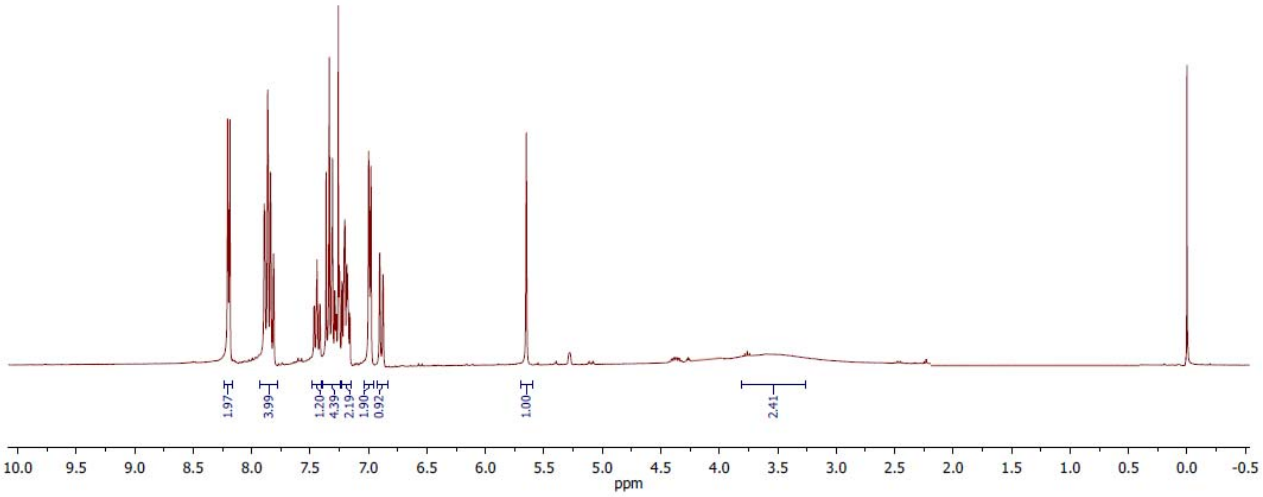


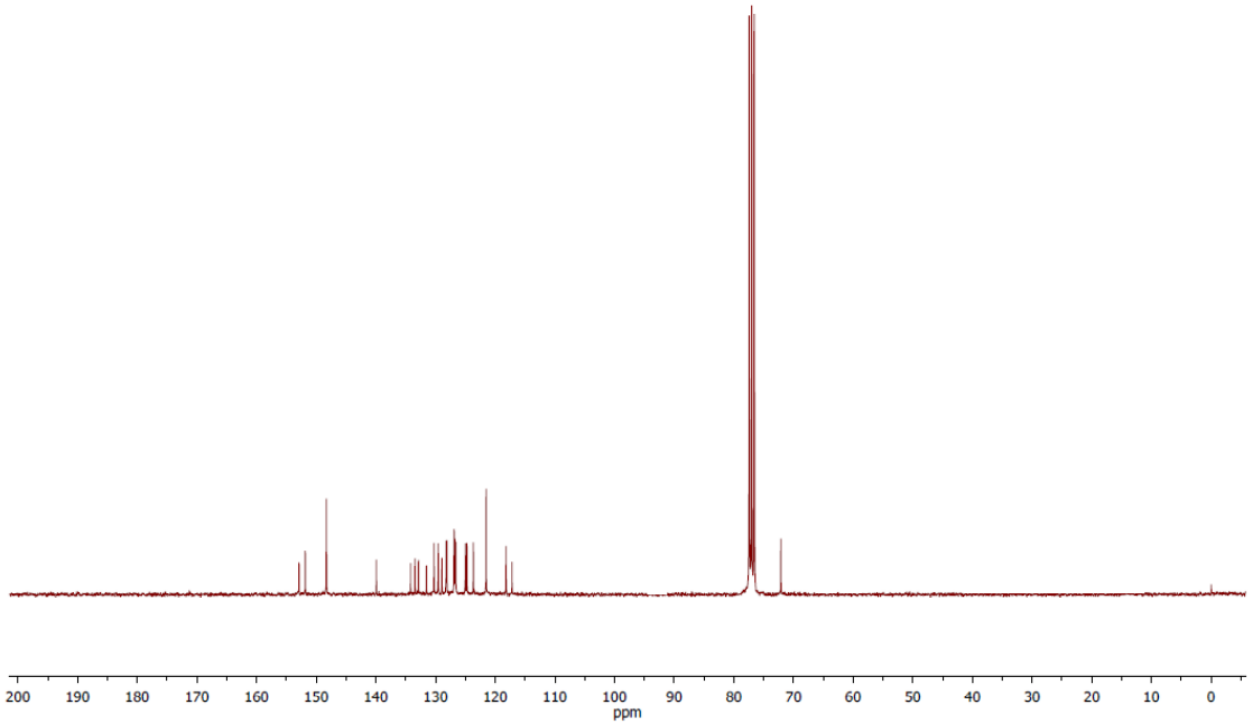


(S_a,*R*)-**L2**: (***S*****$_a$**)-2'-[(***R***)-hydroxy(pyridin-4-yl)methyl]-(1,1'-binaphthalen)-2-ol

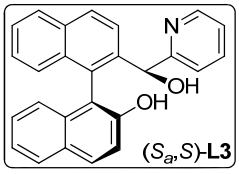


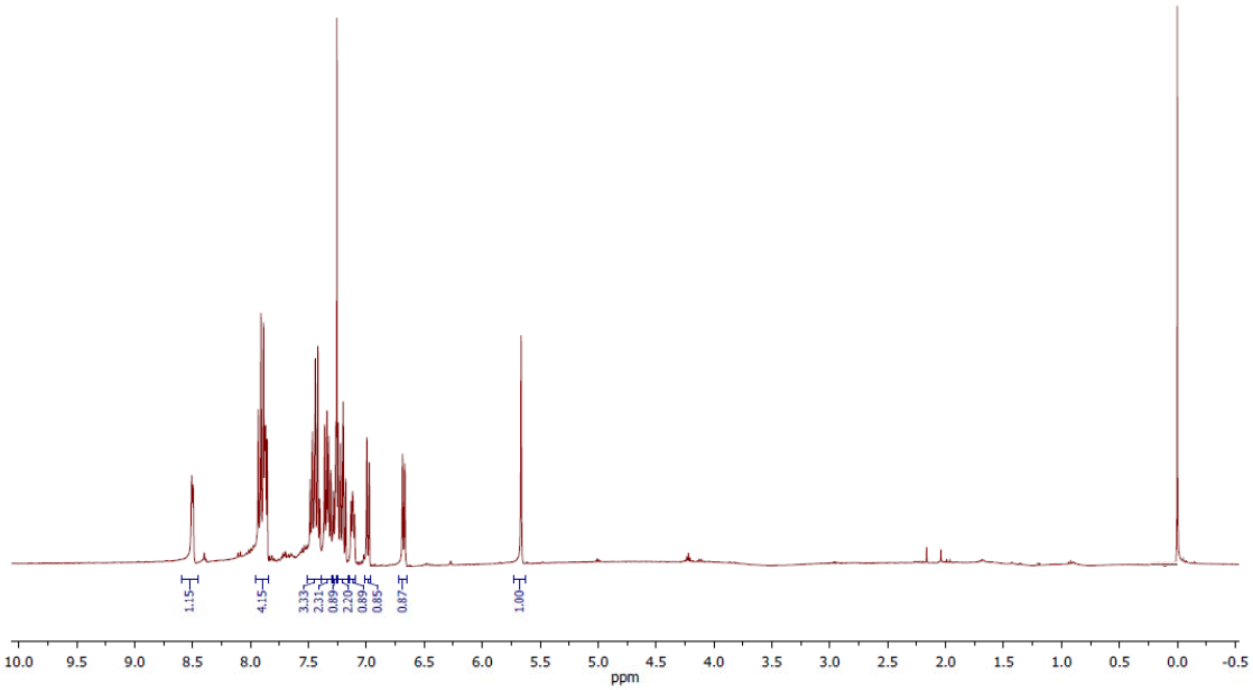


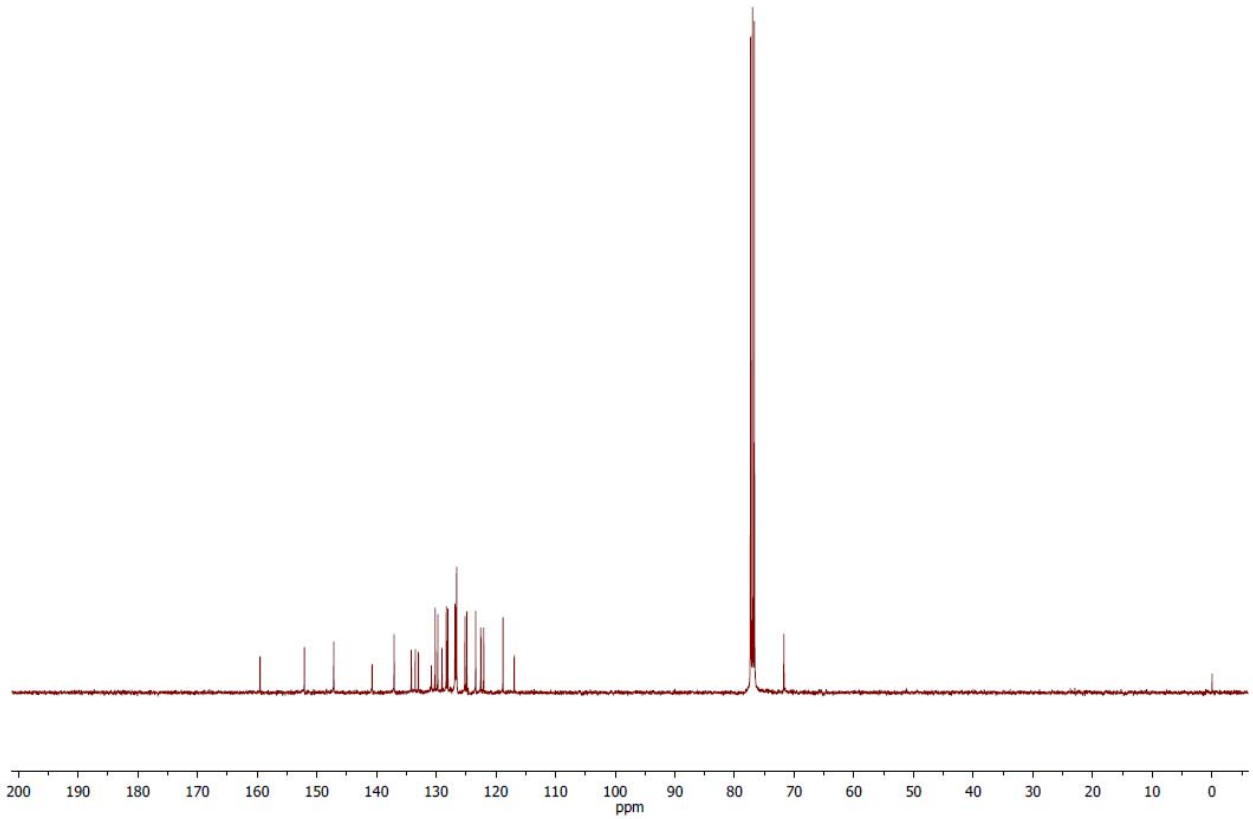




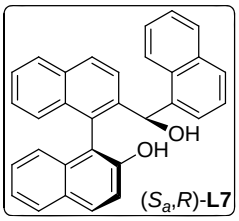
(S_a,*S*)-**L3: (*S*$_a$)-2'-[(*S*)-hydroxy(pyridin-2-yl)methyl]-(1,1'-binaphthalen)-2-ol**

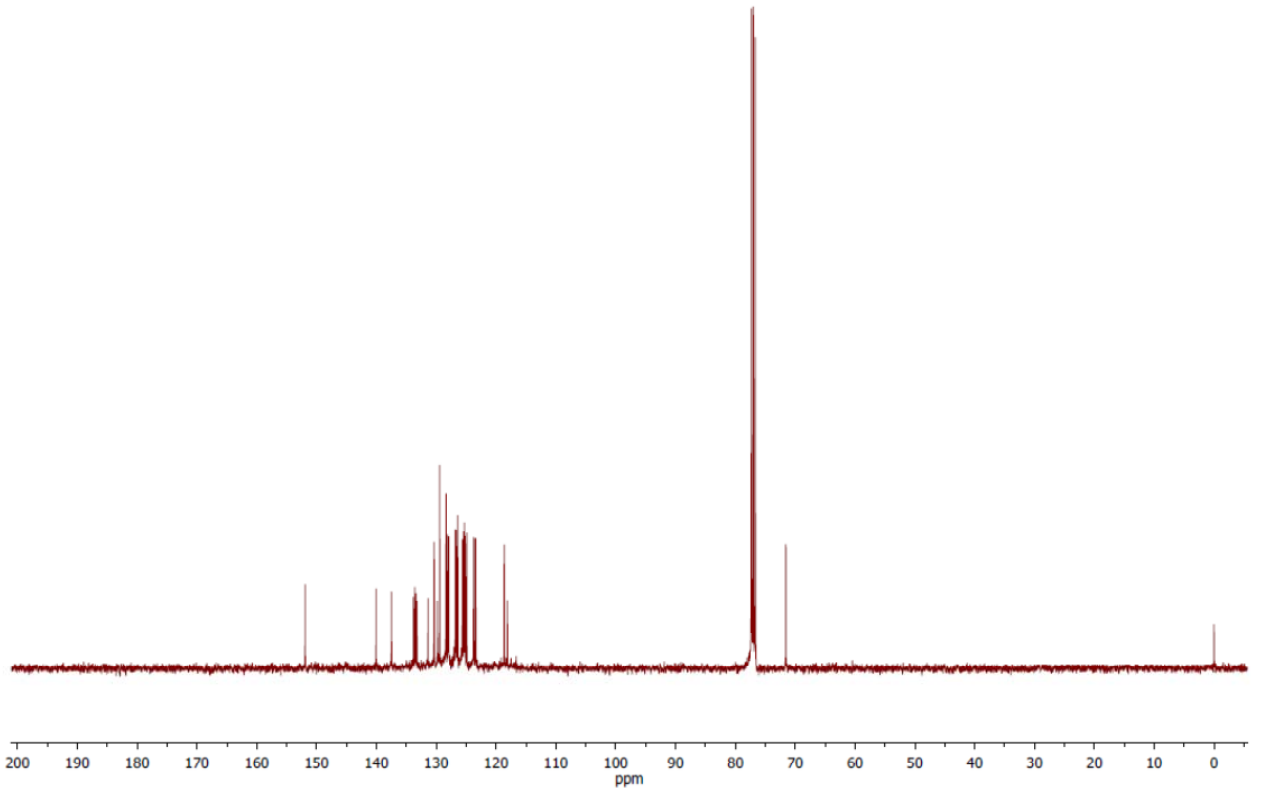




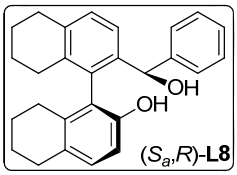


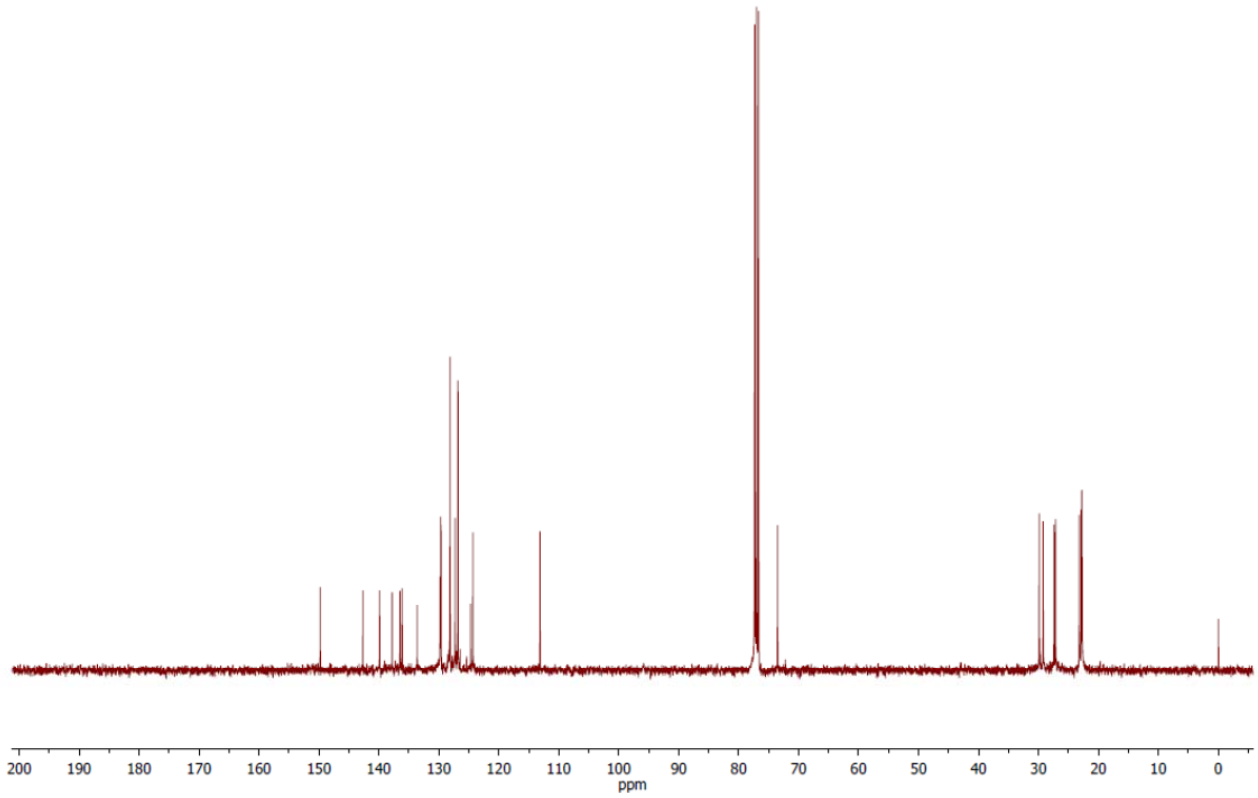
(S_a,*R*)-**L7: (*S*$_a$)-2'-[(*R*)-hydroxy(naphthalen-1-yl)methyl]-(1,1'-binaphthalen)-2-ol**



