Supporting Information

Palladium-Catalyzed Decarboxylative *O*-Allylation of Phenols with γ-Methylidene-δ-valerolactone

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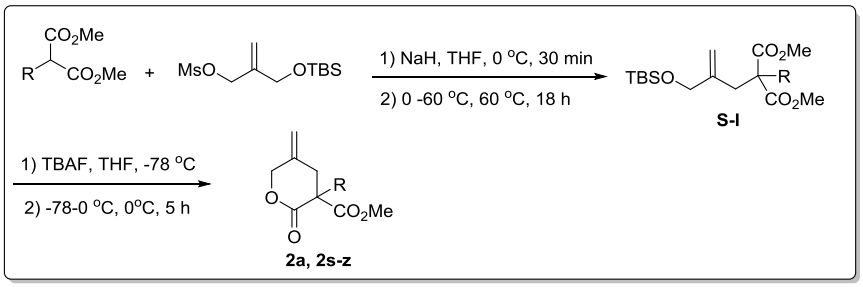
TABLE OF CONTENTS **PAGE**

I. General Experiment Information and Materials

All commercial reagents were used without further purification unless otherwise noted. Solvents were freshly dried according to *the purification handbook Purification of Laboratory Chemicals* before using. All of γ-Methylidene-δ-valerolactones **2**, **6** and *ortho*-hydroxy benzylic alcohols **4a-s** were prepared according to literature procedure,[1-6] *ortho*-hydroxy benzylic alcohol **4t** is commercial reagent and was used without further purification. Proton and carbon magnetic resonance spectra (^{1}H NMR and ^{13}C NMR) were recorded on a Bruker Avance 500 MHz spectrometer. Tetramethylsilane (TMS) served as the internal standard for ^{1}H NMR, and $CDCl_3$ served as the internal standard for ^{13}C NMR. ^{1}H NMR data were reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, td = triplet of doublet, dt = doublet of triplet, dd = doublet of doublet), coupling constants (Hz), and integration. Infrared Spectroscopy was conducted on Thermo Fisher Nicolet is 10. The X-ray single-crystal diffraction was performed on Saturn 724+ instrument. High resolution mass spectra were obtained on an Ultima Global spectrometer with an ESI source.

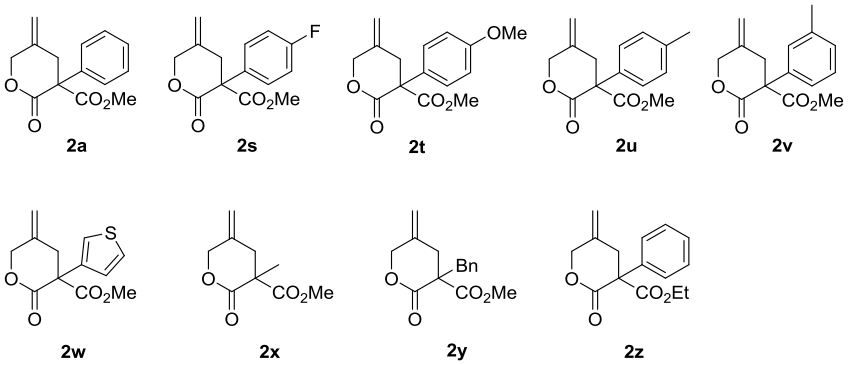
II. Experimental Procedure and Characterization Data

A) Preparation of γ-Methylidene-δ-valerolactones 2a, 2s-2z [1-3]

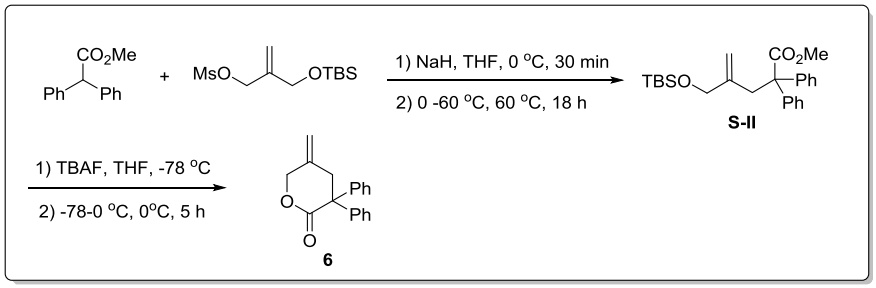


A solution of dimethyl phenylmalonate (2.08 g, 10.0 mmol) in THF (15 mL) was added to a suspension of NaH (420 mg, 10.5 mmol; 60 wt% in mineral oil) in THF (5 mL) at 0 ℃. The mixture was stirred for 30 min at 0 ℃ and a solution of 2-(tert-butyldimethylsiloxy)methyl-2-propen-1-yl methanesulfonate (3.23 g, 11.5 mmol) in THF (12mL) was added to it. The resulting mixture was stirred for 18 h at 60 ℃ and was quenched with water. After extraction with EtOAc, the organic layer was washed with NaCl (saturated aqueous), dried over Na_2SO_4, filtered, and concentrated under vacuum. The crude product was purified by flash columnchromatography on silica gel eluting with petroleum ether/ethyl acetate (20:1, v/v) to afford the product **S-I**.

TBAF (1.1 equiv; 1.0 M solution in THF) was added to a solution of **S-I** in THF at -78 ℃. The mixture was stirred for 5 h while gradually raising the temperature to 0 ℃ and the reaction was quenched with water. After extraction with EtOAc, the organic layer was washed with NaCl (saturated aqueous), dried over Na_2SO_4, filtered, and concentrated under vacuum. The crude product was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (5:1, v/v) to afford the products **2a**, **2s-2z**.



B) Preparation of γ-Methylidene-δ-valerolactones 6 [4]



A solution of methyl diphenylacetate (2.26 g, 10.0 mmol) in THF (15 mL) was added to a suspension of NaH (420 mg, 10.5 mmol; 60 wt% in mineral oil) in THF (5 mL) at 0 ℃. The mixture was stirred for 30 min at 0 ℃ and a solution of 2-(tert-butyldimethylsiloxy)methyl-2-propen-1-yl methanesulfonate (3.23 g, 11.5 mmol) in THF (12mL) was added to it. The resulting mixture was stirred for 36 h at 60 ℃ and was quenched with water. After extraction with EtOAc, the organic layer was washed with NaCl (saturated aqueous), dried over Na_2SO_4, filtered, and concentrated under vacuum. The crude product was purified by flash columnchromatography on silica gel eluting with petroleum ether/ethyl acetate (30:1, v/v) to afford the product **S-II**.

TBAF (1.1 equiv; 1.0 M solution in THF) was added to a solution of **S-II** in THF at -78 ℃. The mixture was stirred for 5 h while gradually raising the temperature to 0 ℃ and the reaction was quenched with water. After extraction with EtOAc, the organic layer was washed with NaCl (saturated aqueous), dried over Na_2SO_4, filtered, and concentrated under vacuum. The crude product was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (10:1, v/v) to afford the products **6**.

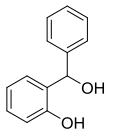
C) Preparation of ortho-hydroxy benzylic alcohols 4

Method A[5]:

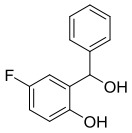
Under a nitrogen atmosphere, a solution of substituted salicylaldehyde (5.0 mmol) in tetrahydrofuran (10 mL) was added dropwise to a solution of the phenyl Grignard reagent (10.0 mmol, 1.0 M in THF, 10 mL), and the mixture was stirred at room temperature. After complete conversion (monitored by TLC), the reaction mixture was quenched by saturated ammonium chloride (10 mL) and extracted with EtOAc (30 mL × 3). The combined organic layer was dried by anhydrous Na_2SO_4 and concentrated. The residue was chromatographed on silica gel eluting with petroleum ether/EtOAc (5:1, v/v) to give the products **4a-4l**.

Method B[6]:

Under a nitrogen atmosphere, to an oven-dried flask charged with a solution of the R^1Br (12.5 mmol) in dry THF (12.5 mL) was added n-BuLi (12.5 mmol, 2.5 M in hexane, 5mL) dropwise at−78 ℃. The resulting mixture was stirred at the same temperature for 1 h, and then a solution of substituted salicylaldehyde (5 mmol) in dry THF (2.5 mL) was added dropwise. The reaction mixture was allowed to warm to room temperature and stirred overnight. Upon completion of the reaction (monitored by TLC), the reaction mixture was cooled to 0 ℃ and treated with saturated aqueous NH_4Cl solution (20 mL). The mixture was extracted with EtOAc (3 × 30 mL). The combined organic layers were dried over Na_2SO_4, filtered, and concentrated. The residue was chromatographed on silica gel eluting with petroleum ether/EtOAc (5:1, v/v) to give the pure products **4m-4s**.



4a



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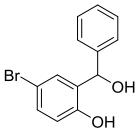

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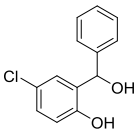

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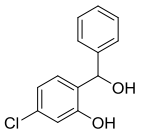

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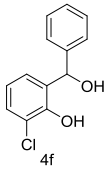

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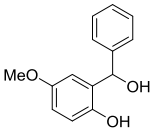

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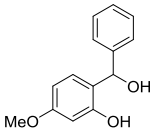

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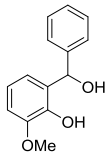

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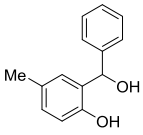

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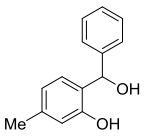

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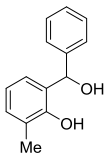
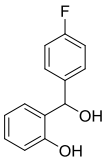


4l



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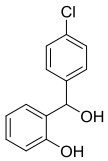

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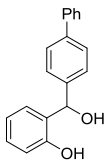

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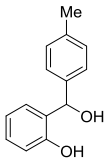

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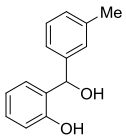

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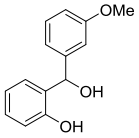

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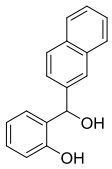
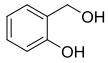
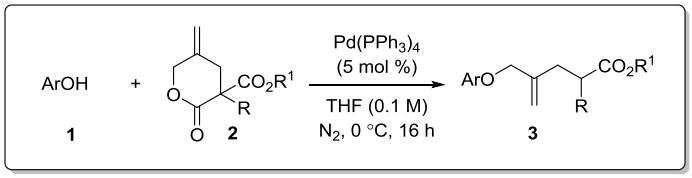


4s

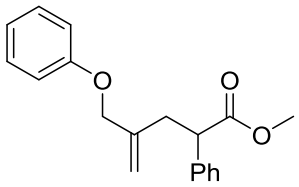


4t

D) Synthesis of decarboxylative *O*-allylation products 3

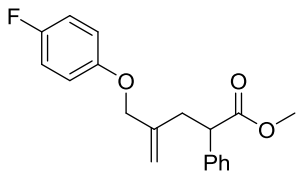


General Procedure: Under a nitrogen atmosphere, to an oven dried 10 mL Schlenck flask equipped with a stirring bar was added Phenoles **1** (0.1 mmol), GMDVs **2** (0.15 mmol), $Pd(PPh_3)_4$ (5 mol %) and dry THF (1.0 mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred at 0 ℃ for the indicated time. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (15;1), giving the corresponding product **3**.



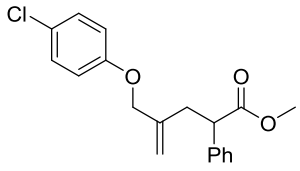
3a

3a: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (25.5 mg, 86% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35-7.29 (m, 4H), 7.28-7.23 (m, 3H), 6.97-6.91 (m, 1H), 6.87 (d, *J* = 8.0 Hz, 2H), 5.16 (s, 1H), 5.01 (s, 1H), 4.46-4.38 (m, 2H), 3.91 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.64 (s, 3H), 2.96 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.61 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 158.5, 141.9, 138.5, 129.4, 128.7, 127.9, 127.4, 120.9, 114.7, 114.5, 70.7, 52.0, 50.0, 36.7 ppm. IR (KBr, cm^{-1}): 3060, 2962, 2920, 1733, 1653, 1492, 1450, 1344, 1260, 1028, 905, 753, 693. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{20}O_3Na$: 319.1305, found: 319.1321.



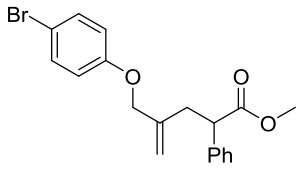
3b

3b: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (28.6 mg, 91% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.23 (m, 5H), 7.00-6.87 (m, 2H), 6.85-6.73 (m, 2H), 5.15 (s, 1H), 5.01 (s, 1H), 4.4-4.31 (m, 2H), 3.89 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.64 (s, 3H), 2.95 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.60 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 157.3 (d, *J* = 238.9 Hz), 154.7, 141.8, 138.5, 128.7, 127.9, 127.5, 115.8 (d, *J* = 10.1 Hz), 115.6 (d, *J* = 4.9 Hz), 114.6, 71.5, 52.1, 50.0, 36.6 ppm. IR (KBr, cm^{-1}): 3029, 2954, 2920, 2851, 1734, 1655, 1600, 1503, 1435, 1349, 1204, 1020, 909, 827, 731, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{19}FO_3Na$: 337.1210, found: 337.1215



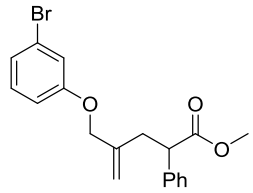
3c

3c: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (28.4 mg, 86% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35-7.23 (m, 5H), 7.20 (d, *J* = 9.0 Hz, 2H), 6.78 (d, *J* = 9.0 Hz, 2H), 5.14 (s, 1H), 5.02 (s, 1H), 4.42-4.32 (m, 2H), 3.88 (dd, *J* = 8.5, 6.5 Hz, 1H), 3.63 (s, 3H), 2.94 (dd, *J* = 15.0, 6.5 Hz, 1H), 2.59 (dd, *J* = 14.5, 6.6 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 157.1, 141.6, 138.4, 129.2, 128.7, 127.9, 127.5, 125.7, 116.0, 114.7, 71.1, 52.1, 50.0, 36.6 ppm. IR (KBr, cm^{-1}): 3029, 2920, 2850, 1735, 1656 ,1490, 1453, 1238, 1161, 1066, 911, 823, 732, 699, 672. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{19}ClO_3Na$: 353.0915, found: 353.0913.



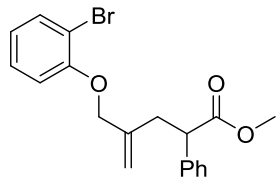
3d

3d: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (34.5 mg, 92% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.29 (m, 6H), 7.27 (td, *J* = 8.5, 4.0 Hz, 1H), 6.73 (d, *J* = 8.5 Hz, 2H), 5.14 (s, 1H), 5.02 (s, 1H), 4.42-4.32 (m, 2H), 3.88 (dd, *J* = 8.5, 6.5 Hz, 1H), 3.63 (s, 3H), 2.94 (dd, *J* = 14.5, 9.0 Hz, 1H), 2.58 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 157.6, 141.5, 138.4, 132.2, 128.7, 127.9, 127.5, 116.5, 114.7, 113.0, 71.0, 52.1, 50.0, 36.6 ppm. IR (KBr, cm^{-1}): 3029, 2950, 2920, 2850, 1735, 1655, 1465, 1349, 1237, 1003, 910, 821, 732, 698, 646. HRMS (ESI) $[M+H]^+$ calcd for $C_{19}H_{20}BrO_3$: 375.0590, found: 375.0592.



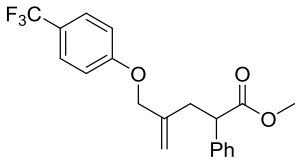
3e

3e: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (33.4 mg, 89% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.37-7.22 (m, 5H), 7.09 (dt, *J* = 16.0, 8.0 Hz, 2H), 7.03 (d, *J* = 1.5 Hz, 1H), 6.79 (dd, *J* = 8.0, 1.0 Hz, 1H), 5.15 (s, 1H), 5.02 (s, 1H), 4.45-4.33 (m, 2H), 3.88 (dd, *J* = 8.5, 7.0 Hz, 1H), 3.64 (s, 3H), 2.94 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.59 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 159.3, 141.4, 138.4, 130.5, 128.7, 127.8, 127.5, 124.0, 122.7, 118.0, 114.9, 113.7, 71.0, 52.1, 50.0, 36.6 ppm. IR (KBr, cm^{-1}): 3028, 2920, 2850, 1735, 1658, 1589, 1475, 1433, 1223, 1158, 1016, 910, 769, 732, 699, 679. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{19}BrO_3Na$: 397.0410, found: 397.0414.



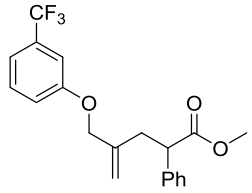
3f

3f: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (33.8 mg, 90% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.54 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.38-7.28 (m, 4H), 7.28-7.19 (m, 2H), 6.89-6.72 (m, 2H), 5.22 (s, 1H), 5.03 (s, 1H), 4.56-4.40 (m, 2H), 3.99 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.64 (s, 3H), 2.98 (dd, *J* = 14.5, 9.0 Hz, 1H), 2.65 (dd, *J* = 14.5, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.9, 154.8, 141.2, 138.5, 133.3, 128.7, 128.3, 127.9, 127.4, 122.0, 115.0, 113.3, 112.2, 71.7, 52.1, 50.0, 36.7 ppm. IR (KBr, cm^{-1}): 2960, 2920, 2850, 1734, 1656, 1585, 1477, 1440, 1261, 1159, 1030, 799, 748, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{19}BrO_3Na$: 397.0410, found: 397.0414.



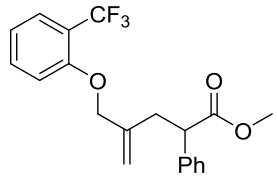
3g

3g: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (29.9 mg, 82% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.51 (d, *J* = 9.0 Hz, 2H), 7.35-7.23 (m, 5H), 6.91 (d, *J* = 8.5 Hz, 2H), 5.17 (s, 1H), 5.05 (s, 1H), 4.50-4.39 (m, 2H), 3.89 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.64 (s, 3H), 2.95 (dd, *J* = 14.5, 8.5 Hz, 1H), 2.60 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 160.9, 141.3, 138.4, 128.7, 127.9, 127.5, 126.8 (q, *J* = 3.5 Hz), 124.3 (q, *J* = 271.7 Hz), 123.1 (d, *J* = 32.6 Hz), 114.9, 114.7, 71.0, 52.1, 50.1, 36.5 ppm. IR (KBr, cm^{-1}): 2921, 1736, 1614, 1435, 1328, 1254, 1160, 1112, 1068, 1009, 912, 836, 733, 699. HRMS (ESI) $[M+H]^+$ calcd for $C_{20}H_{20}F_3O_3$: 365.1359, found: 365.1367.



3h

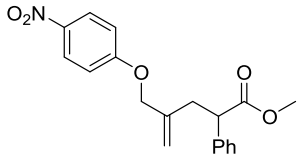
3h: Prepared according to the general procedure above, and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (30.2 mg, 83% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38-7.29 (m, 5H), 7.28-7.24 (m, 1H), 7.20 (d, *J* = 7.5 Hz, 1H), 7.10 (s, 1H), 7.02 (dd, *J* = 8.5, 2.0 Hz, 1H), 5.18 (s, 1H), 5.05 (s, 1H), 4.48-4.38 (m, 2H), 3.89 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.64 (s, 3H), 2.96 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.61 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 158.7, 141.4, 131.9, 131.6, 129.9, 128.7, 127.8, 127.5, 123.9 (q, *J* = 273.3 Hz), 118.2, 117.6 (q, *J* = 3.4 Hz), 115.0, 111.5 (q, *J* = 3.7 Hz), 71.1, 52.1, 50.1, 36.6 ppm. IR (KBr, cm^{-1}): 2965, 2921, 1736, 1657，1451, 1329, 1262, 1164, 1124, 1065, 1046, 880, 796, 733, 698. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{19}F_3O_3Na$: 387.1179, found: 387.1178.