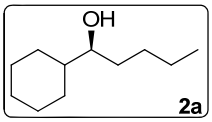


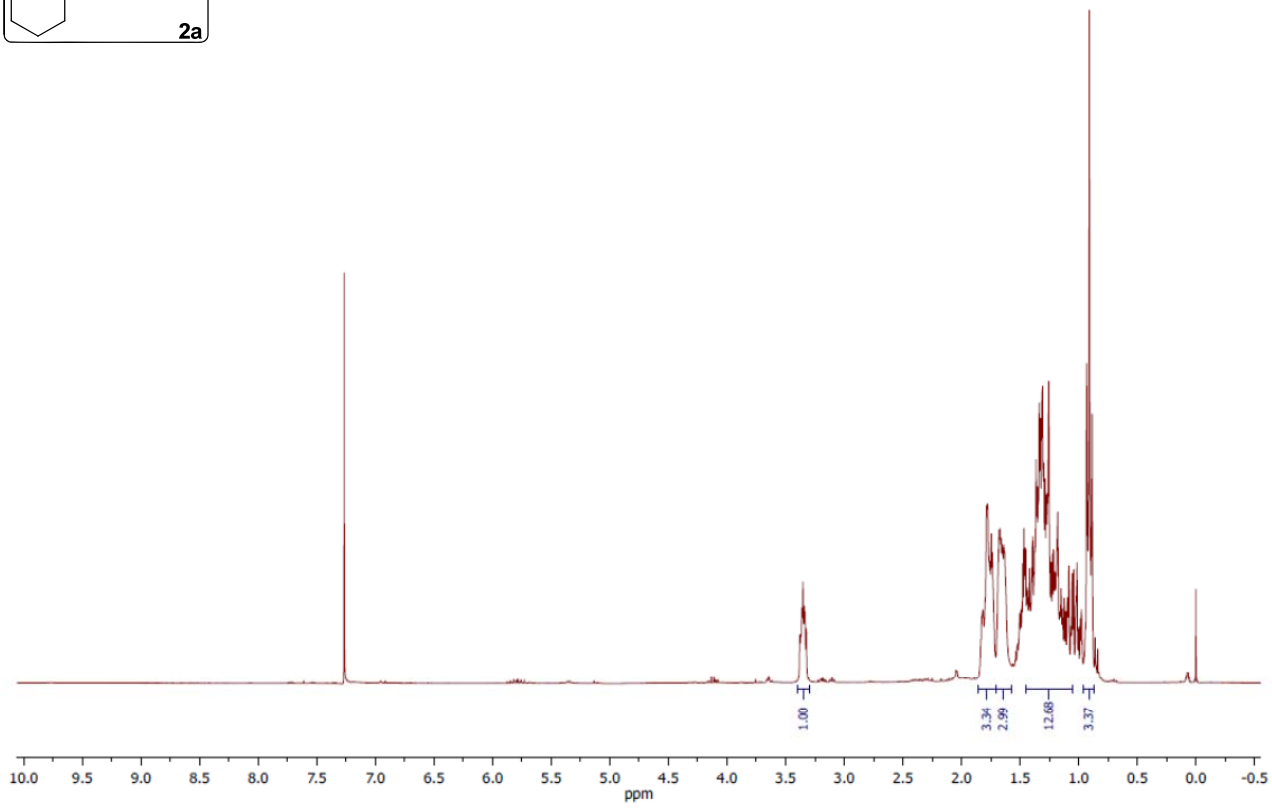
(S_a,*R*)-(*8H*)-**L1: (*S*$_a$)-2'-[(*R*)-hydroxy(phenyl)methyl]-5,5',6,6',7,7',8,8'-octahydro-(1,1'-binaphthalen)-2-ol:**

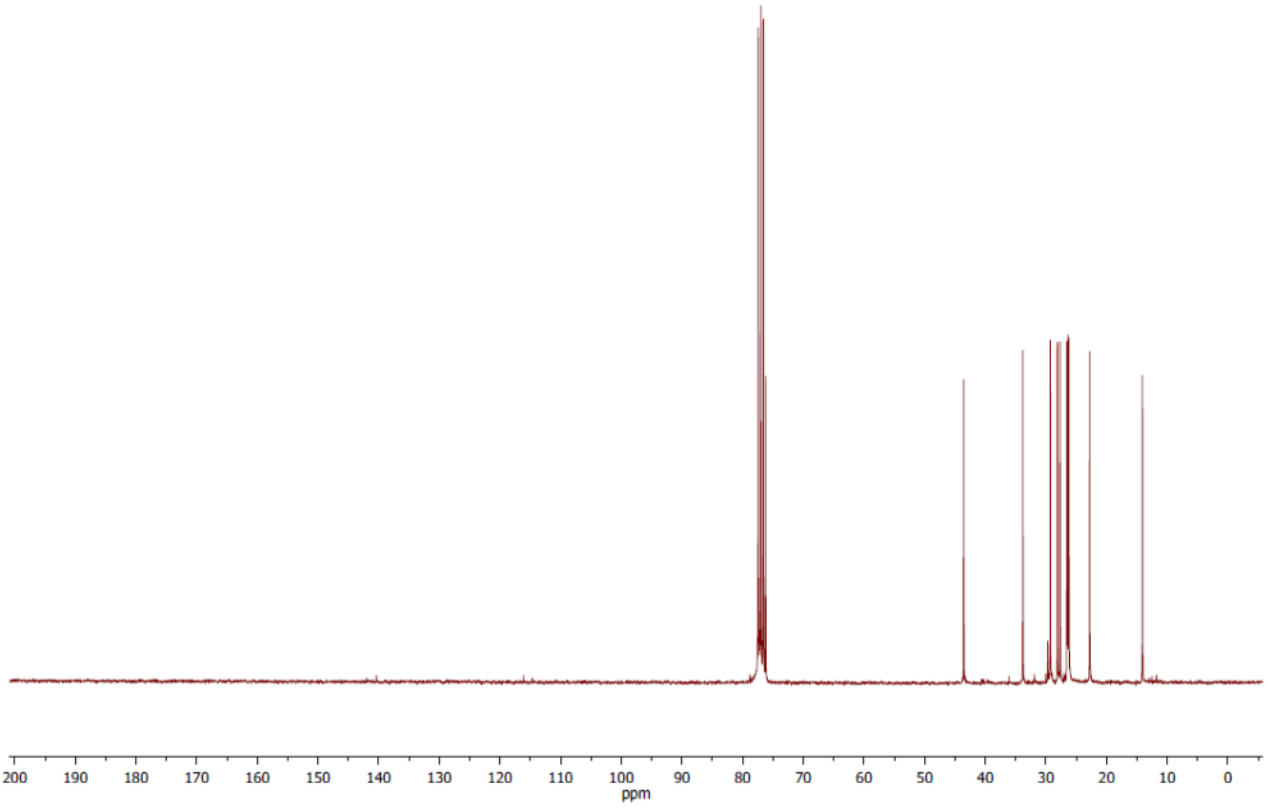




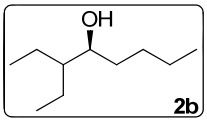
(2a): **(*S*)-1-cyclohexylpentan-1-ol**

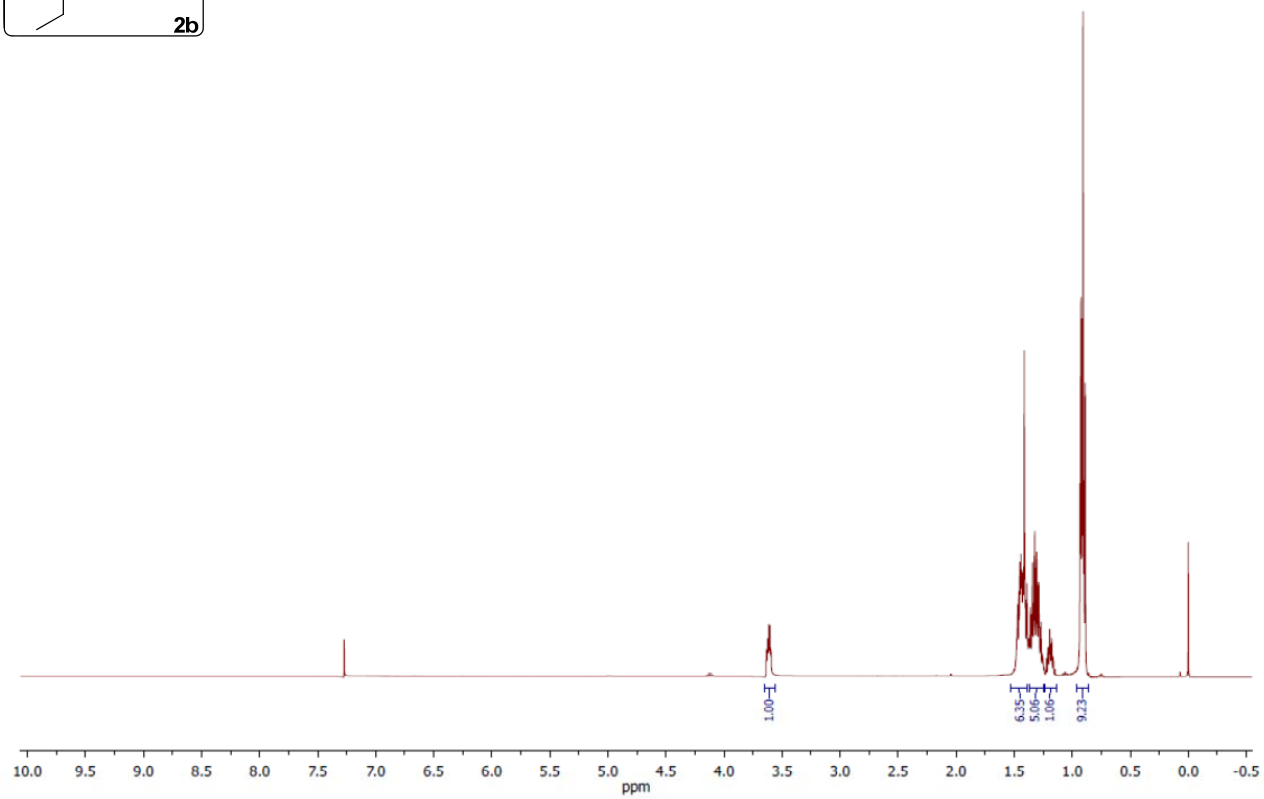


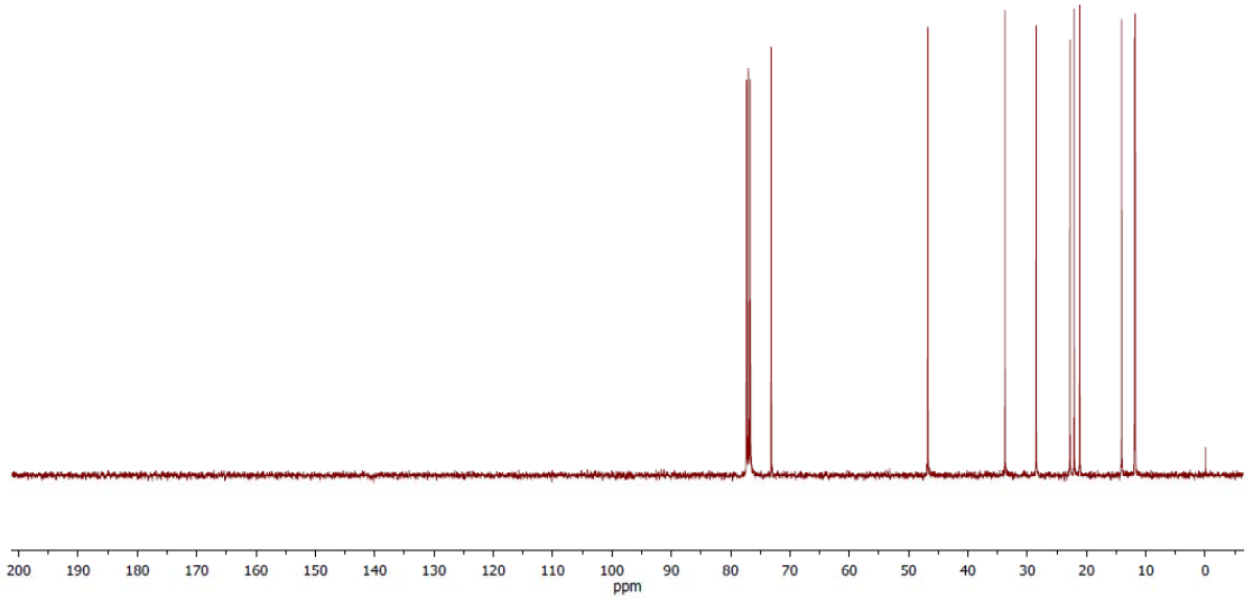




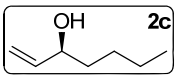
(2b): (-)-3-ethyloctan-4-ol

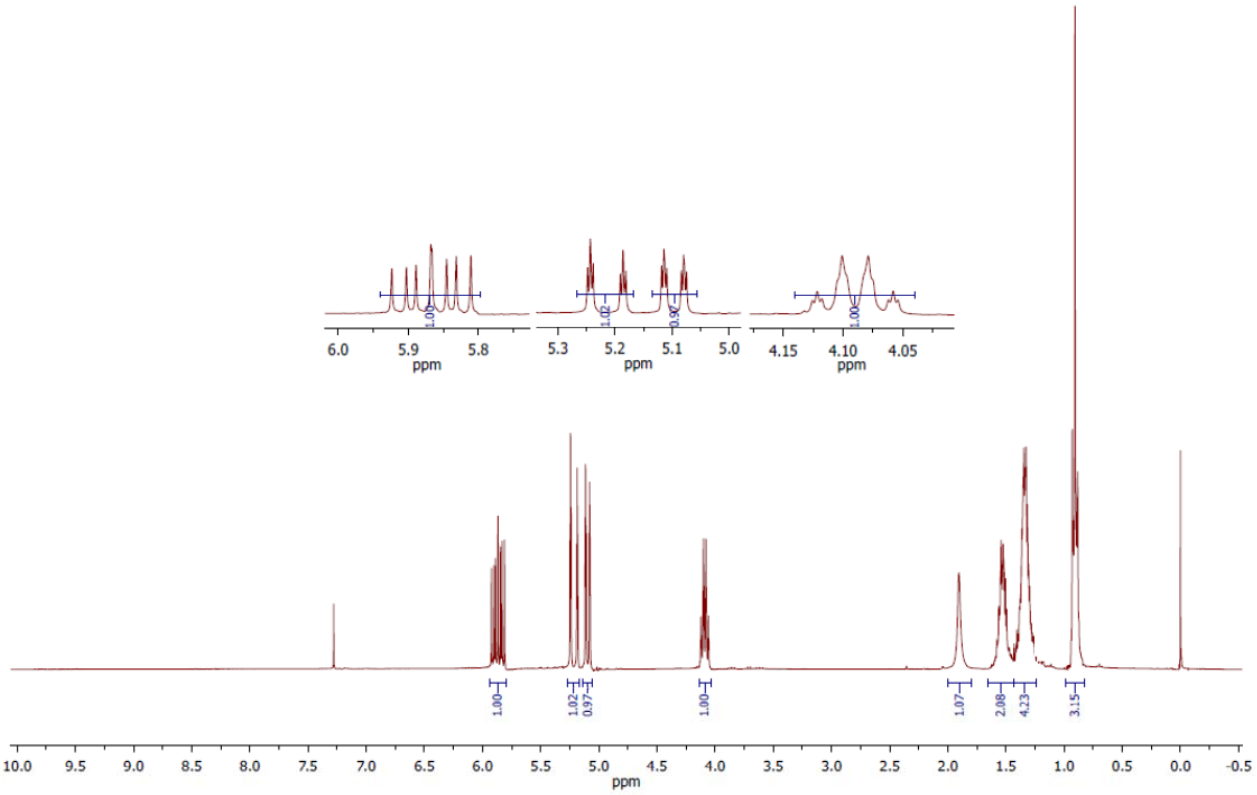


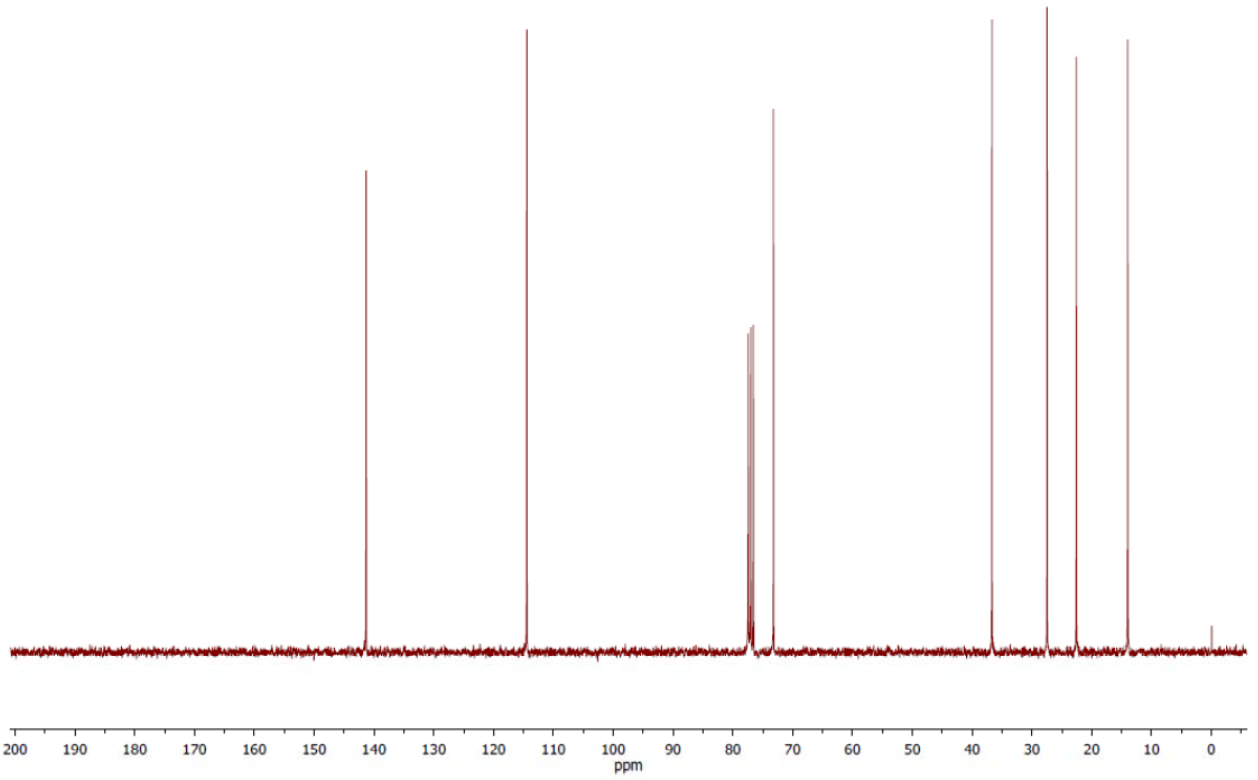




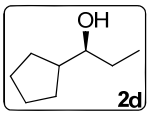
(2c): (*S*)-hept-1-en-3-ol

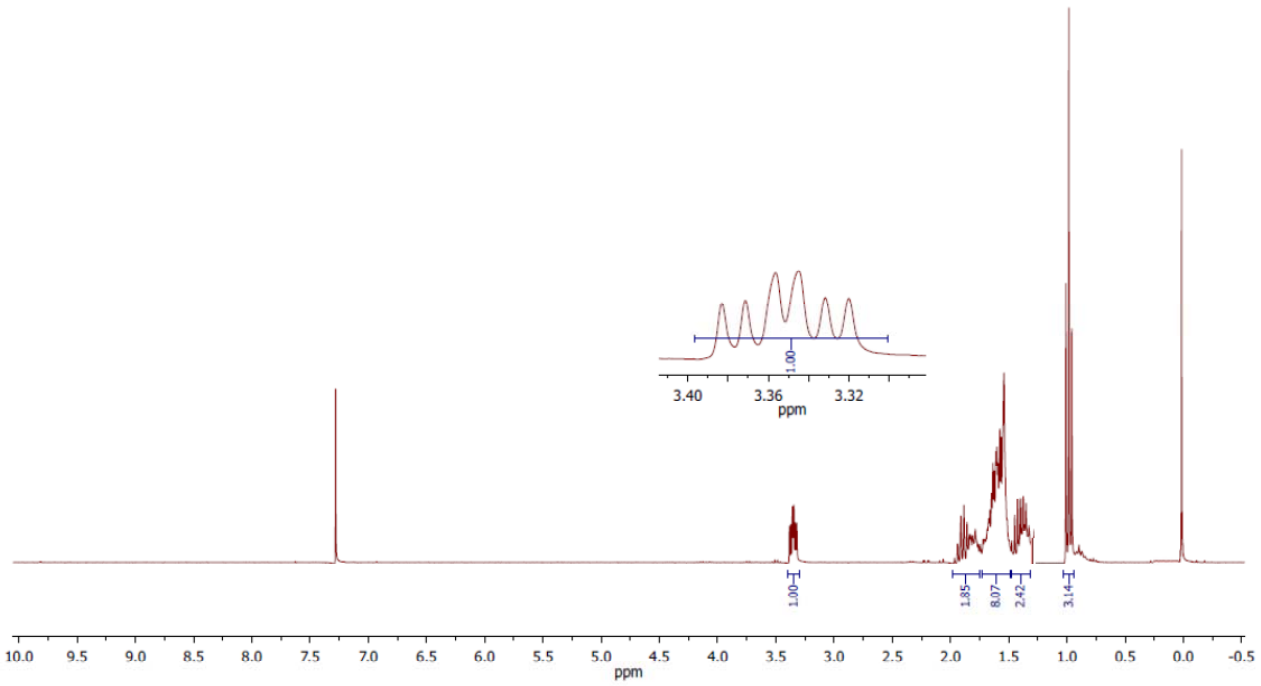


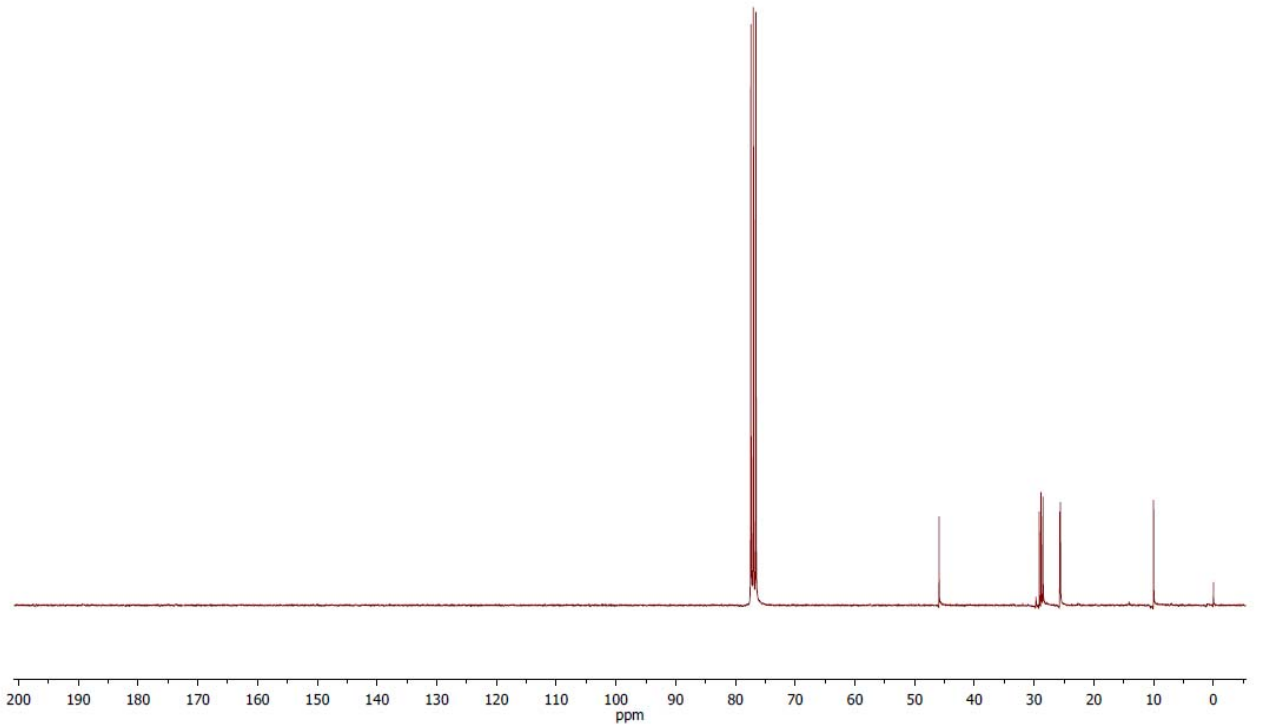