3i

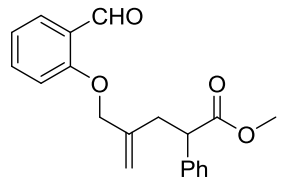
3i: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (28.8mg, 79% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.56 (d, *J* = 7.5 Hz, 1H), 7.43 (t, *J* = 7.5 Hz, 1H), 7.36-7.22 (m, 5H), 6.99 (t, *J* = 7.5 Hz, 1H), 6.88 (d, *J* = 8.0 Hz, 1H), 5.21 (s, 1H), 5.03 (s, 1H), 4.50 (q, *J* = 12.6 Hz, 2H), 3.91 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.63 (s, 3H), 2.95 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.63 (dd, *J* = 15.0, 7.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 156.3, 141.0, 138.4, 133.1, 128.7, 127.9, 127.4, 127.1 (q, *J* = 5.0 Hz), 123.7 (q, *J* = 272.9 Hz), 120.1, 118.8 (q, *J* = 31.4 Hz), 114.7, 112.8, 71.0,

52.0, 49.8, 36.4 ppm. IR (KBr, cm^{-1}): 2956, 1735, 1608, 1495, 1458, 1323, 1275, 1258, 1162, 1118, 1058, 1037, 913, 756, 699. HRMS (ESI) $C_{20}H_{19}F_3O_3Na^+$ calcd for $[M+Na]^+$: 387.1179, found: 387.1188.



3j

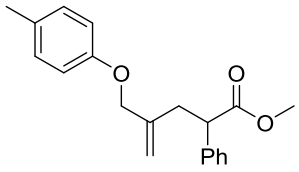
3j: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (27.3 mg, 80% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.17 (d, *J* = 9.0 Hz, 2H), 7.36 – 7.26 (m, 5H), 6.90 (d, *J* = 9.5 Hz, 2H), 5.18 (s, 1H), 5.08 (s, 1H), 4.55 – 4.41 (m, 2H), 3.88 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.65 (s, 3H), 2.95 (dd, *J* = 15.0, 9.0Hz, 1H), 2.61 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.6, 163.5, 141.6, 140.7, 138.2, 133.6, 128.8, 127.8, 127.6, 115.3, 114.7, 71.5, 52.2, 50.1, 36.4 ppm. IR (KBr, cm^{-1}): 2962, 2921, 1729, 1654, 1588, 1493, 1433, 1336, 1259, 1106, 1027, 907, 842, 800, 732, 695. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{19}NO_5Na$: 364.1155, found: 364.1169.



3k

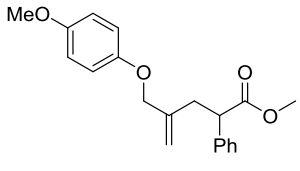
3k: Prepared according to the general procedure aboveand purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (26.0 mg, 80% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 10.52 (s, 1H), 7.84 (dd, *J* = 7.5, 1.5 Hz, 1H), 7.54-7.45 (m, 1H), 7.36-7.23 (m, 5H), 7.02 (t, *J* = 7.5 Hz, 1H), 6.87 (d, *J* = 8.5 Hz, 1H), 5.22 (s, 1H), 5.09 (s, 1H), 4.56 – 4.47 (m, 2H), 3.90 (dd, *J* = 9.0, 6.6 Hz, 1H), 3.63 (s, 3H), 2.99 (dd, *J* = 15.0, 9.5 Hz, 1H), 2.62 (dd, *J* = 15.0, 7.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 189.51, 173.6, 160.8, 141.1, 138.2, 135.8, 128.8, 128.4,

127.8, 127.6, 125.0, 120.9, 114.9, 112.7, 71.1, 52.1, 50.1, 36.6 ppm. IR (KBr, cm^{-1}): 3030, 2953, 2859, 2759, 1734, 1688, 1598, 1482, 1454, 1394, 1235, 1160, 1011, 912, 760, 733, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{20}O_3Na$: 347.1254, found: 347.1258.



3l

3l: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (23.0 mg, 74% yield). ^1H NMR (500 MHz, $CDCl_3$) δ 7.36-7.22 (m, 5H), 7.05 (d, *J* = 8.0 Hz, 2H), 6.77 (d, *J* = 8.5 Hz, 2H), 5.15 (s, 1H), 5.00 (s, 1H), 4.45-4.33 (m, 2H), 3.90 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.63 (s, 3H), 2.95 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.60 (dd, *J* = 15.0, 6.5 Hz, 1H), 2.28 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 156.4, 142.1, 138.5, 130.1, 129.8, 128.7, 127.9, 127.4, 114.5, 114.4, 70.9, 52.0, 50.0, 36.8, 20.0 ppm. IR (KBr, cm^{-1}): 3029, 2950, 2922, 1736, 1654, 1510, 1453, 1349, 1236, 1028, 909, 816, 732, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_3Na$: 333.1461, found: 333.1469.



3m

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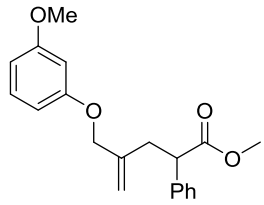
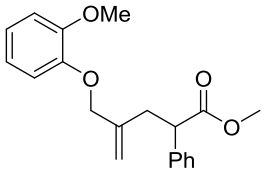
3m: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (29.0 mg, 89% yield). ^1H NMR (500 MHz, $CDCl_3$) δ 7.36-7.28 (m, 4H), 7.27-7.22 (m, 1H), 6.80 (s, 4H), 5.14 (s, 1H), 4.99 (s, 1H), 4.41-4.31 (m, 2H), 3.90 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.75 (s, 3H), 3.63 (s, 3H), 2.95 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.60 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 153.9, 152.7, 142.2, 138.5, 128.6, 127.9, 127.4, 115.6, 114.5, 114.3, 71.5, 55.6, 52.0, 50.0, 36.7 ppm. IR (KBr, cm^{-1}):

2951, 1735, 1658, 1507, 1437, 1228, 1159, 1038, 825, 731, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_4Na$: 349.1410, found: 319.1421.



3n

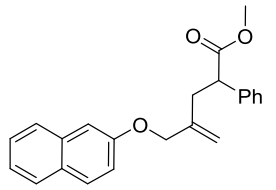
3n: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (29.4 mg, 90% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.28 (m, 4H), 7.28-7.22 (m, 1H), 7.15 (t, *J* = 8.0 Hz, 1H), 6.48 (dd, *J* = 17.5, 8.0 Hz, 3H), 5.16 (s, 1H), 5.01 (s, 1H), 4.46-4.34 (m, 2H), 3.90 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.77 (s, 3H), 3.63 (s, 3H), 2.96 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.60 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 160.8, 159.8, 141.9, 138.5, 129.8, 128.7, 127.9, 127.4, 114.5, 106.9, 106.4, 101.2, 70.8, 55.2, 52.0, 50.0, 36.7 ppm. IR (KBr, cm^{-1}): 2920, 2849, 1735, 1453, 1334, 1150, 1042, 912, 764, 732, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_4Na$: 349.1410, found: 319.1413.



3o

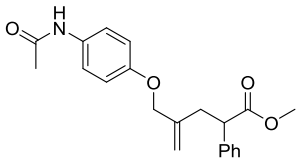
3o: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (29.4 mg, 90% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.28 (m, 4H), 7.27-7.22 (m, 1H), 6.94-6.82 (m, 3H), 6.79 (d, *J* = 8.0 Hz, 1H), 5.15 (s, 1H), 4.99 (s, 1H), 4.57-4.39 (m, 2H), 4.03-3.91 (m, 1H), 3.86 (d, *J* = 10.5 Hz, 3H), 3.63 (s, 3H), 2.95 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.62 (dd, *J* = 14.5, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.9, 149.6, 148.0, 141.7, 138.6, 128.6, 127.9, 127.3, 121.3, 120.7, 114.4, 113.9, 111.8, 71.9,

55.8, 52.0, 49.9, 36.7 ppm. IR (KBr, cm^{-1}): 3061, 3027, 2923, 2851, 1733, 1657, 1501, 1452, 1327, 1250, 1026, 906, 740, 698. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_4Na$: 349.1410, found: 319.1414.



3p

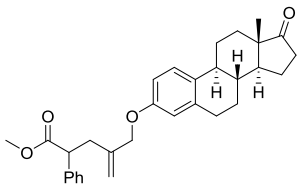
3p: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (29.4 mg, 85% yield). ^1H NMR (500 MHz, $CDCl_3$) δ 7.78-7.66 (m, 3H), 7.42 (t, *J* = 7.0 Hz, 1H), 7.37-7.29(m, 5H), 7.28-7.20(m, 1H), 7.15 (dd, *J* = 9.0, 2.5 Hz, 1H), 7.08 (d, *J* = 2.0 Hz, 1H), 5.22 (s, 1H), 5.05 (s, 1H), 4.57-4.47 (m, 2H), 3.94 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.63 (s, 3H), 3.01 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.66 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 156.5, 141.8, 138.5, 134.4, 129.4, 129.0, 128.7, 127.9, 127.6, 127.4, 126.7, 126.3, 123.6, 118.9, 114.7, 107.0, 70.9, 52.0, 50.1, 36.8 ppm. IR (KBr, cm^{-1}): 3056, 3024, 2919, 2850, 1732, 1653, 1627, 1597, 1507, 1451, 1390, 1213, 1158, 1012, 908, 835, 809, 769, 743, 697. HRMS (ESI) $[M+Na]^+$ calcd for $C_{23}H_{22}O_3Na$: 369.1461, found: 369.1469.