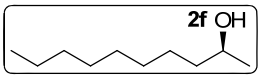
(2d): (+)-1-cyclopentylpropan-1-ol

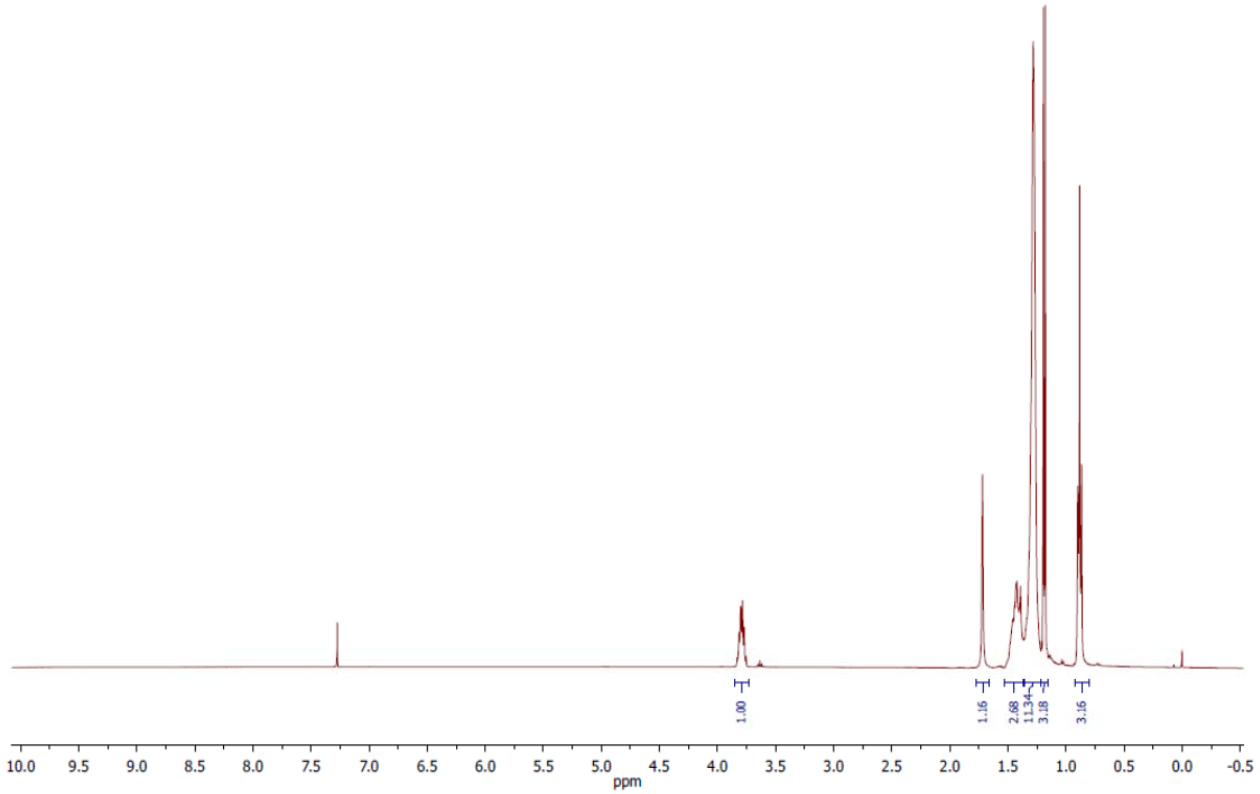


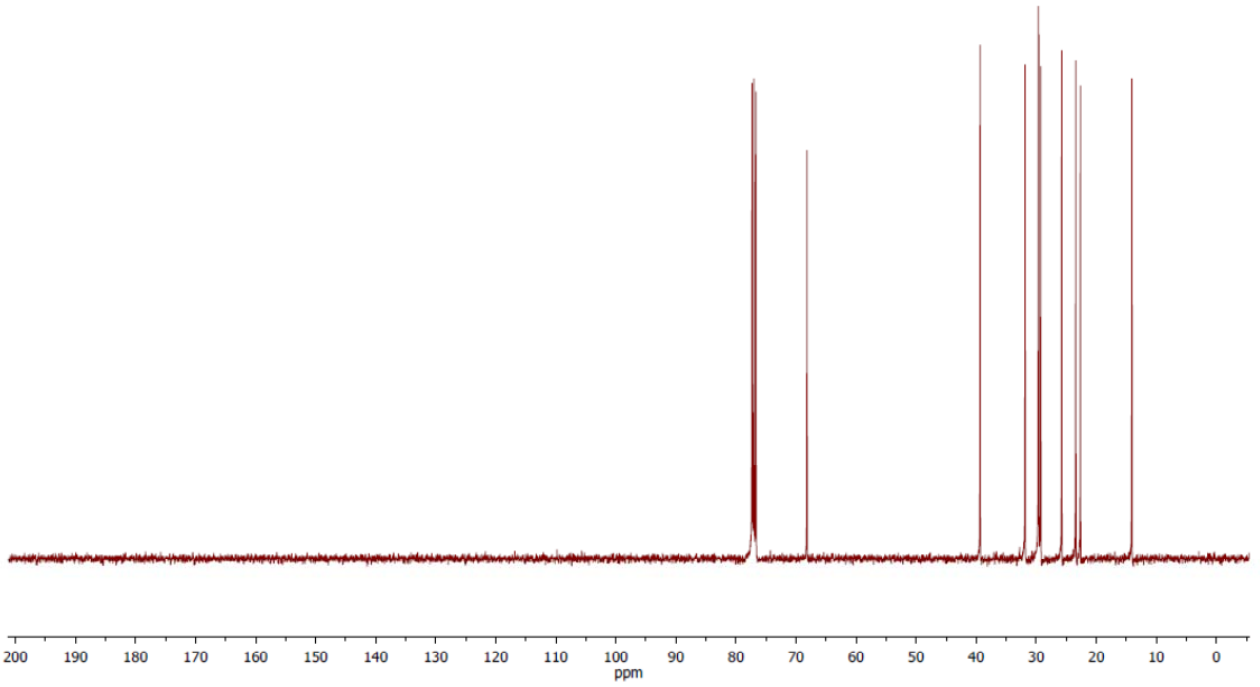




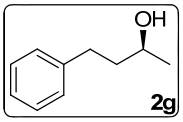
(2f): (*S*)-decan-2-ol

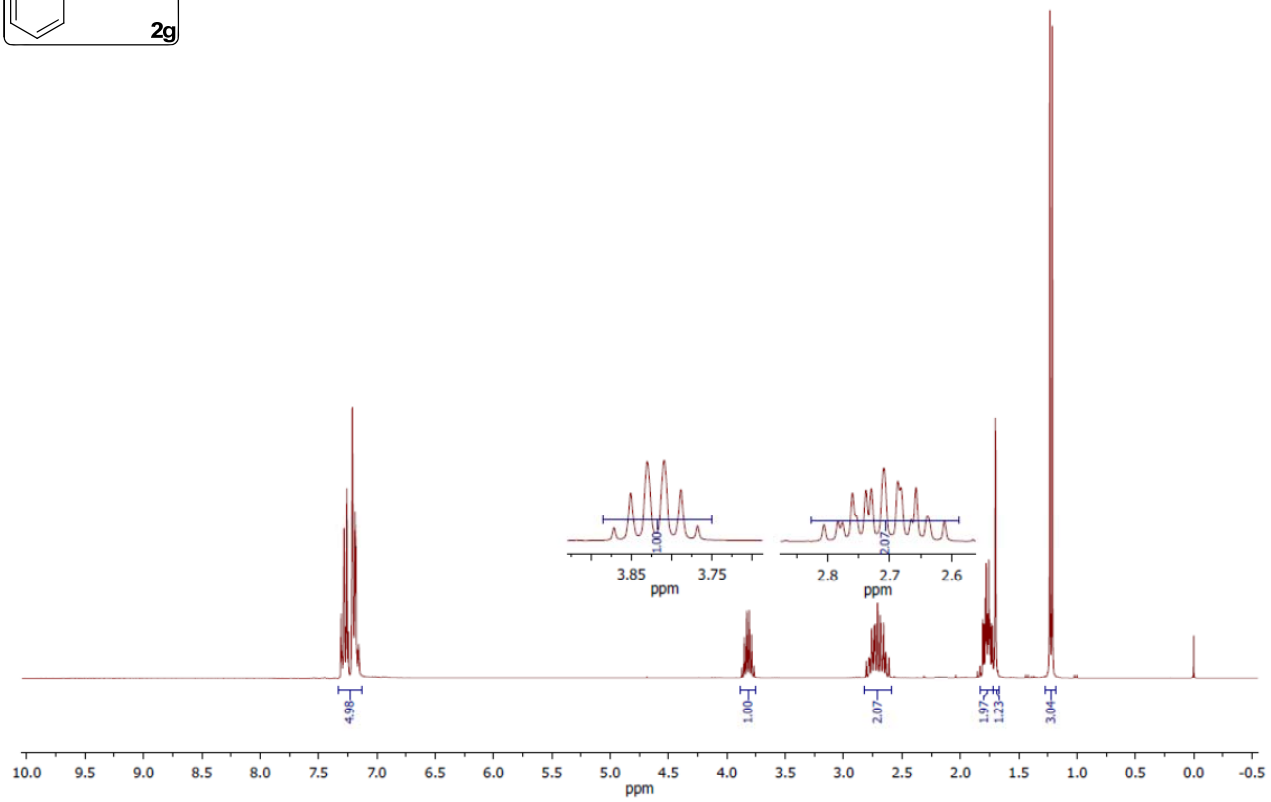


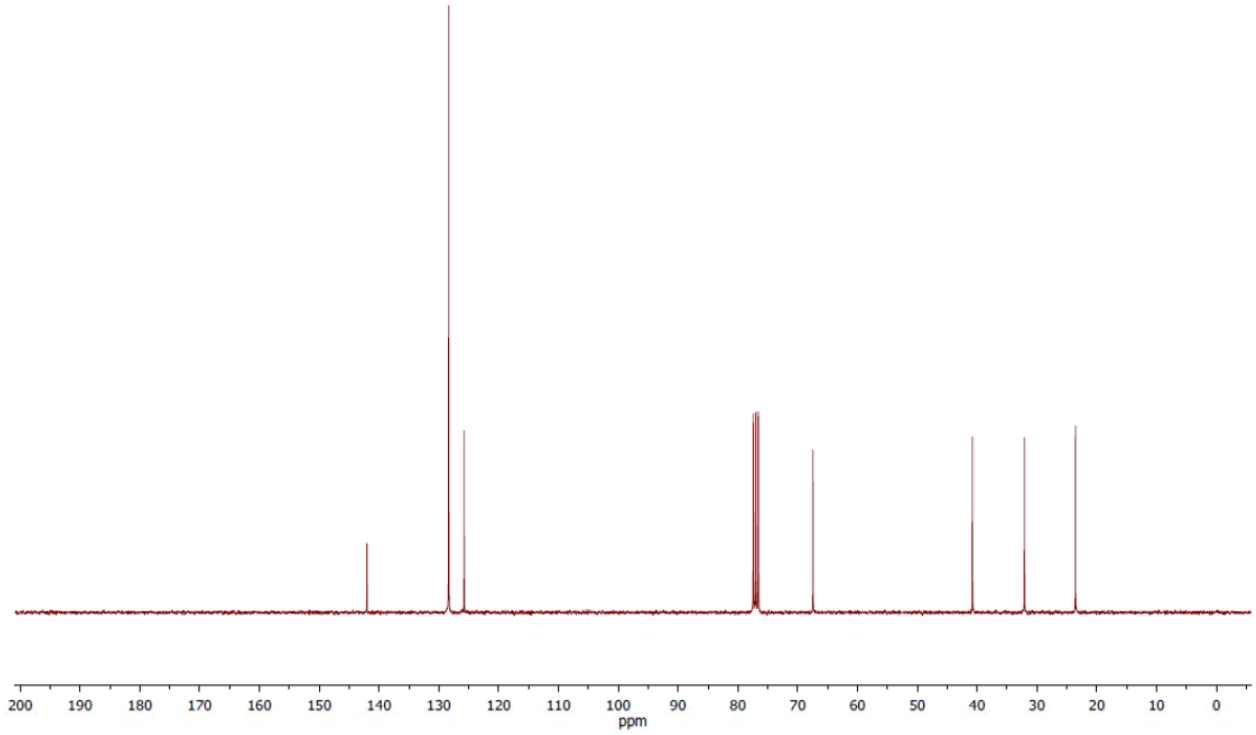




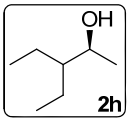
(2g): (*S*)-4-phenylbutan-2-ol

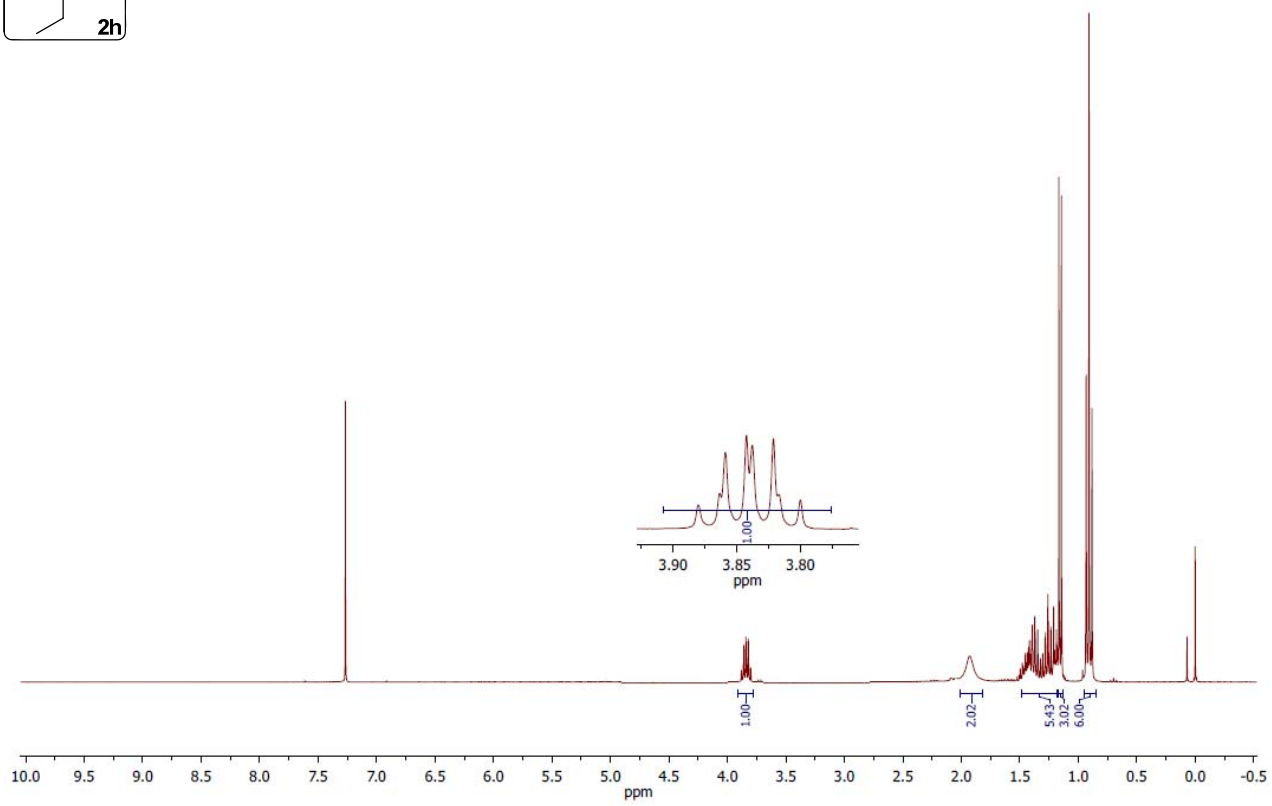


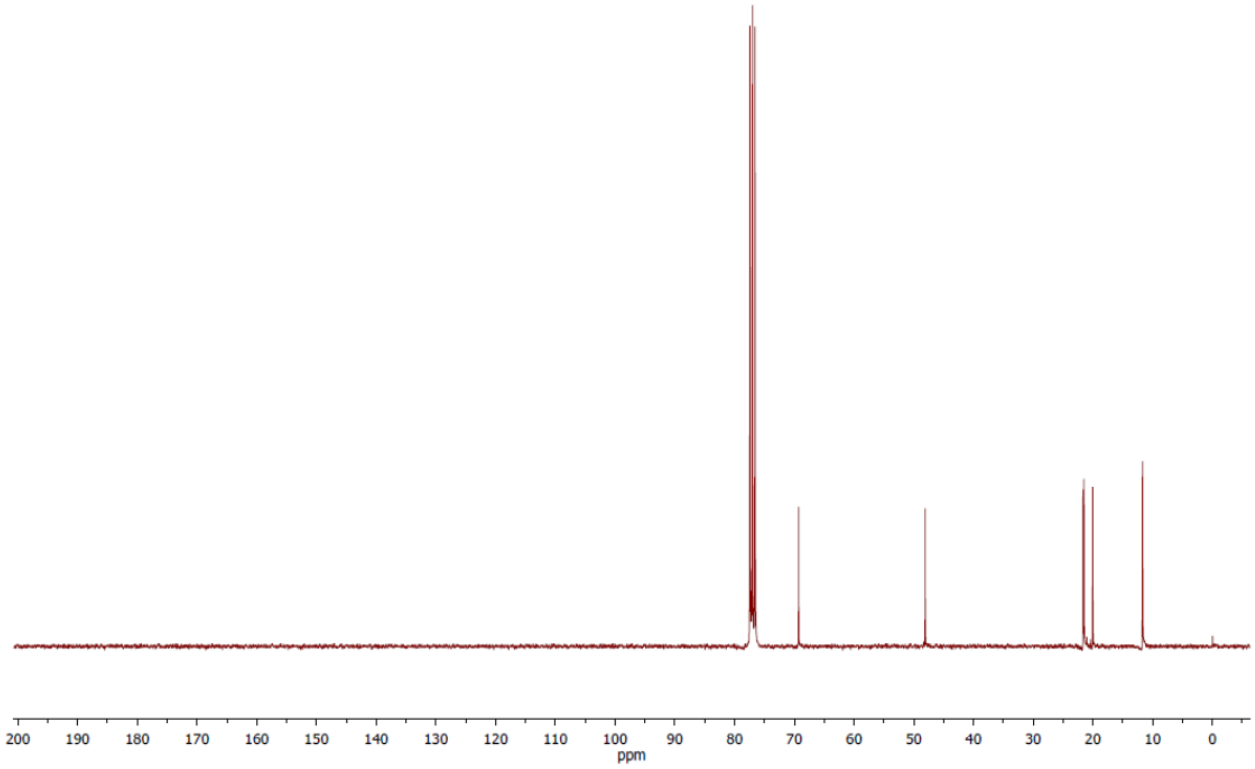