3q

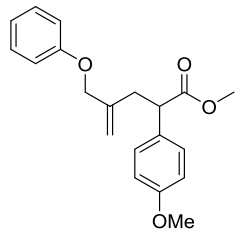
3q: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (30.0 mg, 85% yield). ^1H NMR (500 MHz, $CDCl_3$) δ 7.36 (d, *J* = 9.0 Hz, 3H), 7.32 (d, *J* = 4.0 Hz, 4H), 7.29-7.23 (m, 1H), 6.81 (d, *J* = 9.0 Hz, 2H), 5.14 (s, 1H), 5.00 (s, 1H), 4.43-4.33 (m, 2H), 3.89 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.64 (s, 3H), 2.94 (dd, *J* = 14.5, 9.0

Hz, 1H), 2.59 (dd, *J* = 15.0, 7.0 Hz, 1H), 2.13 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 168.3, 155.3, 141.8, 138.4, 131.2, 128.7, 127.9, 127.4, 121.8, 115.0, 114.5, 71.1, 52.1, 50.0, 36.6, 24.3 ppm. IR (KBr, cm^{-1}): 3295, 3059, 2962, 2922, 2853, 1734, 1662, 1509, 1436, 1370, 1260, 1021, 908, 800, 723, 696. HRMS (ESI) $[M+Na]^+$ calcd for $C_{21}H_{23}NO_4Na$: 376.1519, found: 376.1524.



3r

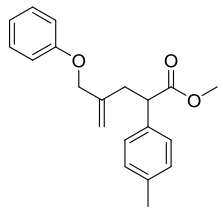
3r: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (35.9 mg, 76% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ7.36 (d, *J* = 9.0 Hz, 2H), 7.33- 7.23 (m, 6H), 6.80 (d, *J* = 9.0 Hz, 2H), 5.14 (s, 1H), 5.00 (s, 1H), 4.43-4.33 (m, 2H), 3.89 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.63 (s, 3H), 2.94 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.59 (dd, *J* = 15.0, 6.5 Hz, 1H), 2.12 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 156.6, 142.0, 138.5, 137.7, 132.2, 128.7, 127.9, 127.4, 126.3, 114.7, 114.4, 112.3, 70.8, 52.1, 50.4, 50.0, 48.0, 44.0, 38.3, 36.7, 35.9, 31.6, 29.6, 26.5, 25.9, 21.6, 13.8 ppm. IR (KBr, cm^{-1}): 3027, 2921, 2855, 1733, 1654, 1495, 1257, 1155, 1024, 908, 805, 731, 697. HRMS (ESI) $[M+Na]^+$ calcd for $C_{31}H_{36}O_4Na$: 495.2506, found: 495.2507.



3s

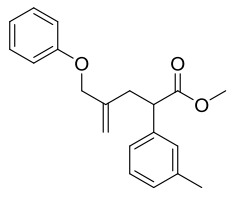
3s: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (20.9 mg, 64% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.29-7.21 (m, 4H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.90-6.81 (m, 4H), 5.16 (s, 1H), 5.00 (s, 1H), 4.45-4.35 (m, 2H), 3.89-3.80 (m, 1H),

3.77 (s, 3H), 3.63 (s, 3H), 2.93 (dd, *J* = 14.5, 8.5 Hz, 1H), 2.59 (dd, *J* = 15.0, 7.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 174.1, 158.9, 158.5, 141.2, 130.5, 129.4, 128.9, 120.8, 114.7, 114.5, 114.0, 70.7, 55.2, 52.0, 49.1, 36.8 ppm. IR (KBr, cm^{-1}): 2925, 1733, 1597, 1510, 1493, 1243, 1031, 906, 793, 795, 690. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_4Na$: 349.1410, found: 349.1408.



3t

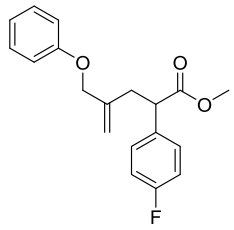
3t: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (23.0mg, 74% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.28 (s, 1H), 7.25 (s, 1H), 7.22 (d, *J* = 7.0 Hz, 2H), 7.13 (d, *J* = 7.0 Hz, 2H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.87 (d, *J* = 8.0 Hz, 2H), 5.16 (s, 1H), 5.01 (s, 1H), 4.46-4.35 (m, 2H), 3.87 (t, *J* = 7.5 Hz, 1H), 3.63 (s, 3H), 2.94 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.59 (dd, *J* = 15.0, 6.5 Hz, 1H), 2.32 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 174.0, 158.5, 142.0, 137.1, 135.5, 129.4, 127.8, 120.8, 114.7, 114.4, 70.7, 52.0, 50.0, 36.7, 21.1 ppm. IR (KBr, cm^{-1}): 2962, 1735,1597, 1197, 1054, 879, 800, 754, 691. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_3Na$: 333.1461, found: 333.1455.



3u

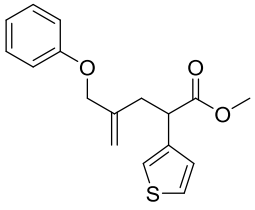
3u: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (25.8mg, 83% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.27 (d, *J* = 7.0 Hz, 1H), 7.24 (s, 1H), 7.20

(t, *J* = 7.5 Hz, 1H), 7.12 (d, *J* = 8.0 Hz, 2H), 7.07 (d, *J* = 7.5 Hz, 1H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.87 (d, *J* = 7.5 Hz, 2H), 5.16 (s, 1H), 5.02 (s, 1H), 4.51-4.27 (m, 2H), 3.86 (t, *J* = 7.0 Hz, 1H), 3.63 (s, 3H), 2.95 (dd, *J* = 15.0, 9.5 Hz, 1H), 2.59 (dd, *J* = 15.0, 6.5 Hz, 1H), 2.32 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.9, 158.5, 142.0, 138.4, 138.3, 129.4, 128.5, 128.2, 124.9, 120.8, 114.7, 114.4, 70.7, 52.0, 49.9, 36.7, 21.4 ppm. IR (KBr, cm^{-1}): 3027, 2950, 1736, 1654, 1598, 1494, 1240, 1032, 909, 780, 754, 692. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_3Na$: 333.1461, found: 333.1466.



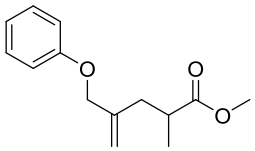
3v

3v: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (25.8mg, 82% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.32-7.23 (m, 4H), 6.99 (t, *J* = 8.5 Hz, 2H), 6.94 (t, *J* = 7.0 Hz, 1H), 6.87 (d, *J* = 8.5 Hz, 2H), 5.16 (s, 1H), 4.99 (s, 1H), 4.49-4.35 (m, 2H), 3.95 – 3.83 (m, 1H), 3.63 (s, 3H), 2.93 (dd, *J* = 14.8, 8.9 Hz, 1H), 2.59 (dd, *J* = 14.9, 6.8 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 162.1 (d, *J* = 246.5 Hz), 158.6, 141.7, 134.2 (d, *J* = 2.9 Hz), 129.4 (d, *J* = 8.2 Hz), 129.4, 120.9, 115.5 (d, *J* = 21.5 Hz), 114.8, 114.6, 70.7, 52.1, 49.2, 36.8 ppm. IR (KBr, cm^{-1}): 3039, 2951, 1736, 1653, 1598, 1495, 1224, 1031, 911, 835, 754, 691. HRMS (ESI) $[M+Na]^+$ calcd for $C_{19}H_{19}FO_3Na$: 333.1461, found: 333.1455.



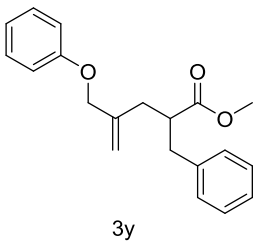
3w

3w: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (26.3mg, 87% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.30-7.23 (m, 3H), 7.15 (d, *J* = 1.5 Hz, 1H), 7.07 (d, *J* = 5.0 Hz, 1H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.88 (d, *J* = 8.0 Hz, 2H), 5.18 (s, 1H), 5.02 (s, 1H), 4.48-4.35 (m, 2H), 4.05 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.65 (s, 3H), 2.91 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.63 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.5, 158.5, 141.8, 138.6, 129.4, 127.0, 125.8, 122.0, 120.9, 114.7, 114.6, 70.6, 52.0, 45.5, 36.7 ppm. IR (KBr, cm^{-1}): 2960, 2923, 1735, 1596, 1493, 1214, 1051, 1030, 907, 799, 754, 690. HRMS (ESI) $[M+Na]^+$ calcd for $C_{17}H_{18}O_3SNa$: 325.0869, found: 325.0869.



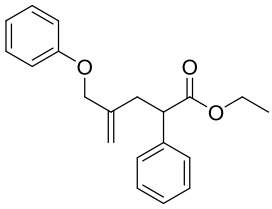
3x

3x: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (19.2mg, 82% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.27 (dd, *J* = 15.5, 7.5 Hz, 2H), 6.98-6.86 (m, 3H), 5.19 (s, 1H), 5.02 (s, 1H), 4.51-4.40 (m, 2H), 3.65 (s, 3H), 2.82-2.68 (m, 1H), 2.55 (dd, *J* = 14.5, 8.0 Hz, 1H), 2.25 (dd, *J* = 14.5, 6.5 Hz, 1H), 1.19 (d, *J* = 7.0 Hz, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 176.6, 158.6, 142.2, 129.4, 120.8, 114.7, 114.3, 70.4, 51.6, 37.9, 37.2, 17.2 ppm. IR (KBr, cm^{-1}): 2923, 1736, 1598, 1494, 1195, 1055, 754, 691. HRMS (ESI) $[M+Na]^+$ calcd for $C_{14}H_{18}O_3Na$: 257.1148, found: 257.1154.