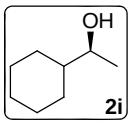
(2h): (+)-3-ethylpentan-2-ol

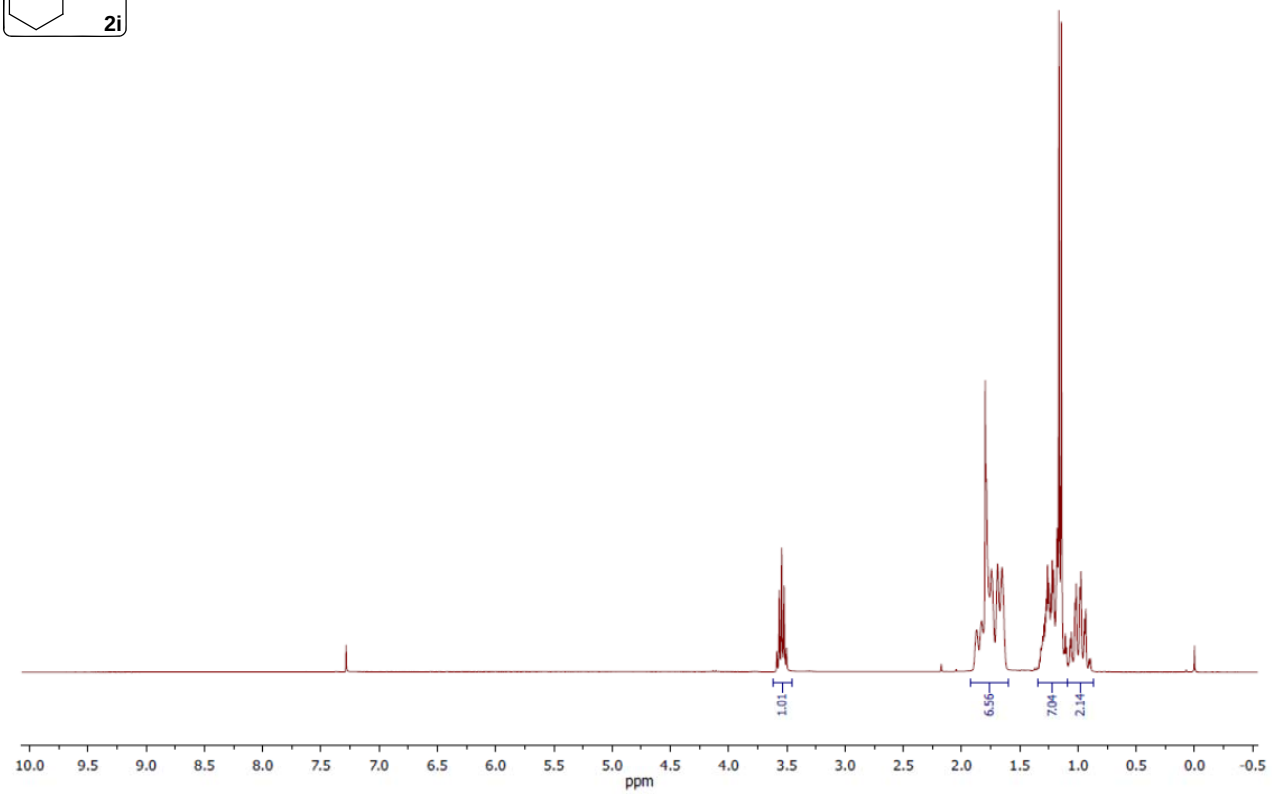


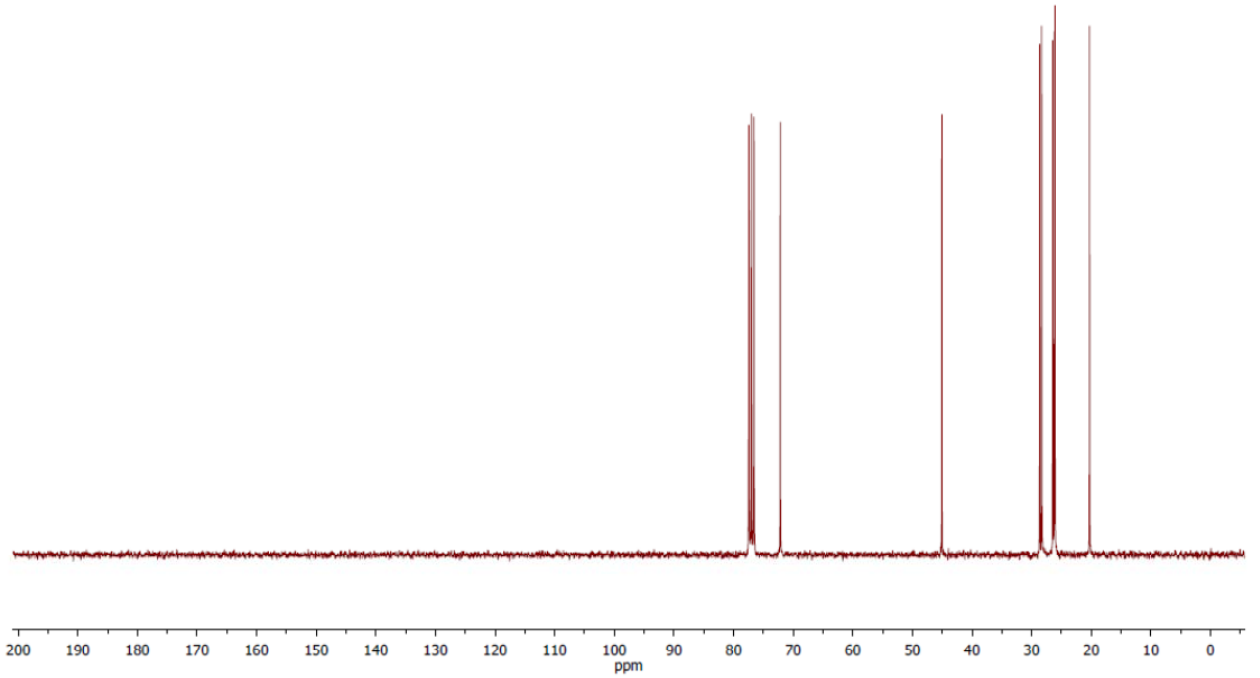




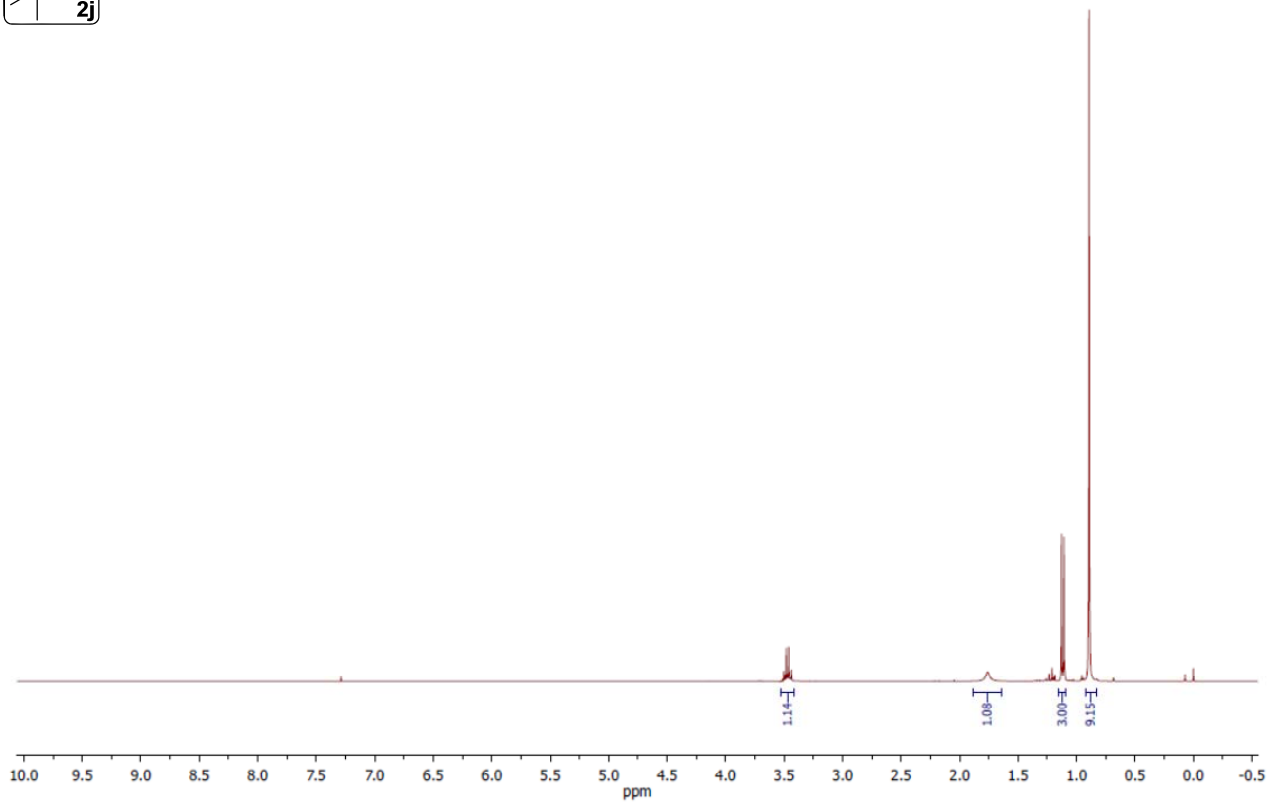
(2i): (*S*)-1-cyclohexylethanol

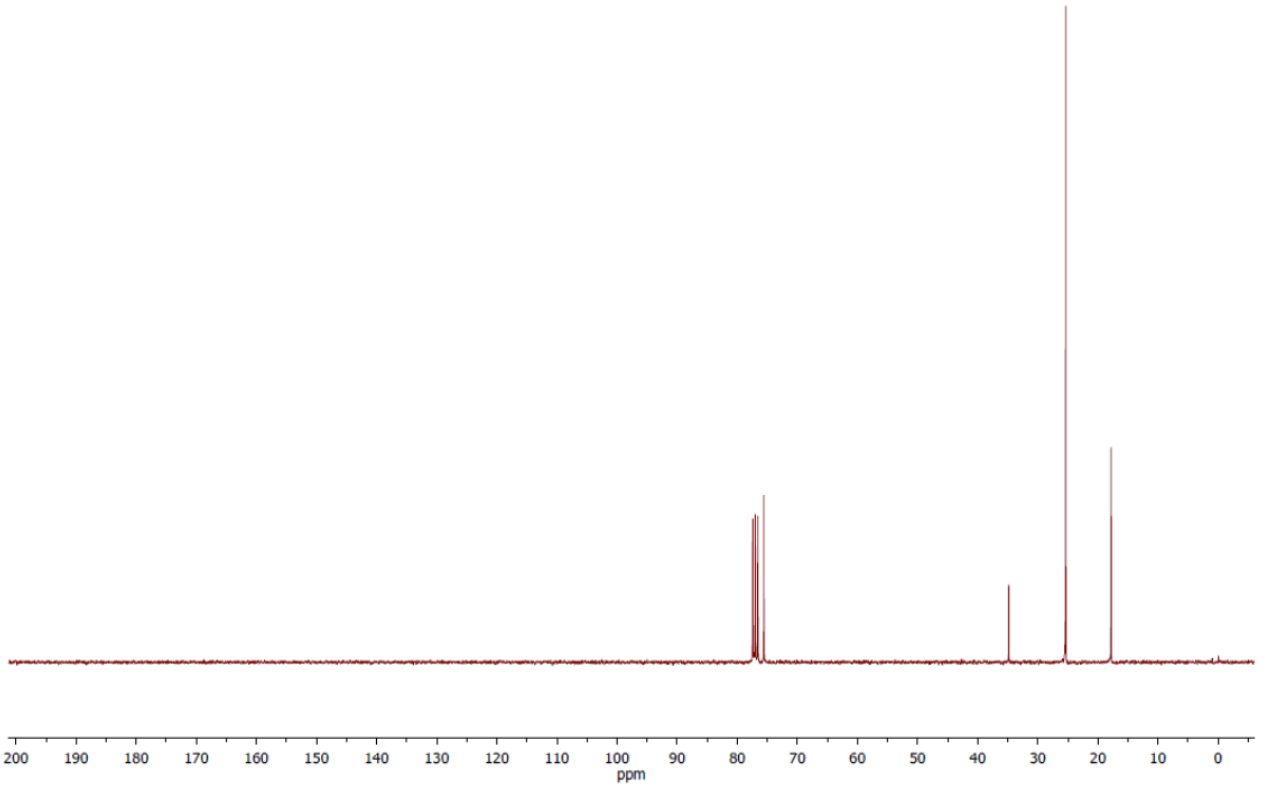




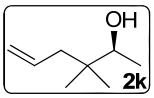


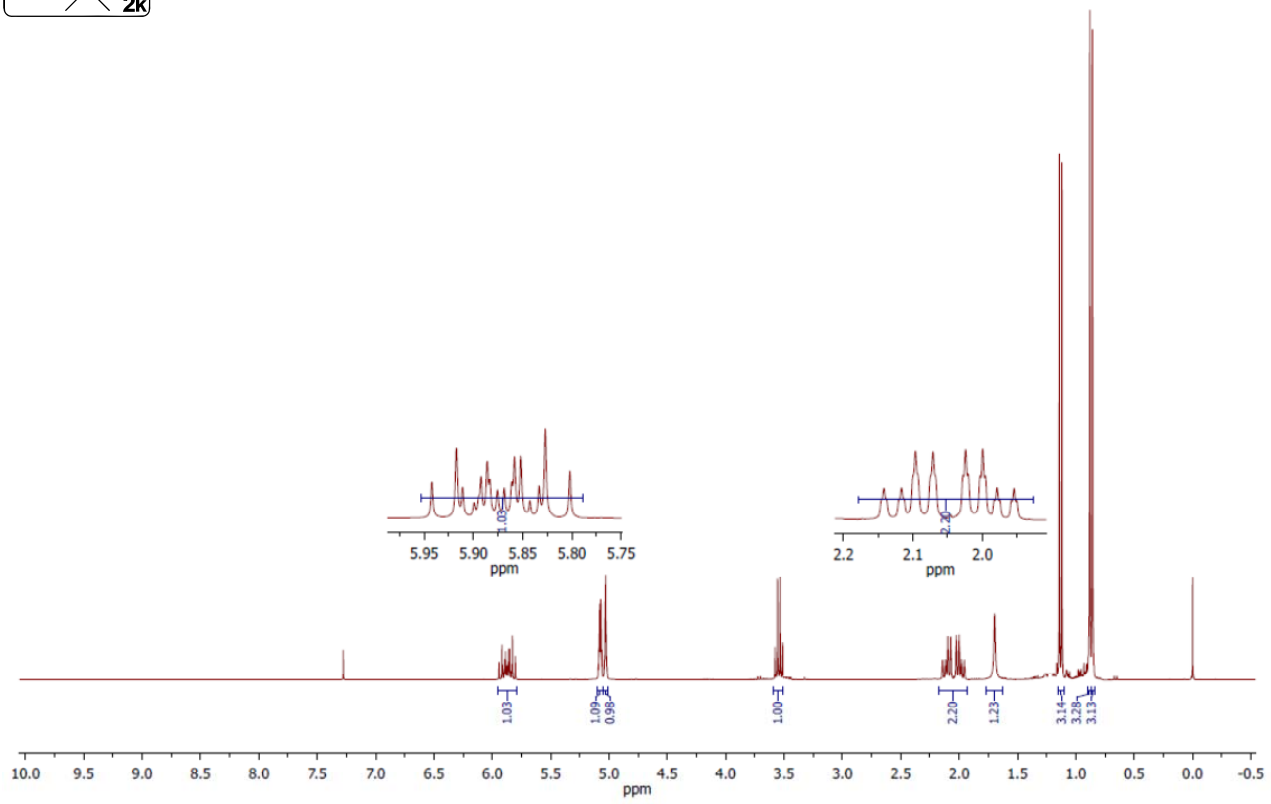
(2j): (*S*)-3,3-dimethylbutan-2-ol

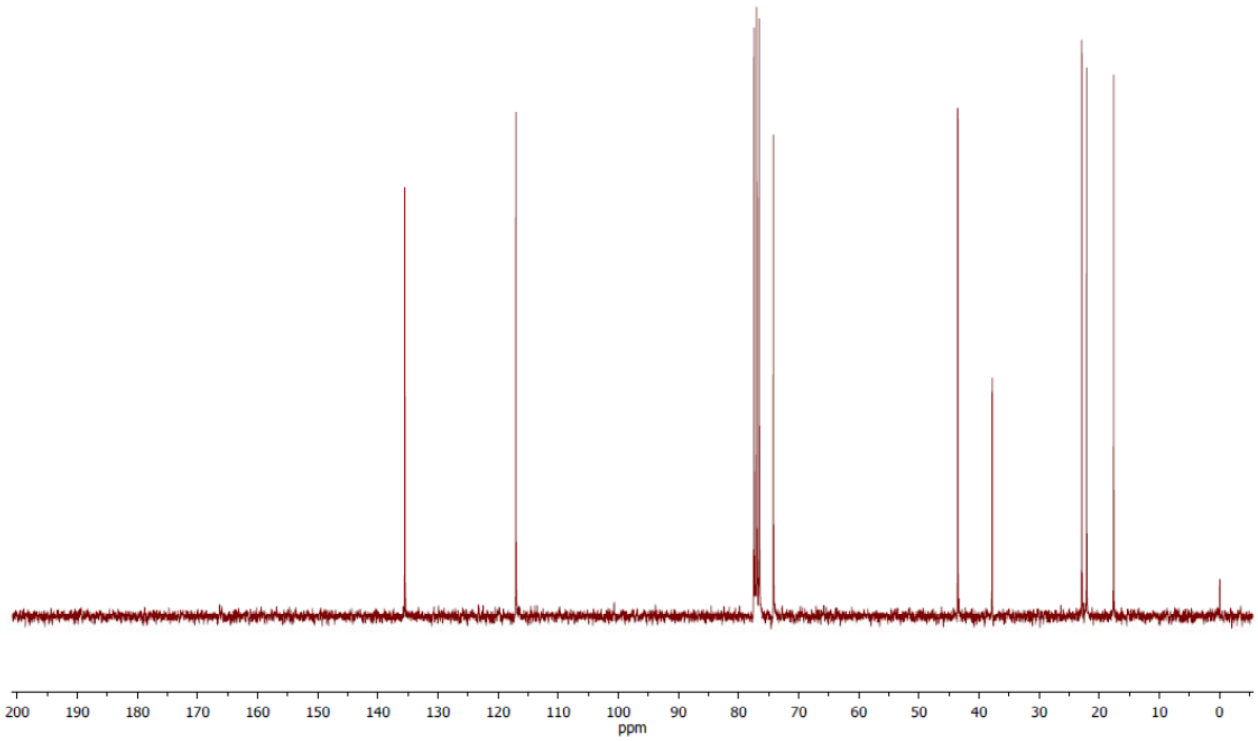




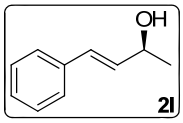
(2k): (*S*)-3,3-dimethylhex-5-en-2-ol

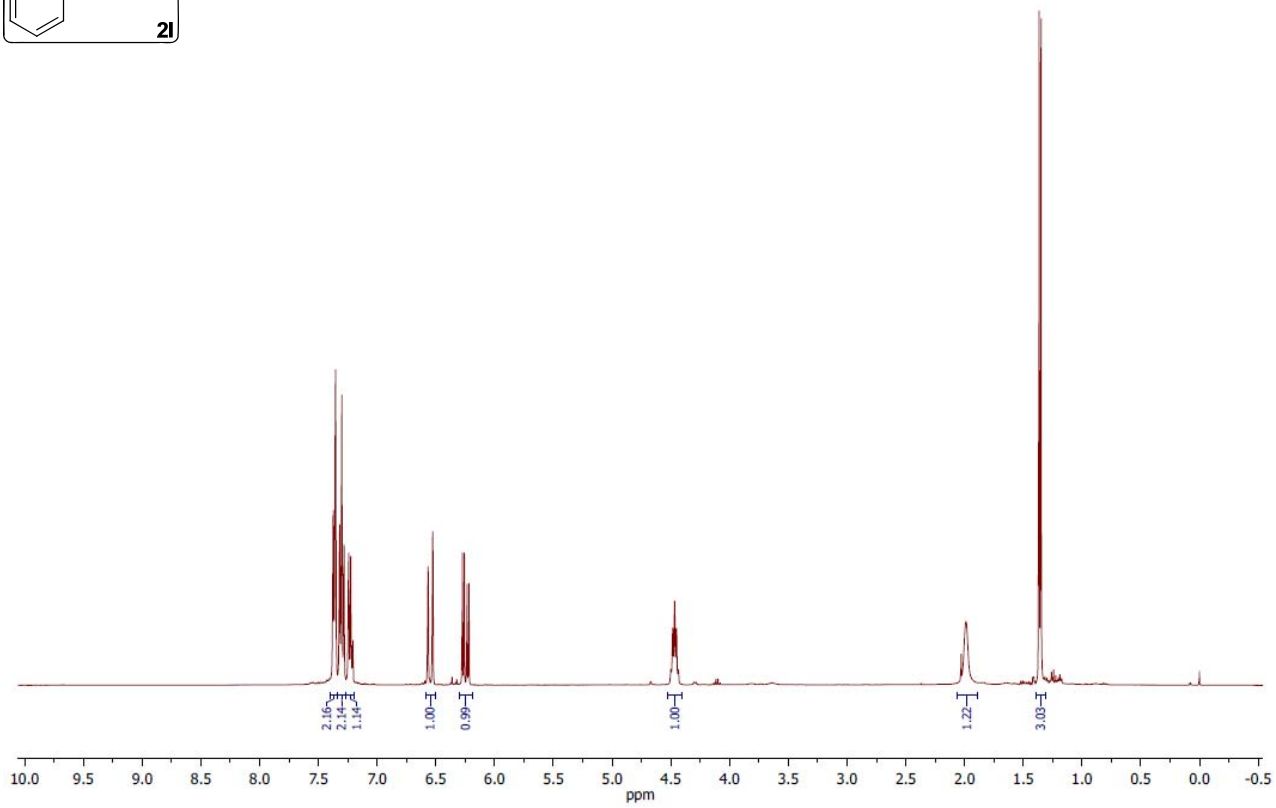


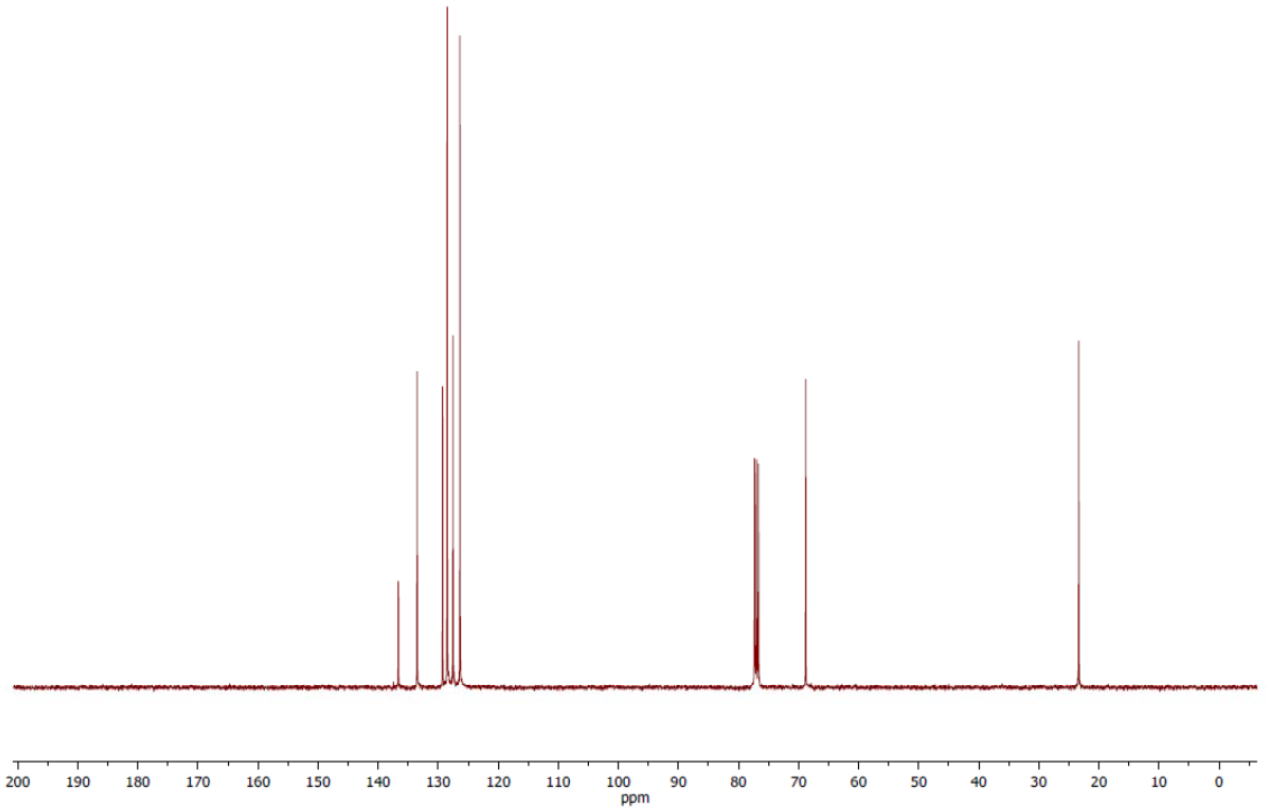




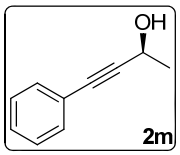
(2l): **(*S*,*E*)-4-phenylbut-3-en-2-ol**

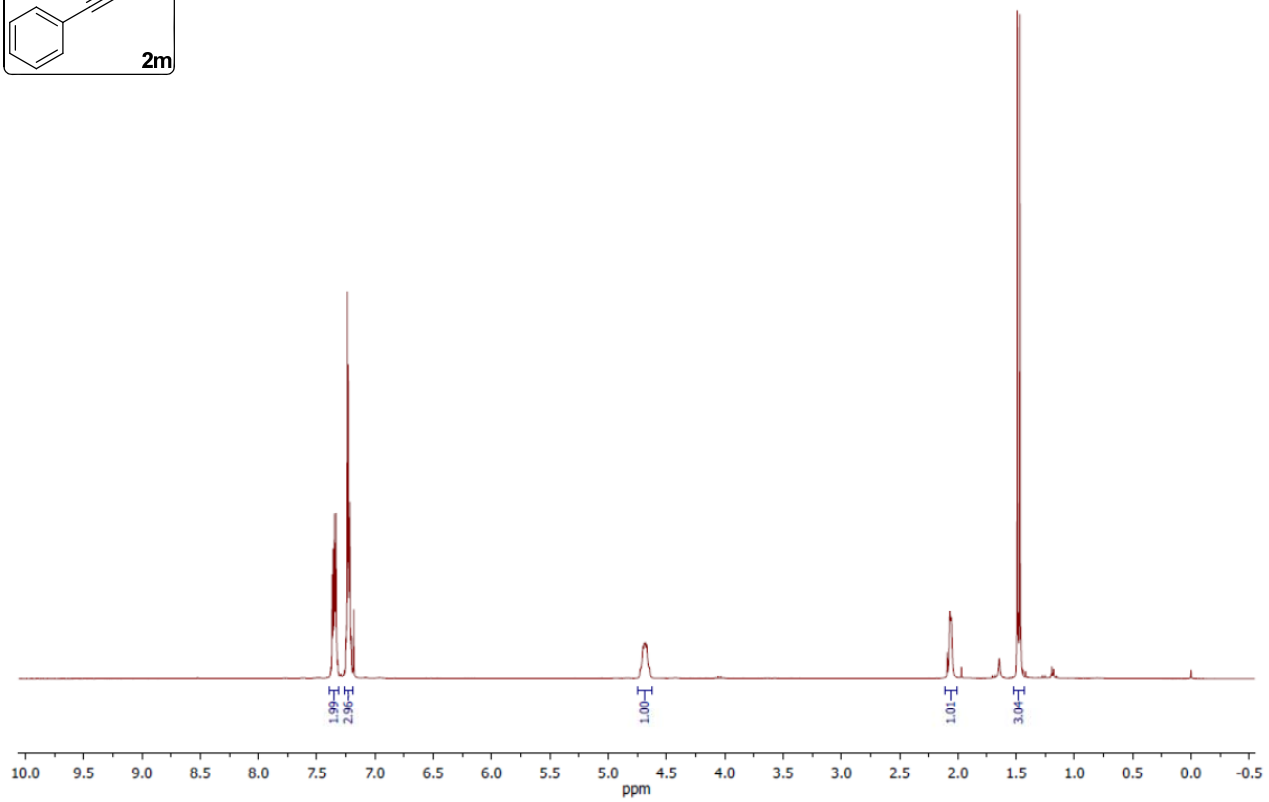


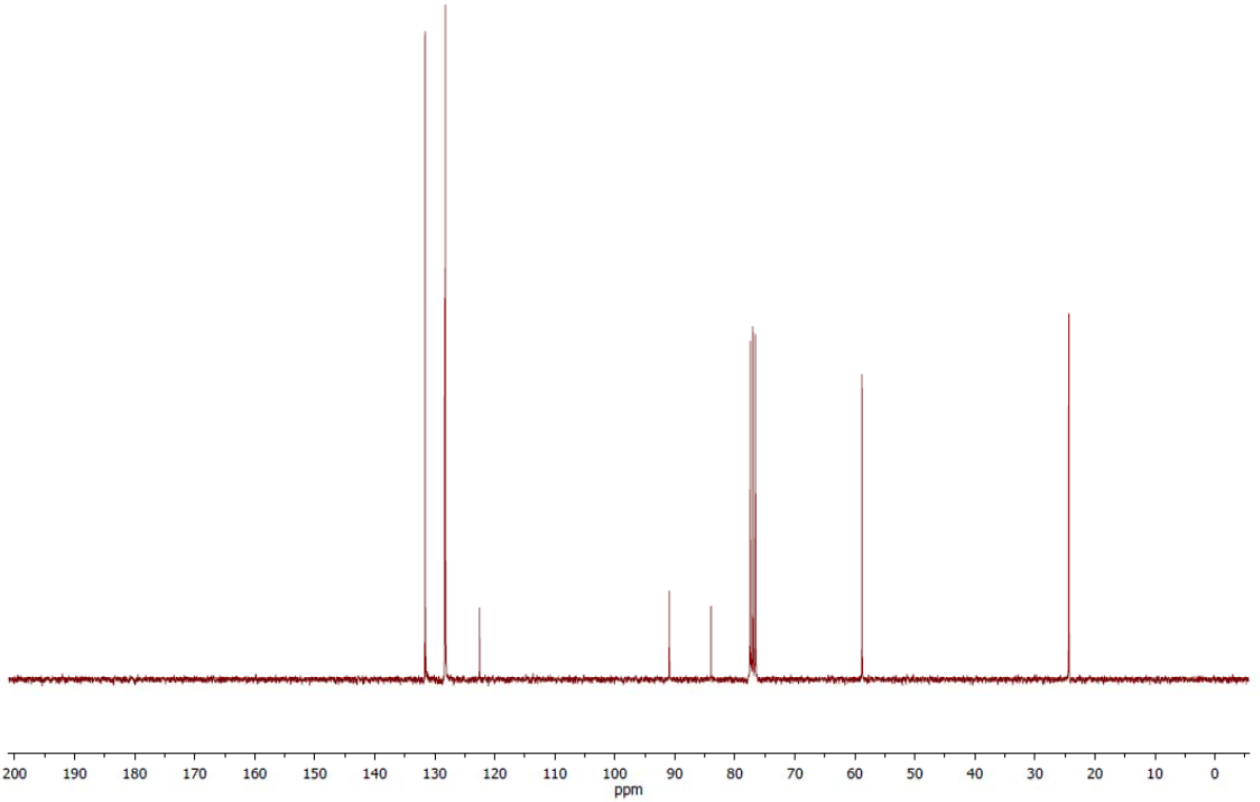




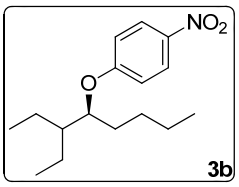
(2m): 4-phenyl-3-butin-2ol

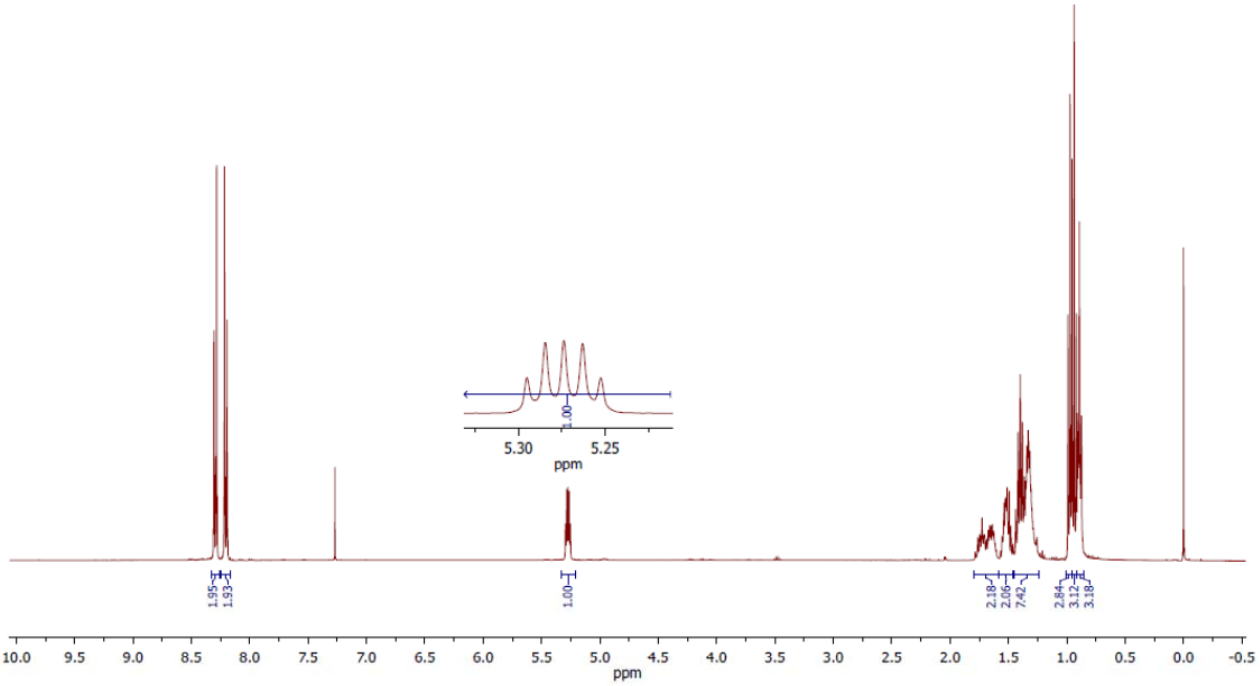


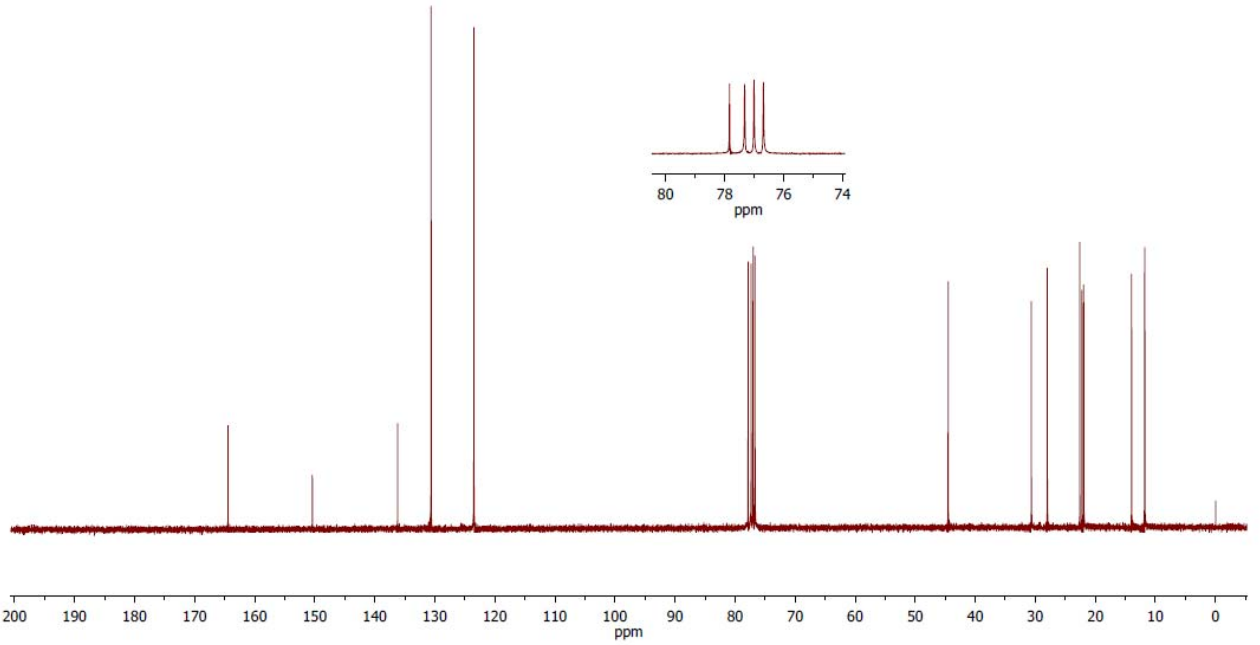




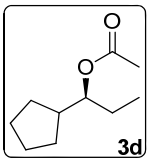
(3b): (*S*)-1-[(3-ethyloctan-4-yl)oxy]-4-nitrobenzene