3y

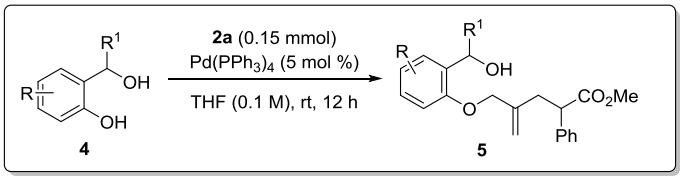
3y: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (25.5mg, 82% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.27 (t, *J* = 7.0 Hz, 4H), 7.20 (t, *J* = 7.0 Hz, 1H), 7.15 (d, *J* = 7.5 Hz, 2H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.87 (d, *J* = 8.0 Hz, 2H), 5.18 (s, 1H), 5.04 (s, 1H), 4.52-4.37 (m, 2H), 3.55 (s, 3H), 3.05-2.88 (m, 2H), 2.81 (t, *J* = 10.0 Hz, 1H), 2.50 (dd, *J* = 14.5, 9.0 Hz, 1H), 2.38 (d, *J* = 14.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.4, 158.5, 142.1, 138.9, 129.4, 128.8, 128.4, 126.5, 120.9, 114.7, 114.4, 70.4, 51.5, 46.1, 38.6, 35.6 ppm. IR (KBr, cm^{-1}): 3028, 2950, 1735, 1598, 1370, 1216, 1032, 910, 754, 693. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_3Na$: 333.1461, found: 333.1458.



3z

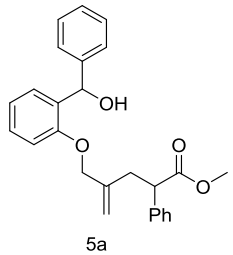
3z: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (15:1, v/v) as the eluent. Colorless oil (22.0mg, 71% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.32 (q, *J* = 7.0 Hz, 4H), 7.29-7.22 (m, 3H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.87 (d, *J* = 8.5 Hz, 2H), 5.17 (s, 1H), 5.02 (s, 1H), 4.48-4.37 (m, 2H), 4.24-3.99 (m, 2H), 3.88 (dd, *J* = 9.0, 6.5 Hz, 1H), 2.96 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.60 (dd, *J* = 14.5, 6.0 Hz, 1H), 1.18 (t, *J* = 7.0 Hz, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.3, 158.5, 142.0, 138.7, 129.4, 128.6, 127.9, 127.3, 120.8, 114.7, 114.3, 70.7, 60.8, 50.1, 36.7, 14.1 ppm. IR (KBr, cm^{-1}): 3030, 2981, 2932, 1731, 1652, 1598, 1494, 1369, 1239, 1032, 910, 754, 694. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_3Na$: 333.1461, found: 333.1464.

E) Synthesis of decarboxylative *O*-allylation products 5



General procedure: Under a nitrogen atmosphere,to an oven dried 10 mL Schlenck flask equipped with a stirring bar was added γ-methylidene-δ-valerolactones **2a** (0.15 mmol), *ortho*-hydroxy benzylic alcohols **4** (0.1 mmol), $Pd(PPh_3)_4$ (5 mol%), and dry THF(1.0mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred room temperature for the indicated time. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (5:1, v/v), giving the corresponding product **5**.

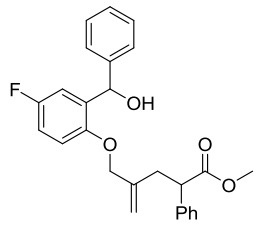
Large-scale Reaction: Under a nitrogen atmosphere, to an oven dried 100 mL Schlenck flask equipped with a stirring bar was added γ-methylidene-δ-valerolactones **2a** (1.4g, 5.7 mmol), *ortho*-hydroxy benzylic alcohols **4a** (760.9mg, 3.8 mmol), $Pd(PPh_3)_4$ (5 mol%), and dry THF (38mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred room temperature for the indicated time. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (5;1, v/v), giving the corresponding product **5a** (1.53g, 78% yield).



5a

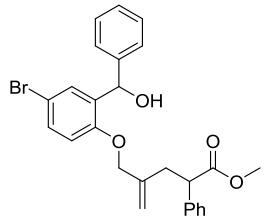
5a: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (33 mg, 82% yield, dr = 1:1). ^1H NMR (500 MHz, $CDCl_3$) δ 7.40-7.33 (m, 2H), 7.33 – 7.22 (m, 8H),

7.21-7.14 (m, 2H), 6.95 (t, *J* = 7.5 Hz, 1H), 6.77 (d, *J* = 8.0 Hz, 1H), 6.12-6.03 (m, 1H), 5.06 (s, 1H), 4.98 (s, 1H), 4.46-4.29 (m, 2H), 3.89-3.75 (m, 1H), 3.61 (d, *J* = 4.0 Hz, 3H), 3.02 (dd, *J* = 10.5, 5.5 Hz, 1H), 2.91-2.79 (m, 1H), 2.50-2.39 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 155.6, 155.5, 143.3, 141.7, 141.6, 138.3, 132.1, 128.7, 128.6, 128.1, 128.0, 127.9, 127.8, 127.5, 127.1, 126.5, 126.4, 121.0, 114.6, 111.7, 72.0, 70.9, 52.1, 50.0, 36.4 ppm. IR (KBr, cm^{-1}): 3511, 3030, 2950, 1733, 1654, 1598, 1489, 1452, 1397, 1231, 1017, 913, 754, 732, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{26}O_4Na$: 425.1723, found: 425.1725.



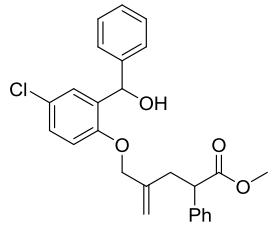
5b

Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil 5b (32.4 mg, 77% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38-7.22 (m, 9H), 7.19 (t, *J* = 7.0 Hz, 1H), 7.09 (dd, *J* = 9.0, 2.5 Hz, 1H), 6.90-6.81 (m, 1H), 6.66 (dd, *J* = 8.5, 4.0 Hz, 1H), 6.05 (d, *J* = 9.5 Hz, 1H), 5.05 (s, 1H), 4.99 (s, 1H), 4.38-4.26 (m, 2H), 3.84-3.75 (m, 1H), 3.61 (d, *J* = 2.5 Hz, 3H), 3.01-2.77 (m, 2H), 2.44 (dd, *J* = 15.0, 6.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 173.7, 157.2 (d, *J* = 239.7 Hz), 151.4, 142.7, 141.6, 138.2, 134.1 (d, *J* = 6.5 Hz), 134.0 (d, *J* = 6.3 Hz), 128.7, 127.3, 127.8, 127.5 (d, *J* = 8.7 Hz), 126.5 (d, *J* = 2.0 Hz), 114.7, 114.5 (d, *J* = 14.0 Hz), 114.2 (d, *J* = 23.1 Hz), 112.7 (d, *J* = 2.2 Hz), 112.6 (d, *J* = 2.4 Hz), 71.5, 71.2, 71.1, 52.1, 49.9, 36.3, 36.3 ppm. IR (KBr, cm^{-1}): 3398, 2964, 2922, 1733, 1652, 1491, 1432, 1261, 1191, 1021, 881, 801, 731, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}FO_4Na$: 443.1629, found: 443.1633



5c

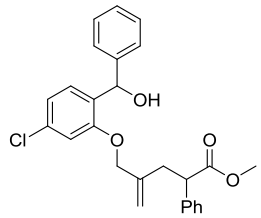
5c: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (37.5 mg, 78% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.50 (d, *J* = 2.5 Hz, 1H), 7.36-7.22 (m, 10H), 7.19 (t, *J* = 7.5 Hz, 1H), 6.61 (d, *J* = 9.0 Hz, 1H), 6.04 (dd, *J* = 9.5, 4.5 Hz, 1H), 5.03 (s, 1H), 4.99 (s, 1H), 4.37-4.28 (m, 2H), 3.82-3.74 (m, 1H), 3.62 (d, *J* = 2.5 Hz, 3H), 2.89-2.74 (m, 2H), 2.47-2.36 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 154.5, 154.4, 142.6, 141.3, 138.2, 134.4, 134.3, 131.1, 130.5, 128.7, 128.3, 127.8, 127.6, 127.5, 126.5, 114.9, 114.8, 113.4, 71.3, 71.2, 71.1, 52.1, 50.0, 36.3 ppm. IR (KBr, cm^{-1}): 3358, 3062, 3029, 2920, 2850, 1734, 1657, 1453, 1236, 1021, 914, 879, 803, 766, 731, 698, 594. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}BrO_4Na$: 503.0834, found: 503.0834.



5d

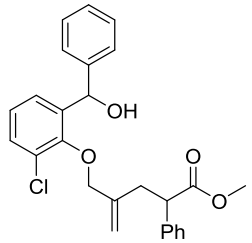
5d: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (31.5 mg, 72% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38-7.29 (m, 5H), 7.29-7.26 (m, 2H), 7.26-7.26 (m, 1H), 7.26-7.24 (m, 2H), 7.19 (t, *J* = 7.0 Hz, 1H), 7.15 (dd, *J* = 9.0, 2.5 Hz, 1H), 6.66 (dd, *J* = 8.5, 1.0 Hz, 1H), 6.05 (dd, *J* = 9.5, 5.0 Hz, 1H), 5.04 (s, 1H), 4.99 (s, 1H), 4.39-4.28 (m, 2H), 3.85-3.75 (m, 1H), 3.62 (d, *J* = 3.0 Hz, 3H), 2.90-2.75 (m, 2H), 2.43 (dd, *J* = 15.5, 6.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 154.0, 142.6, 141.4, 138.2, 134.0, 133.9, 128.7, 128.3, 128.1, 127.8, 127.6, 127.5, 126.5, 126.1, 114.9, 114.8, 112.9, 71.3, 71.2, 52.1, 50.0, 36.3 ppm. IR (KBr,

cm^{-1}): 3359, 3029, 2919, 2850, 1734, 1658, 1484, 1454, 1238, 1018, 901, 802, 767, 729, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}ClO_4Na$: 459.1334, found: 459.1338.