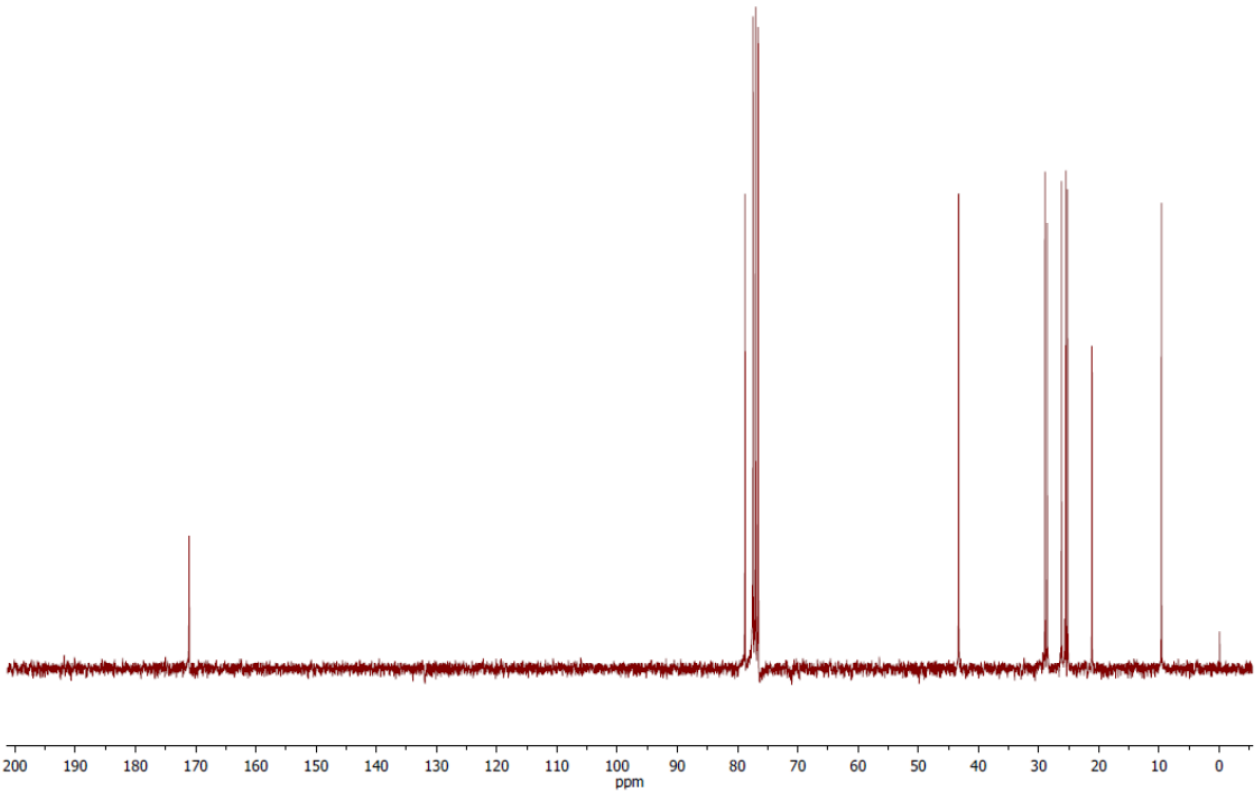




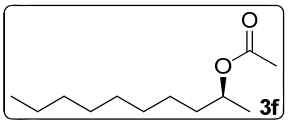


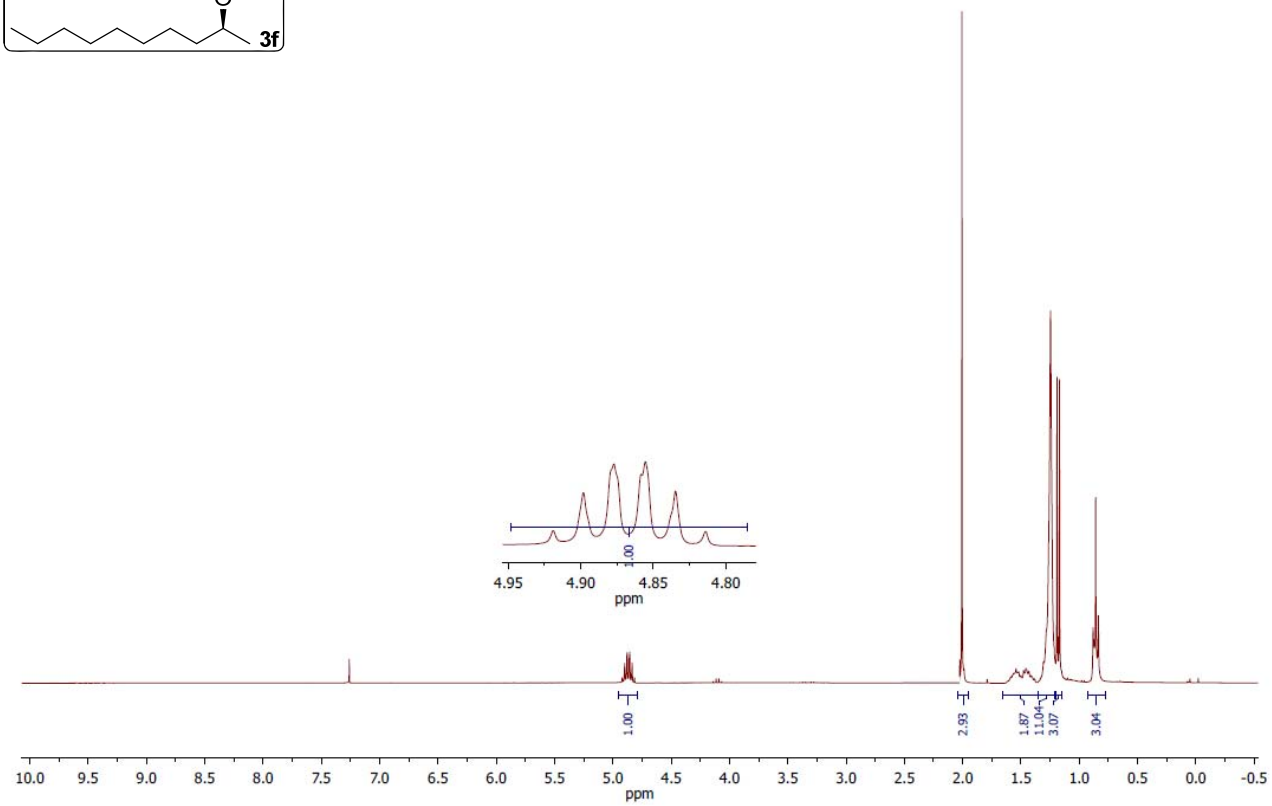
(3d): (*S*)-1-cyclopentylpropyl acetate

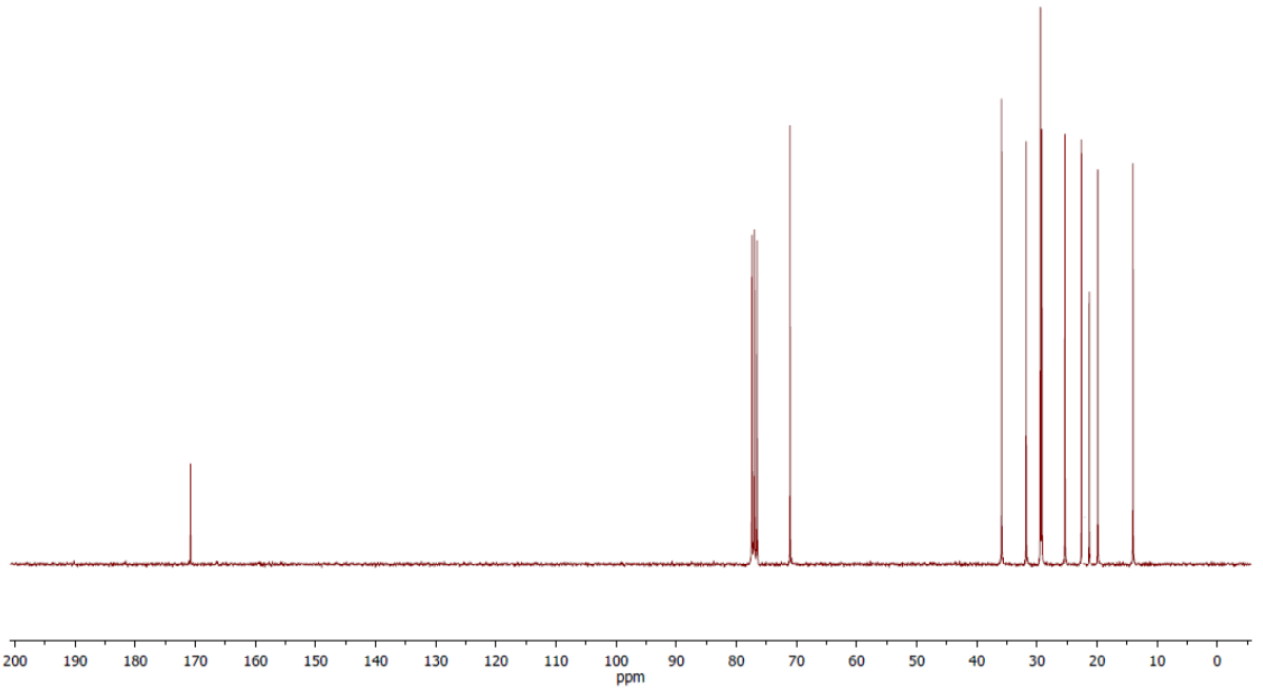




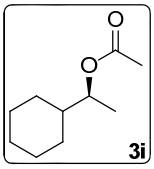
(3f): (*S*)-decan-2-yl acetate

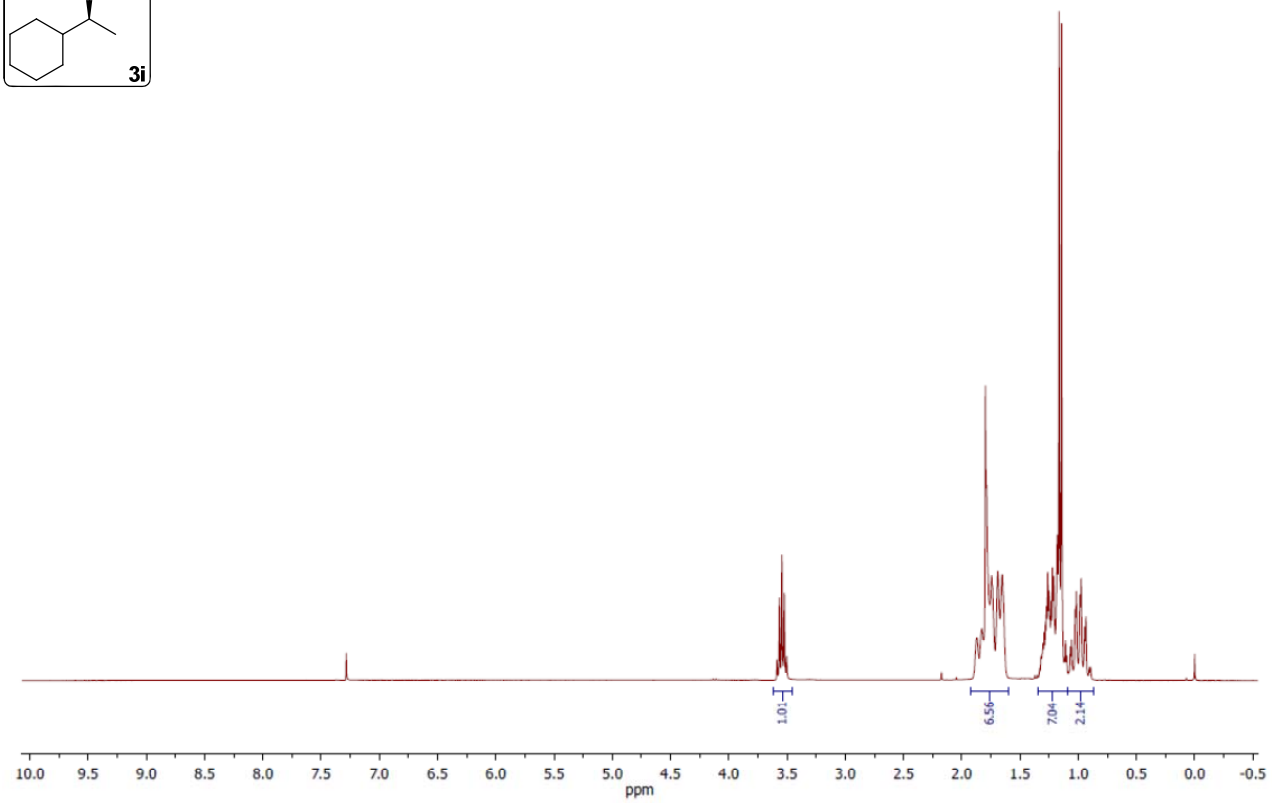


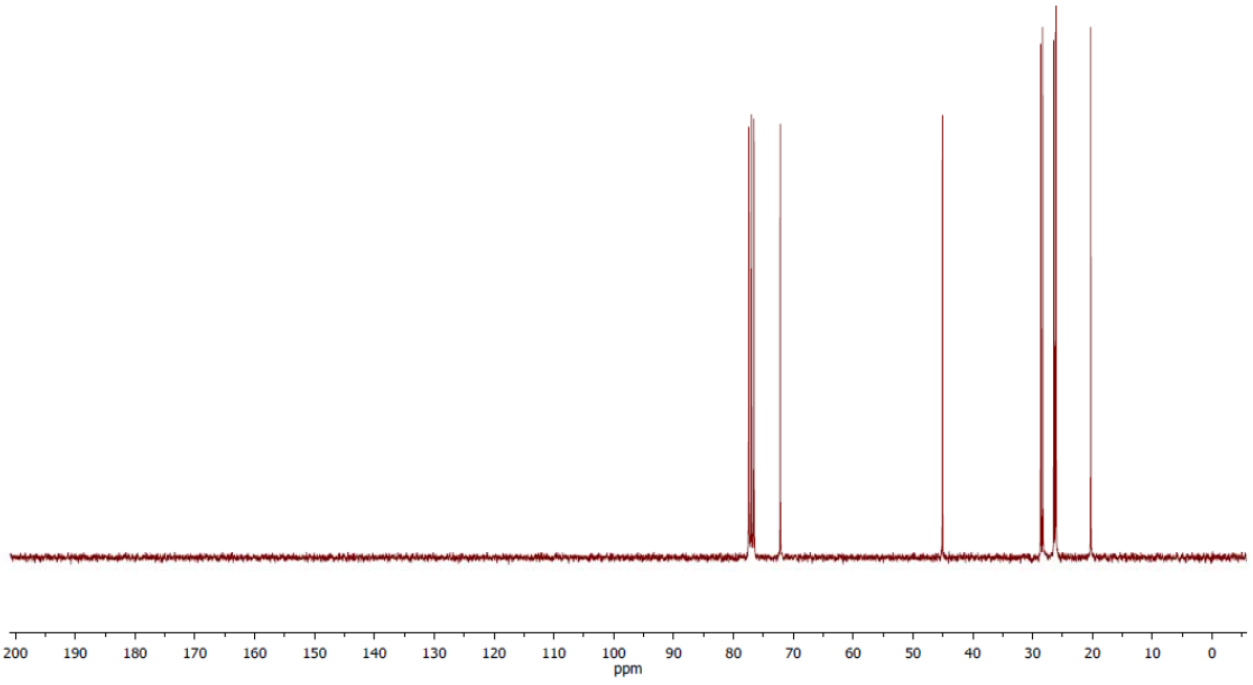




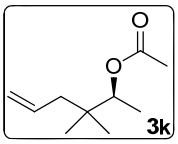
(3i): (*S*)-1-cyclohexylethyl acetate

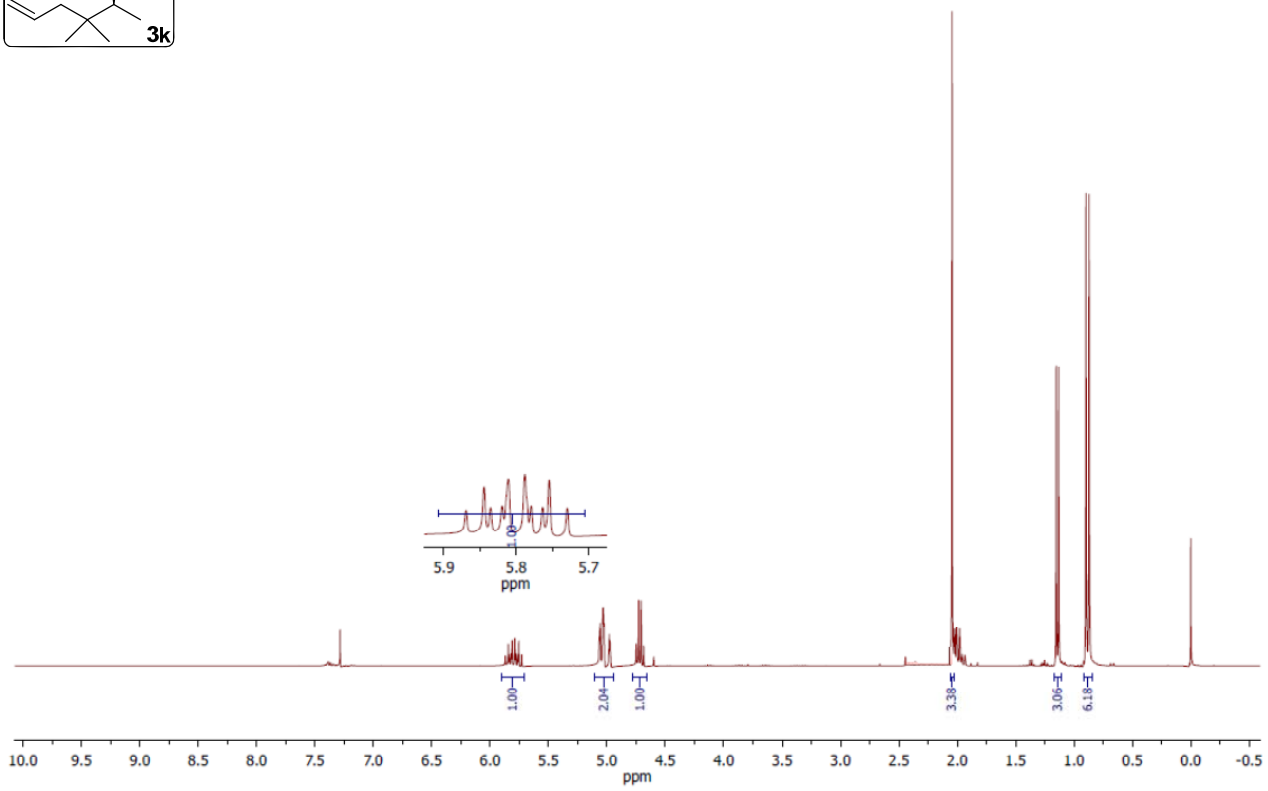


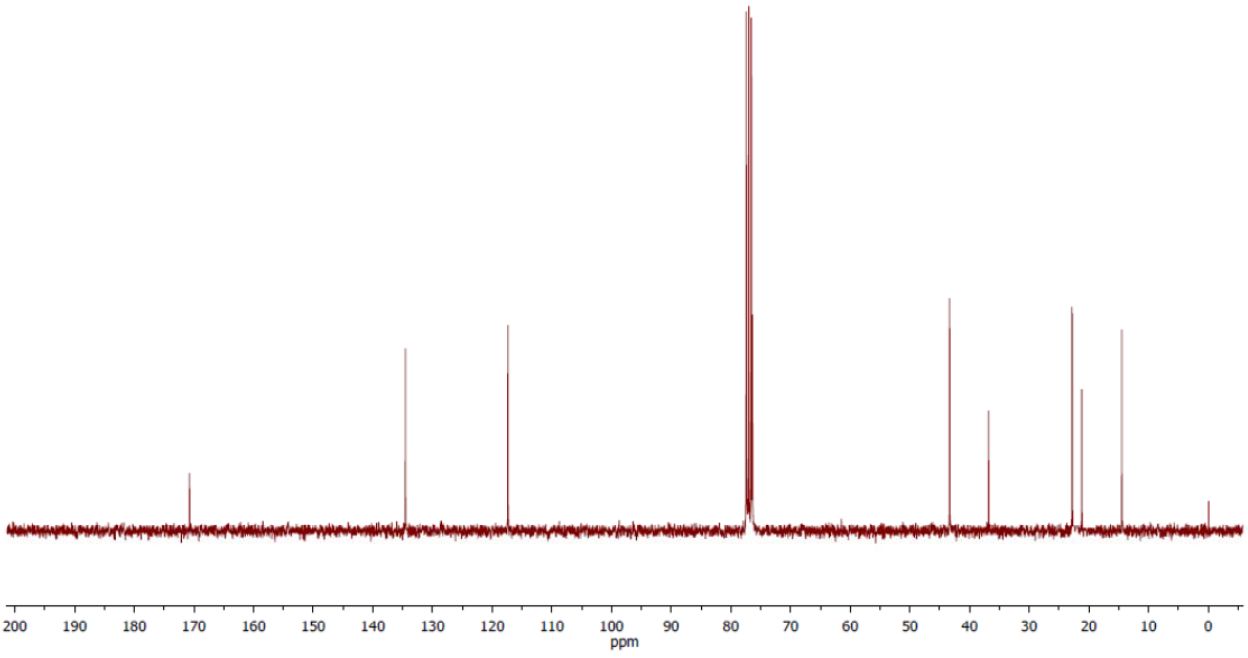




(3k): (*S*)-3,3-dimethylhex-5-en-2-yl acetate

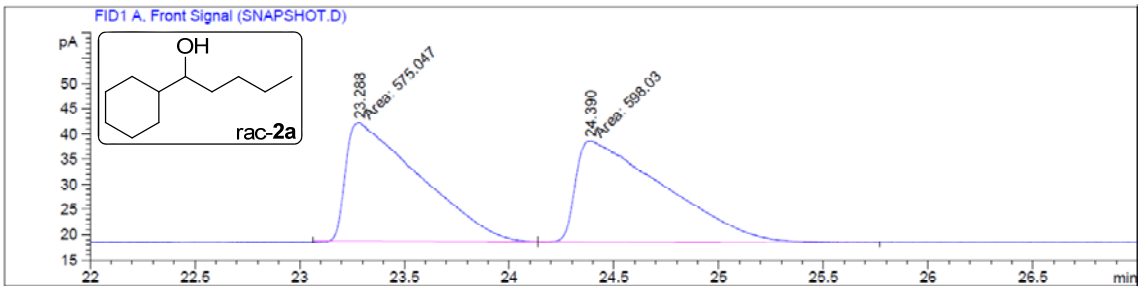




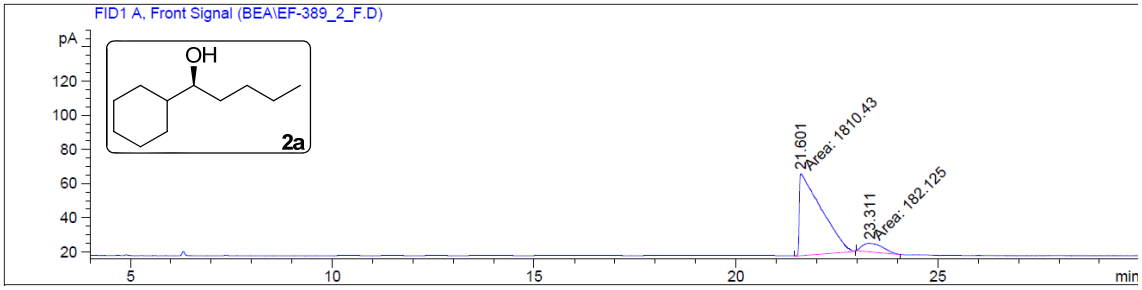


5. Chromatograms (GC, HPLC)

(2a): **(*S*)-1-cyclohexylpentan-1-ol**

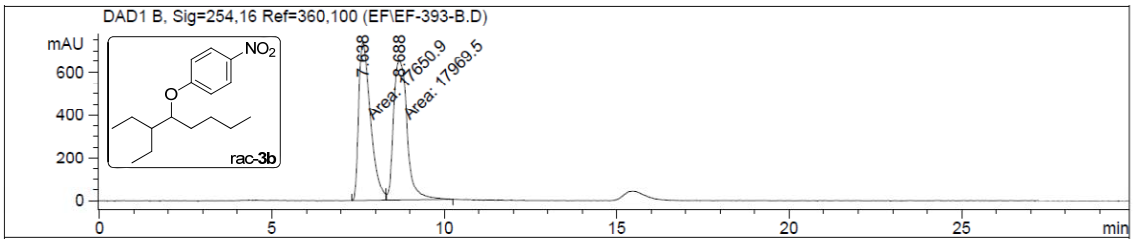


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	23.288	MF	0.4086	575.04688	23.45809	49.02038
2	24.390	FM	0.4964	598.03027	20.07777	50.97962

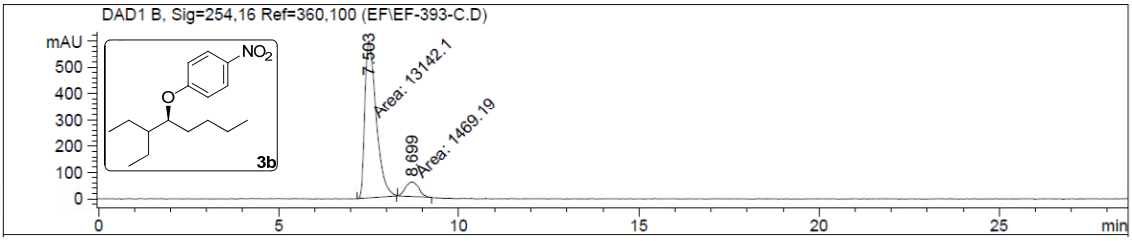


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	21.601	MM	0.6285	1810.42761	48.01290	90.85970
2	23.311	MM	0.6002	182.12535	5.05716	9.14030

(3b): (*S*)-1-[(3-ethyloctan-4-yl)oxy]-4-nitrobenzene

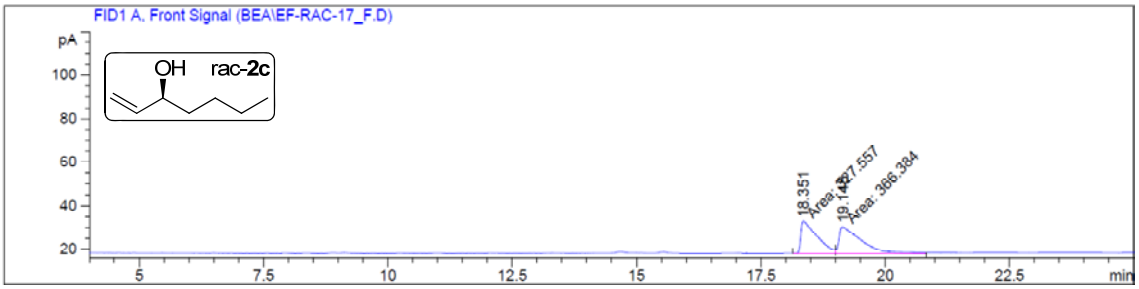


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.638	MF	0.3992	1.76509e4	736.97107	49.5528
2	8.688	FM	0.4607	1.79695e4	650.06836	50.4472

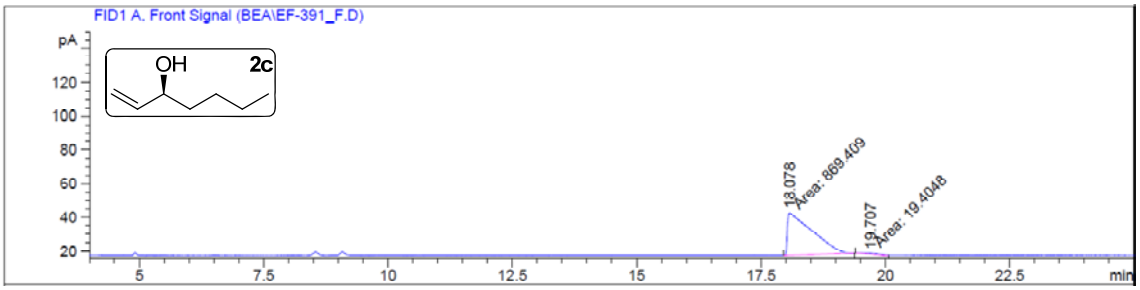


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.503	MM	0.3668	1.31421e4	597.21136	89.9449
2	8.699	MM	0.4241	1469.18726	57.73433	10.0551

(2c): (*S*)-hept-1-en-3-ol

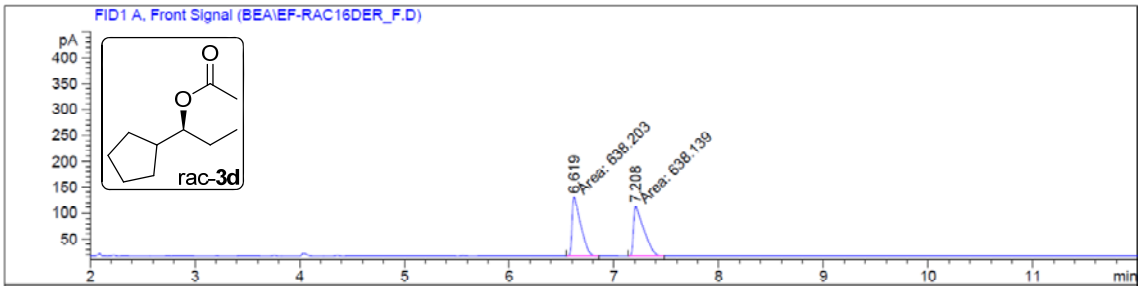


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	18.351	MF	0.3705	327.55664	14.73479	47.20240
2	19.148	FM	0.5011	366.38397	12.18684	52.79760

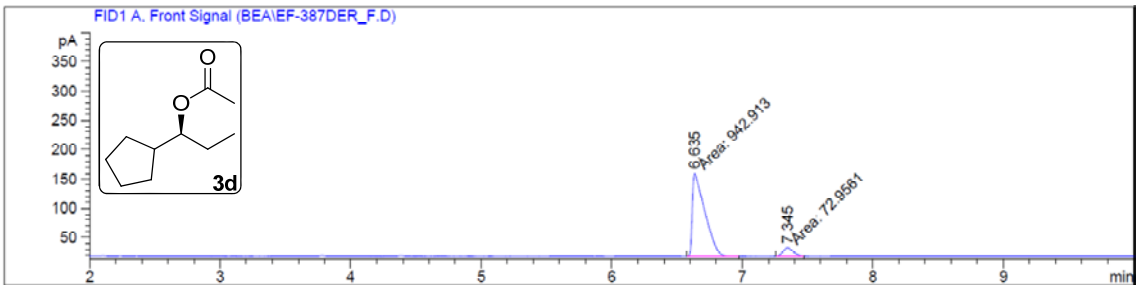


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	18.078	MM	0.5718	869.40936	25.34164	97.81678
2	19.707	MM	0.4309	19.40478	7.50555e-1	2.18322

(3d): (*S*)-1-cyclopentylpropyl acetate

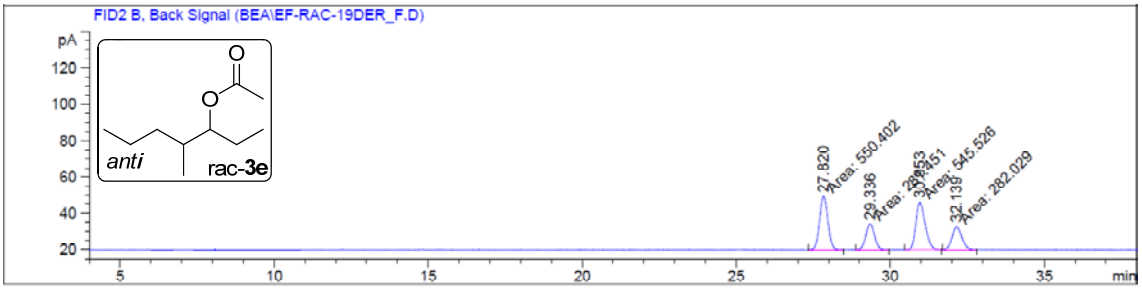


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	6.619	MM	0.0944	638.20325	112.65652	50.00252
2	7.208	MM	0.1139	638.13898	93.35101	49.99748

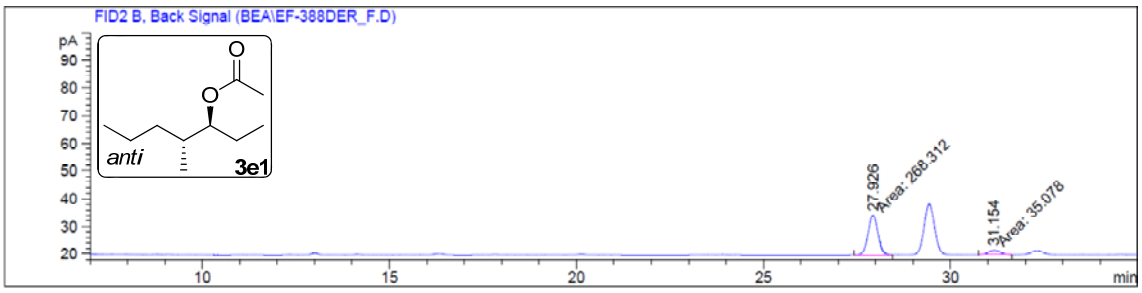


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	6.635	MM	0.1107	942.91284	141.96185	92.81835
2	7.345	MM	0.0867	72.95611	14.02194	7.18165

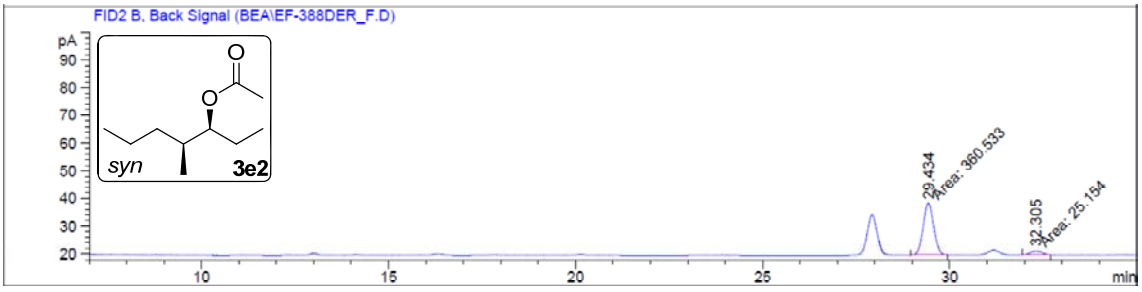
(3*S*,4*R*)-4-methylheptan-3-yl acetate + (3*S*,4*S*)-4-methylheptan-3-yl acetate (3e1 + 3e2):



Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	27.820	MM	0.3098	550.40186	29.60610	33.16857
2	29.336	MM	0.3263	281.45068	14.37498	16.96091
3	30.953	MM	0.3492	545.52631	26.03963	32.87475
4	32.139	MM	0.3699	282.02921	12.70760	16.99577

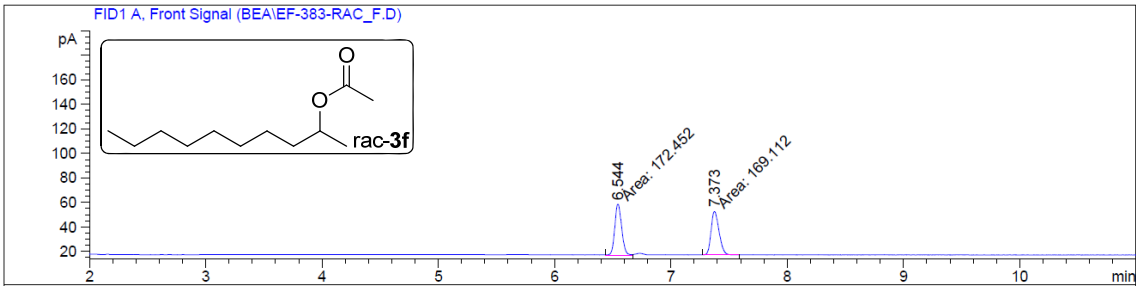


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	27.926	MM	0.3082	268.31201	14.51172	88.43799
2	31.154	MM	0.3316	35.07796	1.76326	11.56201

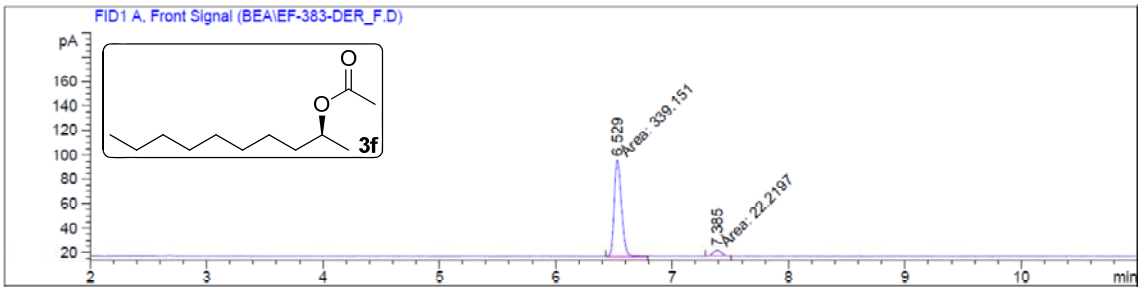


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	29.434	MM	0.3221	360.53253	18.65756	93.47812
2	32.305	MM	0.3060	25.15400	1.36999	6.52188