5e

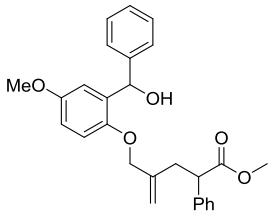
5e: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (29.3 mg, 67% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.32 (dd, *J* = 12.0, 6.5 Hz, 4H), 7.29-7.22 (m, 6H), 7.18 (t, *J* = 7.0 Hz, 1H), 6.94 (d, *J* = 8.5 Hz, 1H), 6.77 (s, 1H), 6.04 (d, *J* = 8.5 Hz, 1H), 5.06 (s, 1H), 5.01 (s, 1H), 4.40-4.30 (m, 2H), 3.84-3.76 (m, 1H), 3.62 (d, *J* = 3.5 Hz, 3H), 2.91-2.77 (m, 2H), 2.43 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 156.0, 142.9, 141.2, 141.1, 138.2, 133.9, 130.9, 130.8, 128.7, 128.6, 128.3, 127.8, 127.6, 127.4, 126.4, 121.0, 115.1, 115.0, 112.4, 71.3, 71.2, 71.1, 52.1, 50.0, 36.4, 36.3 ppm. IR (KBr, cm^{-1}): 3360, 2974, 2896, 1732, 1654, 1486, 1453, 1381, 1238, 1088, 1048, 880, 801, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}ClO_4Na$: 459.1334, found: 459.1334.



5f

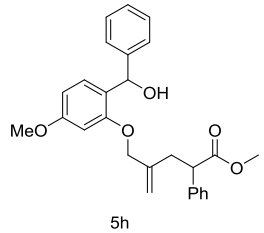
5f: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (31.0 mg, 71% yield, dr = 1:1).^{1}H NMR (500 MHz, $CDCl_3$) δ 7.51 (d, *J* = 7.5 Hz, 1H), 7.38-7.31 (m, 4H), 7.31-7.26 (m, 4H), 7.26-7.23 (m, 2H), 7.03 (t, *J* = 6.0 Hz, 1H),

6.80 (td, *J* = 8.0, 3.5 Hz, 1H), 5.62 (s, 1H), 5.08 (s, 1H), 4.99 (d, *J* = 3.5 Hz, 1H), 4.00 -3.87 (m, 2H), 3.85-3.75 (m, 1H), 3.62 (s, 3H), 2.97-2.84 (m, 1H), 2.53 (dd, *J* = 14.5, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 150.2, 150.1, 142.0, 140.0, 138.4, 129.0, 128.7, 128.6, 128.1, 127.8, 127.7, 127.4, 127.2, 127.1, 126.8, 121.2, 120.5, 115.1, 115.0, 81.0, 72.0, 71.9, 52.0, 50.0, 36.8 ppm. IR (KBr, cm^{-1}): 3358, 3029, 2920, 2850, 1734, 1658, 1453, 1243, 1071, 913, 773, 734, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}ClO_4Na$: 459.1334, found: 459.1342.



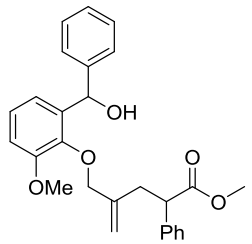
5g

5g: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (31.1 mg, 72% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36 (d, *J* = 4.0 Hz, 2H), 7.33-7.21 (m, 7H), 7.17 (dd, *J* = 8.0, 6.5 Hz, 1H), 6.91 (s, 1H), 6.77-6.64 (m, 2H), 6.04 (d, *J* = 5.0 Hz, 1H), 5.05 (s, 1H), 4.96 (s, 1H), 4.37-4.21 (m, 2H), 3.81 (dd, *J* = 8.5, 3.5 Hz, 1H), 3.73 (s, 3H), 3.61 (d, *J* = 2.5 Hz, 3H), 3.01 (dd, *J* = 14.5, 4.5 Hz, 1H), 2.85 (dd, *J* = 24.5, 10.0 Hz, 1H), 2.44 (dd, *J* = 15.0, 6.0 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 173.7, 153.8, 149.7, 143.2, 143.1, 141.9, 141.9, 138.3, 133.4, 133.3, 128.7, 128.2, 127.9, 127.5, 127.2, 126.5, 126.4, 114.4, 114.0, 112.9, 112.8, 72.0, 71.9, 71.6, 55.6, 52.1, 50.0, 36.5, 36.4 ppm. IR (KBr, cm^{-1}): 3489, 3029, 2949, 1733, 1600, 1494, 1453, 1432, 1208, 1038, 913, 731, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{25}O_4Na$: 455.1829, found: 455.1829.



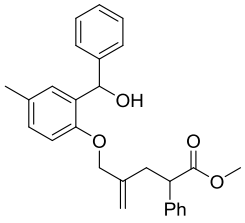
5h

5h: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (30.3 mg, 70% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.40-7.33 (m, 2H), 7.33-7.22 (m, 7H), 7.17 (t, *J* = 7.5 Hz, 1H), 7.13 (d, *J* = 8.5 Hz, 1H), 6.46 (dd, *J* = 8.5, 2.0 Hz, 1H), 6.40 (d, *J* = 1.5 Hz, 1H), 6.03 (t, *J* = 6.0 Hz, 1H), 5.09 (s, 1H), 5.00 (s, 1H), 4.42-4.30 (m, 2H), 3.84-3.74 (m, 4H), 3.62 (d, *J* = 4.0 Hz, 3H), 2.94-2.80(m, 2H), 2.51-2.39 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 160.2, 156.6, 143.6, 141.6, 138.3, 128.8, 128.7, 128.1, 127.8, 127.5, 127.0, 126.4, 124.9, 124.8, 114.8, 104.5, 99.7, 71.7, 71.6, 71.0, 55.4, 52.1, 50.0, 49.9, 36.5, 36.4 ppm. IR (KBr, cm^{-1}): 3361, 2921, 2851, 1733, 1609, 1501, 1451, 1260, 1160, 1044, 881, 798, 731, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{25}O_4Na$: 455.1829, found: 455.1835.



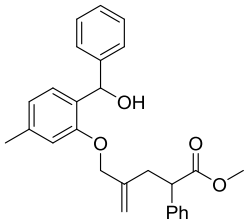
5i

5i: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (30.7 mg, 71% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38-7.32 (m, 2H), 7.32 -7.19 (m, 8H), 7.05 (td, *J* = 8.0, 2.0 Hz, 1H), 6.97-6.91 (m, 1H), 6.86 (d, *J* = 8.5 Hz, 1H), 6.02 (dd, *J* = 14.0, 6.0 Hz, 1H), 4.98 (d, *J* = 10.5 Hz, 1H), 4.91 (d, *J* = 4.5 Hz, 1H), 4.26 (dd, *J* = 24.0, 11.5 Hz, 1H), 4.06 (dd, *J* = 11.5, 5.5 Hz, 1H), 3.97 (dt, *J* = 8.5, 6.5 Hz, 1H), 3.83 (s, 3H), 3.63 (d, *J* = 1.5 Hz, 3H), 3.07-2.91 (m, 2H), 2.57 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 174.0, 152.6, 145.1, 145.0, 143.8, 142.5, 138.7, 138.6, 128.6, 128.2, 127.9, 127.3, 127.1, 126.4, 126.3, 124.2, 119.9, 114.6, 111.8, 75.0, 74.9, 72.1, 72.0, 55.7, 52.0, 49.8, 49.7, 37.0 ppm. IR (KBr, cm^{-1}): 3359, 3029, 2920, 2849, 1734, 1658, 1480, 1440, 1351, 1270, 1064, 907, 792, 732, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{25}O_4Na^+$: 455.1829, found: 455.1834.



5j

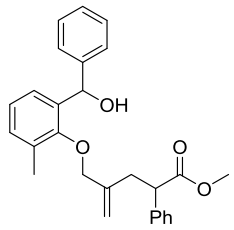
5j: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (20.4 mg, 49% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36 (dd, *J* = 8.0, 3.0 Hz, 2H), 7.33 – 7.21 (m, 7H), 7.17 (t, *J* = 7.5 Hz, 1H), 7.10 (s, 1H), 7.00 (dd, *J* = 8.3, 1.1 Hz, 1H), 6.67 (d, *J* = 8.3 Hz, 1H), 6.07-6.00 (m, 1H), 5.05 (s, 1H), 4.97 (s, 1H), 4.40-4.28 (m, 2H), 3.84-3.76 (m, 1H), 3.62 (d, *J* = 3.5 Hz, 3H), 2.99 (dd, *J* = 11.5, 5.5 Hz, 1H), 2.90-2.79 (m, 1H), 2.53-2.37 (m, 1H), 2.26 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 173.7, 153.5, 143.5, 143.4, 141.8, 138.3, 131.8, 130.3, 130.2, 128.8, 128.7, 128.6, 128.1, 127.9, 127.5, 127.1, 127.0, 126.4, 114.5, 114.4, 111.7, 72.1, 72.0, 71.0, 52.2, 50.0, 49.9, 36.4, 20.6 ppm. IR (KBr, cm^{-1}): 3360, 2960, 2919, 2850, 1733, 1655, 1496, 1452, 1240, 1158, 1021, 911, 802, 732, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{28}O_4Na^+$: 439.1880, found: 439.1885.



5k

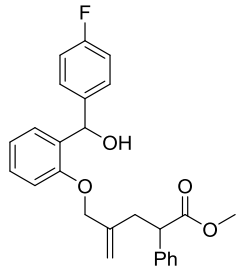
5k: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (21.7 mg, 52% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.39-7.20 (m, 9H), 7.20 -7.09 (m, 2H), 6.76 (d, *J* = 7.5 Hz, 1H), 6.62 (s, 1H), 6.04 (t, *J* = 6.0 Hz, 1H), 5.07 (s, 1H), 4.98 (s, 1H), 4.43-4.32 (m, 2H), 3.86-3.77 (m, 1H), 3.62 (d, *J* = 3.5 Hz, 3H), 2.96 (dd, *J* = 9.5, 6.0 Hz, 1H), 2.90-2.81 (m, 1H), 2.46 (dt, *J* = 12.5, 6.0 Hz, 1H), 2.31 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 173.7, 155.6, 143.5, 141.7, 138.7, 138.3, 129.3,

129.2, 128.7, 128.1, 127.9, 127.5, 127.0, 126.4, 121.6, 114.6, 112.7, 72.0, 71.9, 70.9, 52.1, 50.0, 36.5, 36.5, 21.5 ppm. IR (KBr, cm^{-1}): 3365, 2965, 2922, 1734, 1659, 1452, 1261, 1090, 1042, 880, 801, 731, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{28}O_4Na$: 439.1880, found: 439.1887.



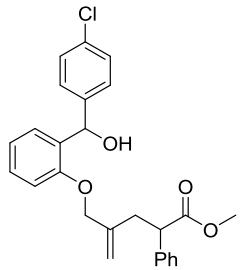
5l

5l: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (20.8 mg, 50% yield, dr = 1:1). ^1H NMR (500 MHz, $CDCl_3$) δ 7.37 (t, *J* = 6.7 Hz, 2H), 7.34-7.29 (m, 6H), 7.29-7.22 (m, 3H), 7.19-7.08 (m, 2H), 7.06-6.99 (m, 1H), 6.07-6.00 (m, 1H), 5.15 (d, *J* = 8.0 Hz, 1H), 4.97 (s, 1H), 4.12-3.95 (m, 2H), 3.90-3.81 (m, 1H), 3.65 (s, 3H), 3.00-2.83 (m, 2H), 2.54-2.47 (m, 1H), 2.25 (d, *J* = 2.5 Hz, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.9, 154.8, 143.8, 142.3, 138.5, 138.4, 136.9, 131.3, 131.0, 128.7, 128.3, 127.9, 127.4, 127.2, 126.5, (126.2, 126.1, dr=1:1), 124.3, 113.7, 75.4, 75.3, 71.8, 71.7, 52.1, 50.3, 36.9, 16.3 ppm. IR (KBr, cm^{-1}): 3453, 3029, 2950, 2923, 2853, 1735, 1658, 1452, 1351, 1257, 1189, 1028, 914, 772, 730, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{28}O_4Na$: 439.1880, found: 439.1888.



5m

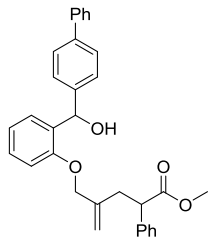
5m: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (30.7 mg, 73% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35-7.28 (m, 4H), 7.27 (d, *J* = 5.5 Hz, 2H), 7.26-7.19 (m, 3H), 6.99-6.89 (m, 3H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.04 (t, *J* = 6.0 Hz, 1H), 5.06 (s, 1H), 4.99 (s, 1H), 4.45-4.31 (m, 2H), 3.80 (dt, *J* = 9.0, 6.0 Hz, 1H), 3.62 (d, *J* = 4.5 Hz, 3H), 3.02 (dd, *J* = 17.5, 5.5 Hz, 1H), 2.85 (dt, *J* = 15.0, 9.5 Hz, 1H), 2.50-2.40 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 173.7, 162.9 (d, *J* = 245.8 Hz), 155.5, 141.6, 139.1, 138.2, 131.9 (d, *J* = 10.6 Hz), 128.7, 128.2 (d, *J* = 4.9 Hz), 128.1 (d, *J* = 4.9 Hz), 127.8, 127.7, 127.5, 121.0, 114.9 (d, *J* = 21.3 Hz), 114.7 (d, *J* = 10.7 Hz), 111.7, 71.5, 71.4, 70.9, 52.1, 49.9, 36.4, 36.4 ppm. IR (KBr, cm^{-1}): 3455, 3063, 3031, 2950, 2924, 1733, 1656, 1601, 1506, 1452, 1222, 1016, 911, 754, 732, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}FO_4Na$: 443.1629, found: 443.1630.



5n

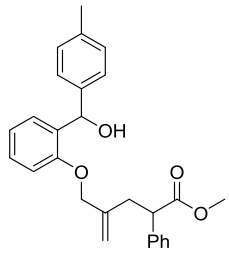
5n: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (32.3 mg, 74% yield, dr = 1:1).^{1}H NMR (500 MHz, $CDCl_3$) δ 7.34-7.28 (m, 5H), 7.27 (s, 2H), 7.23 (dd, *J* = 13.5, 5.0 Hz, 2H), 7.02-6.88 (m, 3H), 6.78 (d, *J* = 8.5 Hz, 1H), 6.05 (t, *J* = 6.0 Hz, 1H), 5.06 (s, 1H), 4.99 (s, 1H), 4.44-4.33 (m, 2H), 3.80 (dt, *J* = 9.5, 6.5 Hz, 1H), 3.62 (d, *J* = 4.5 Hz, 3H), 3.03 (dd, *J* = 17.5, 5.5 Hz, 1H), 2.86 (dt, *J* = 15.0, 9.5 Hz, 1H), 2.52-2.40 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 155.5, 141.9, 141.6, 138.2, 132.8, 131.7, 131.6, 130.3, 128.8, 128.7, 128.2, 127.9, 127.8, 127.5, 121.1, 114.7, 111.7, 71.4, 71.3, 70.9, 52.1, 50.0, 36.5, 36.4 ppm. IR (KBr, cm^{-1}): 3455,

3064, 3031, 2949, 1733, 1654, 1488, 1451, 1349, 1230, 1014, 911, 833, 754, 698. HRMS (ESI) $[M+Na]^+$ calcd for $C_{26}H_{25}ClO_4Na$: 459.1334, found: 459.1342.



5o

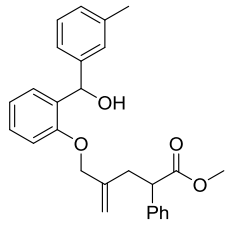
5o: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (34.9 mg, 73% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.58-7.52 (m, 2H), 7.50 (dd, *J* = 8.5, 2.0 Hz, 2H), 7.47-7.39 (m, 4H), 7.33 (dd, *J* = 16.0, 8.0 Hz, 2H), 7.29-7.20(m, 6H), 6.98 (t, *J* = 7.5 Hz, 1H), 6.79 (d, *J* = 8.0 Hz, 1H), 6.14 (dd, *J* = 7.5, 5.0 Hz, 1H), 5.09 (s, 1H), 5.01 (s, 1H), 4.46-4.35 (m, 2H), 3.84 (dt, *J* = 9.0, 6.0 Hz, 1H), 3.59 (d, *J* = 5.0 Hz, 3H), 3.03 (dd, *J* = 14.5, 5.5 Hz, 1H), 2.91 (td, *J* = 14.5, 9.5 Hz, 1H), 2.56-2.47 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 155.6, 142.4, 141.7, 140.9, 140.0, 138.3, 132.1, 132.0, 128.7, 127.9, 127.8, 127.5, 127.2, 127.1, 126.9, 126.91, 121.1, 121.0, 114.7, 111.7, 71.8, 71.7, 71.0, 52.1, 50.0, 36.5 ppm. IR (KBr, cm^{-1}): 3361, 3028, 2920, 2851, 1733, 1656, 1597, 1487, 1451, 1230, 1034, 911, 757, 698. HRMS (ESI) $[M+Na]^+$ calcd for $C_{32}H_{30}O_4Na$: 501.2036, found: 501.2041.



5p

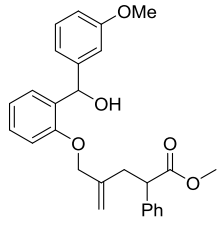
5p: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (21.2 mg, 51% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35-7.23 (m, 8H), 7.22 -7.18 (m, 1H), 7.07 (dd, *J* = 8.0, 1.5 Hz, 2H), 6.95 (t, *J* = 7.5 Hz, 1H), 6.77 (d, *J* = 8.0 Hz, 1H),

6.07 (dd, *J* = 8.0, 4.0 Hz, 1H), 5.09 (s, 1H), 5.00 (s, 1H), 4.44-4.33 (m, 2H), 3.83 (dt, *J* = 9.5, 6.0 Hz, 1H), 3.72-3.55 (m, 3H), 2.98-2.81 (m, 2H), 2.56-2.43 (m, 1H), 2.29 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 173.7, 155.6, 141.7, 140.3, 138.3, 136.7, 132.4, 132.3, 128.9, 128.7, 128.5, 127.9, 127.5, 126.5, 121.0, 114.6, 111.7, 71.8, 71.7, 70.9, 52.1, 50.0, 36.5, 21.1 ppm. IR (KBr, cm^{-1}): 3359, 2963, 2920, 1733, 1655, 1488, 1452, 1260, 1020, 800, 754, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{28}O_4Na$: 439.1880, found: 439.1887.



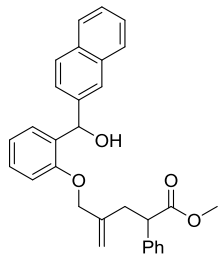
5q

5q: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (20.8 mg, 50% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.33-7.26 (m, 5H), 7.25 (s, 1H), 7.23-7.17 (m, 2H), 7.13 (d, *J* = 2.5 Hz, 2H), 7.04-6.91 (m, 2H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.05 (d, *J* = 5.5 Hz, 1H), 5.09 (s, 1H), 5.00 (s, 1H), 4.44-4.34 (m, 2H), 3.85-3.78 (m, 1H), 3.62 (d, *J* = 3.5 Hz, 3H), 2.98-2.81 (m, 2H), 2.47 (dd, *J* = 14.5, 5.5 Hz, 1H), 2.28 (s, 3H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 155.6, 143.2, 141.7, 138.3, 137.7, 132.3, 130.3, 128.7, 128.5, 128.0, 127.9, 127.8, 127.5, 127.2, 127.1, 123.6, 121.0, 114.7, 111.7, 72.0, 71.9, 70.9, 52.1, 50.0, 36.5, 21.4 ppm. IR (KBr, cm^{-1}): 3359, 2965,2921, 1734, 1657, 1487, 1452, 1261, 1046, 880, 799, 754, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{28}O_4Na$: 439.1880, found: 439.1882.