(3f): (*S*)-decan-2-yl acetate

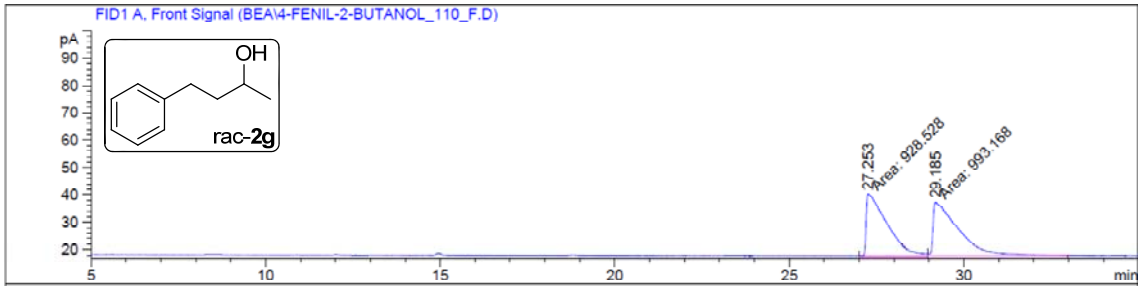


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	6.544	MM	0.0690	172.45200	41.68355	50.48892
2	7.373	MM	0.0797	169.11206	35.35094	49.51108

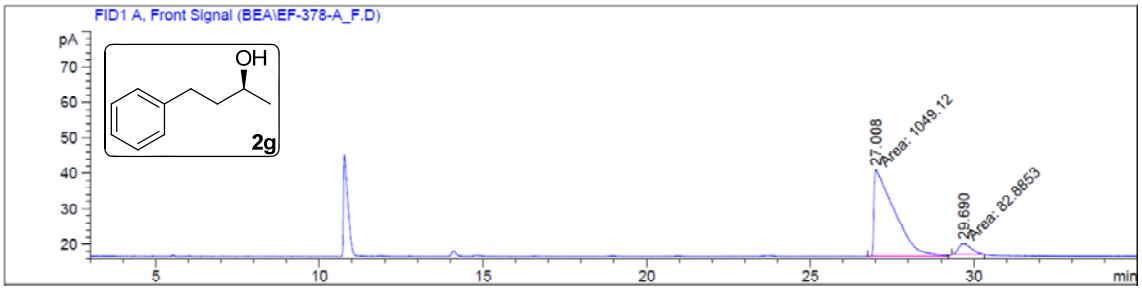


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	6.529	MM	0.0717	339.15070	78.80565	93.85128
2	7.385	MM	0.0794	22.21966	4.66649	6.14872

(2g): (*S*)-4-phenylbut-2-ol

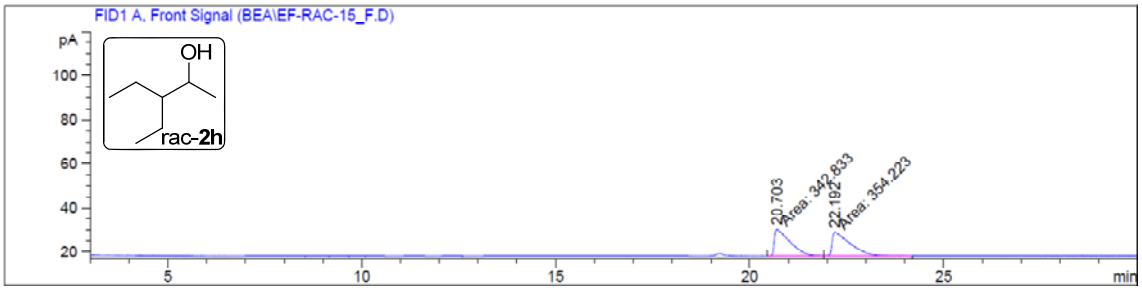


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	27.253	MF	0.6852	928.52838	22.58524	48.31816
2	29.185	FM	0.8441	993.16821	19.61069	51.68184

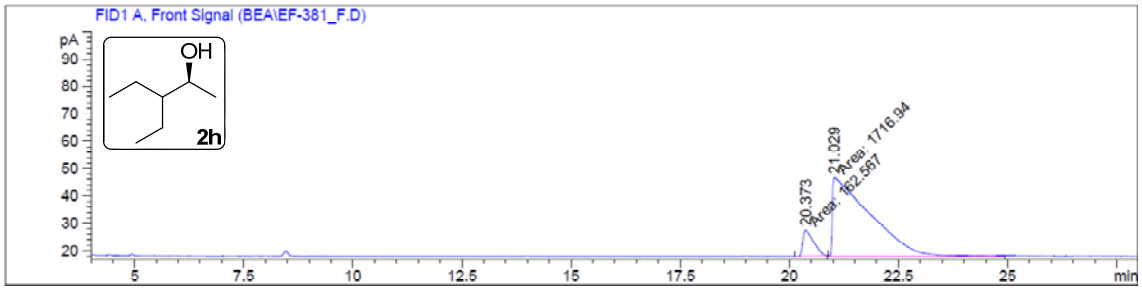


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	27.008	MM	0.7197	1049.12451	24.29403	92.67804
2	29.690	MM	0.4501	82.88529	3.06910	7.32196

(2h): (+)-3-ethylpentan-2-ol

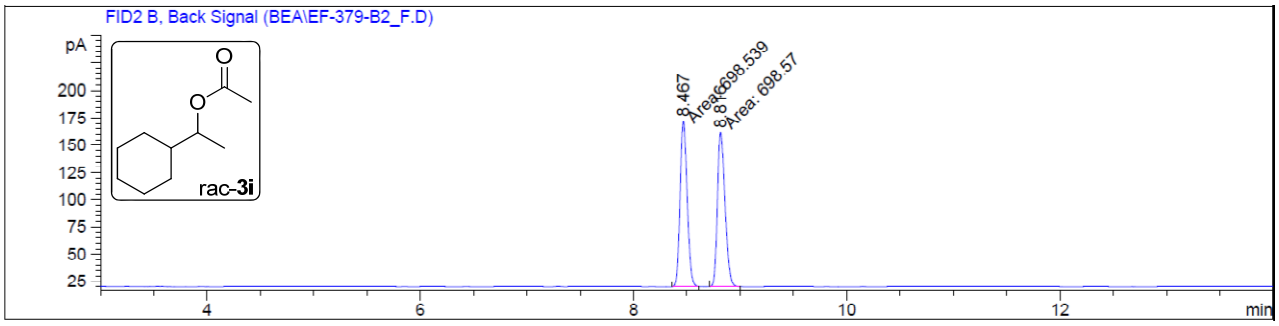


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	20.703	MF	0.4597	342.83286	12.42993	49.18296
2	22.192	FM	0.5397	354.22336	10.93894	50.81704

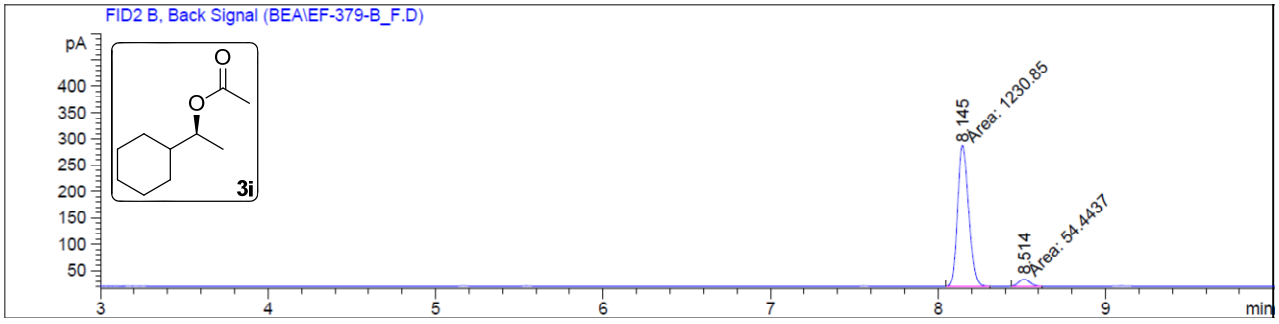


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	20.373	MM	0.2850	162.56718	9.50768	8.64944
2	21.029	MM	0.9983	1716.94287	28.66424	91.35056

(3i): (*S*)-1-cyclohexylethyl acetate

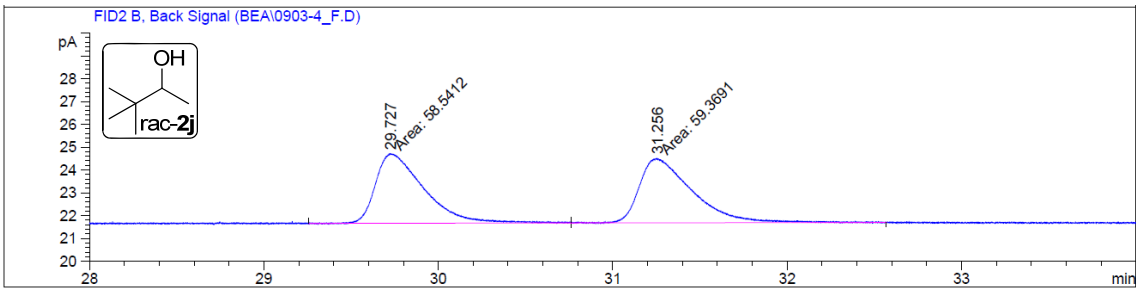


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	8.467	MM	0.0768	698.53894	151.50034	49.99890
2	8.816	MM	0.0822	698.56964	141.60370	50.00110

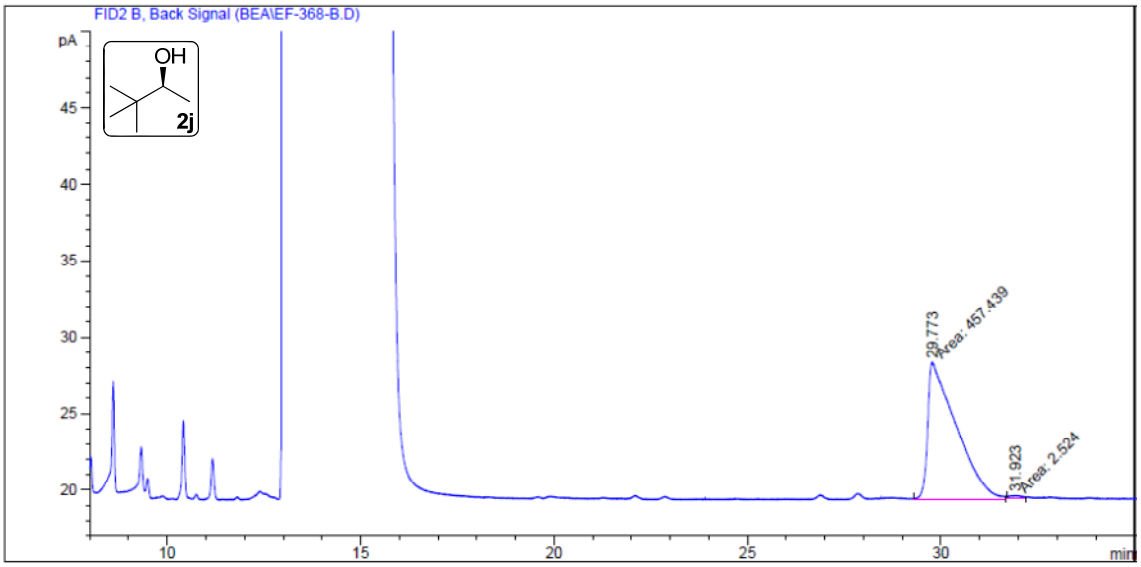


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	8.145	MM	0.0770	1230.85315	266.38245	95.76411
2	8.514	MM	0.0739	54.44371	12.27396	4.23589

(2j): (*S*)-3,3-dimethylbutan-2-ol

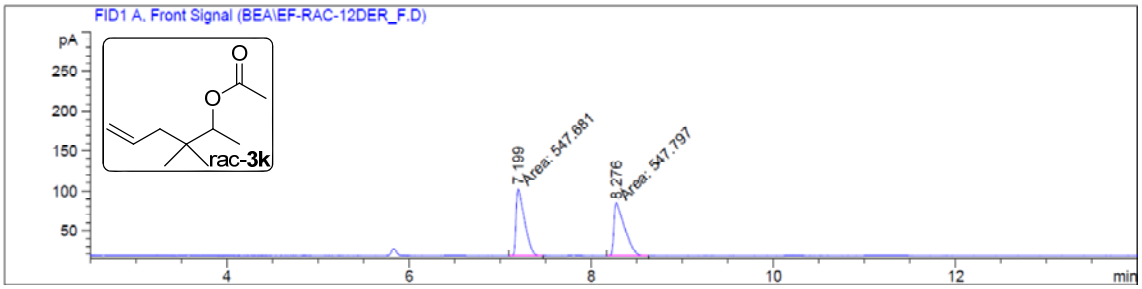


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	29.727	MF	0.3198	58.54120	3.05115	49.64893
2	31.256	FM	0.3501	59.36910	2.82605	50.35107

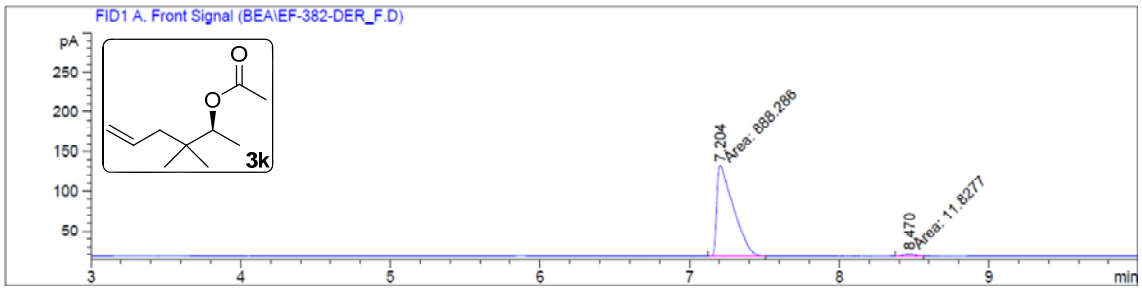


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	29.773	MM	0.8532	457.43884	8.93574	99.45126
2	31.923	MM	0.3146	2.52400	1.33704e-1	0.54874

(3k): (*S*)-3,3-dimethylhex-5-en-2-yl acetate

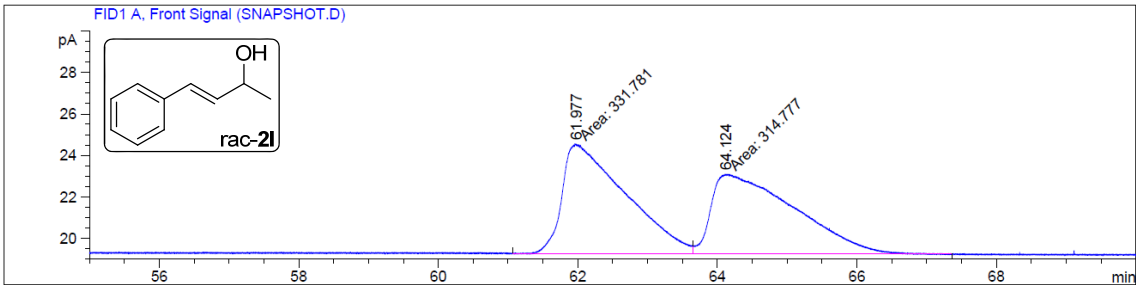


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	7.199	MM	0.1072	547.68140	85.11786	49.99471
2	8.276	MM	0.1368	547.79730	66.74617	50.00529

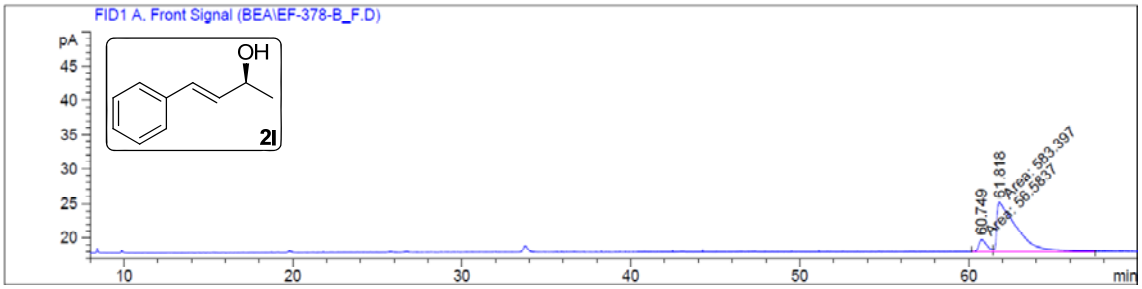


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	7.204	MM	0.1298	888.28650	114.05017	98.68597
2	8.470	MM	0.0920	11.82775	2.14331	1.31403

(2l): **(*S*,*E*)-4-phenylbut-3-en-2-ol**

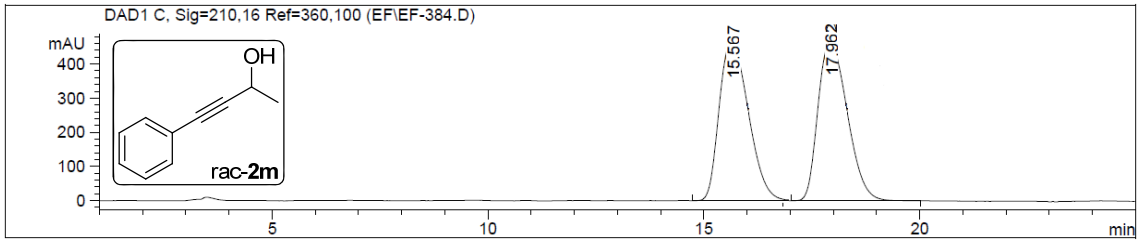


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	61.977	MF	1.0489	331.78058	5.27168	51.31493
2	64.124	FM	1.3710	314.77704	3.82671	48.68507

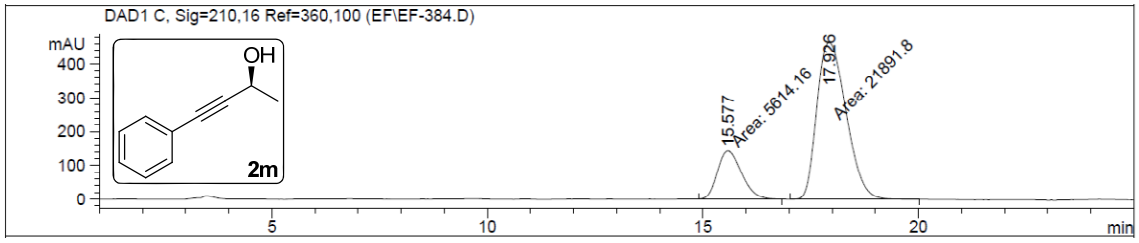


Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	60.749	MF	0.5359	56.58375	1.75973	8.84148
2	61.818	FM	1.3530	583.39697	7.18629	91.15852

(2m): 4-phenyl-3-butin-2ol



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.567	MF	0.7021	1.79695e4	450.68440	50.4472
2	17.962	FM	0.7076	1.77896e4	447.84578	49.5528



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.575	BB	0.6047	4707.90576	121.86532	19.0351
2	17.921	BB	0.7036	2.00249e4	447.86179	80.9649