5r

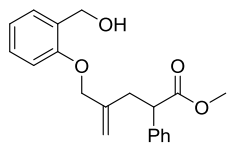
5r: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (30.3mg, 70% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.33-7.23 (m, 6H), 7.23 -7.13 (m, 3H), 6.94 (td, *J* = 7.5, 3.5 Hz, 1H), 6.90-6.73 (m, 3H), 6.43 (t, *J* = 5.0 Hz, 1H), 5.09 (d, *J* = 3.0 Hz, 1H), 4.97 (d, *J* = 5.5 Hz, 1H), 4.50-4.32 (m, 2H), 3.89-3.78 (m, 1H), 3.75 (d, *J* = 12.0 Hz, 3H), 3.61 (s, 3H), 3.36 (dd, *J* = 8.0, 5.0 Hz, 1H), 2.96-2.77 (m, 1H), 2.49 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 156.8, 155.6, 141.8, 138.4, 138.3, 131.2, 131.1, 131.0, 128.6, 128.4, 128.2, 127.9, 127.7, 127.4, 120.7, 120.5, 114.4, 114.3, 111.4, 111.3, 110.3, 70.9, 70.7, , 66.7, 55.3, 55.2, 52.0, 49.9, 36.4 ppm. IR (KBr, cm^{-1}): 3532, 3031, 2949, 2838, 1733, 1489, 1453, 1240, 1160, 1026, 911, 753, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{25}O_4Na$: 455.1829, found: 455.1825.



5s

5s: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (33.5, 74% yield, dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.5 Hz, 1H), 7.82-7.69 (m, 3H), 7.49-7.39 (m, 3H), 7.33-7.18 (m, 7H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.79 (d, *J* = 8.5 Hz, 1H), 6.28 (dd, *J* = 9.5, 4.5 Hz, 1H), 5.09 (s, 1H), 5.00 (s, 1H), 4.49-4.26 (m, 2H), 3.95-3.70 (m, 1H), 3.59 (d, *J* = 4.0 Hz, 3H), 3.14 (dd, *J* = 22.5, 5.0 Hz, 1H), 3.03-2.81 (m, 1H), 2.58-2.36 (m, 1H) ppm,. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.7, 155.7, 141.7, 141.6, 140.7, 140.6, 138.3, 133.2, 132.7, 132.1, 132.0, 128.7, 128.1, 128.0, 127.8, 127.6, 127.5, 125.9, 125.6, 125.0, 125.0, 121.1, 114.8, 114.7, 111.8, 71.9, 71.7, 71.0, 52.1, 50.0, 36.6, 36.5 ppm. IR (KBr, cm^{-1}): 3507, 3057, 2949, 1733, 1654, 1599, 1489,

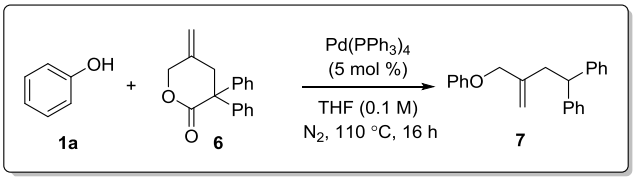
1452, 1358, 1230, 1160, 1027, 909, 820, 753, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{32}H_{28}O_4Na$: 475.1880, found: 475.1883.



5t

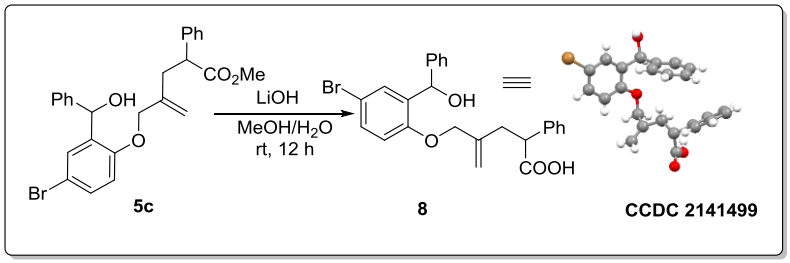
5t: Prepared according to the general procedure above and purified by a flash chromatography column with PE/EA (5:1, v/v) as the eluent. Colorless oil (18.6mg, 57% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.37-7.20 (m, 7H), 6.95 (t, *J* = 7.5 Hz, 1H), 6.79 (d, *J* = 8.5 Hz, 1H), 5.18 (s, 1H), 5.05 (s, 1H), 4.72 (s, 2H), 4.58-4.40 (m, 2H), 3.91 (dd, *J* = 9.0, 6.5 Hz, 1H), 3.63 (s, 3H), 3.00 (dd, *J* = 14.5, 9.0 Hz, 1H), 2.58 (dd, *J* = 15.0, 6.5 Hz, 1H), 2.47 (s, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 156.3, 141.7, 138.3, 129.3, 128.9, 128.8, 128.7, 127.8, 127.5, 120.9, 114.7, 111.3, 70.7, 61.9, 52.1, 50.1, 36.8 ppm. IR (KBr, cm^{-1}): 3360, 3030, 2919, 2850, 1732, 1658, 1601, 1491, 1453, 1359, 1233, 1012, 910, 754, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{20}H_{22}O_4Na$: 349.1410, found: 349.1410.

F) Synthesis of decarboxylative *O*-allylation product 7



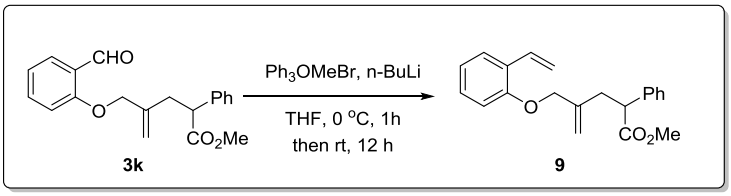
Under a nitrogen atmosphere, to an oven dried 10 mL Schlenck flask equipped with a stirring bar was added GMDVs **6** (0.15 mmol), Phenoles **1a** (0.1 mmol), $Pd(PPh_3)_4$ (5 mol %) and dry THF (1.0 mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred at 110 ℃ for the indicated time. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (15:1, v/v), giving the corresponding colorless oil **7** in 50% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.30-7.21 (m, 10H), 7.17 (t, *J* = 7.0 Hz, 2H), 6.93 (t, *J* = 7.5 Hz, 1H), 6.82 (d, *J* = 8.0 Hz, 2H), 5.10 (s, 1H), 4.92 (s, 1H), 4.35 (s, 2H), 4.25 (t, *J* = 8.0 Hz, 1H), 2.93 (d, *J* = 8.0 Hz, 2H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.6, 144.3, 142.6, 129.4, 128.4, 127.9, 126.3, 120.8, 114.8, 114.7, 70.8, 49.5, 39.2 ppm. IR (KBr, cm^{-1}): 3026, 2922, 1651, 1597, 1493, 1239, 1031, 905, 751, 697. HRMS (ESI) $[M+H]^+$ calcd for $C_{23}H_{23}O$: 315.1743, found: 315.1754.

G) Synthesis of hydrolysis product 8 (CCDC 2141499)



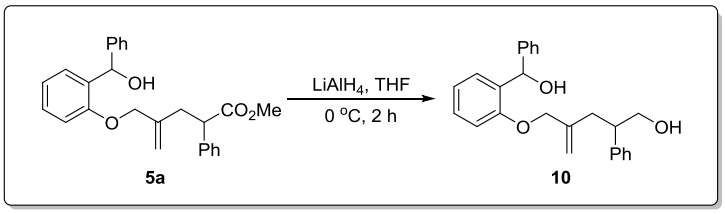
To a flame dried round bottom flask was added compound **5c** (0.1 mmol) and LiOH (0.2 mmol). Then 1.1ml CH_3OH-H_2O (0.09M, 10:1) was added at room temperature and the reaction mixture was then stirred overnight. The mixture was acidified with hydrochloric acid after the completion of the reaction. Then the reaction mixture was extracted with EtOAc, dried over anhydrous sodium sulfate, concentrated the mixture under vacuum and then purified by flash column chromatography with DCM/CH_3OH (20:1, v/v) to afford the corresponding product **8** in 83% yield and 1:1 dr as a white solid. Melting point: 89.8-90.1 ℃. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.51 (s, 1H), 7.30 (d, *J* = 6.0 Hz, 6H), 7.26-7.21 (m, 4H), 7.15 (t, *J* = 7.0 Hz, 1H), 6.59 (d, *J* = 9.0 Hz, 1H), 6.01 (d, *J* = 9.0 Hz, 1H), 5.03 (s, 1H), 5.00 (s, 1H), 4.39-4.23 (m, 2H), 3.77 (t, *J* = 11.5 Hz, 1H), 2.79 (td, *J* = 16.0, 9.0 Hz, 1H), 2.41 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 178.8, (154.4, 154.3, dr=1:1), 142.6, 141.1, 137.5, 134.2, 134.1, 131.1, 130.4, 128.8, 128.3, 128.0, 127.8, 127.5, 126.5, 115.2, 113.5, 113.4, 71.3, 71.2, 49.8, 35.7 ppm. IR (KBr, cm^{-1}): 3029, 2927, 2855, 1707, 1483, 1453, 1238, 1016, 914, 803, 161, 727, 698, 595. HRMS (ESI) $[M+Na]^+$ calcd for $C_{25}H_{23}BrO_4Na$: 489.0672, found: 489.0671.

H) Synthesis of Wittig reaction product 9



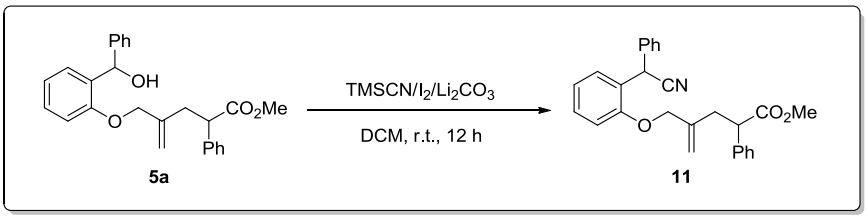
To a flame-dried round-bottom flask, Ph_3PCH_2Br (1.2 equiv) was added. Under nitrogen atmosphere, THF (0.25M) and *n*-BuLi (1.2 equiv) were added at 0 ℃. After 1 h, **3k** (1.0 equiv) was added at room temperature and the reaction mixture was then stirred overnight. The reaction mixture was quenched with NH_4Cl, extracted with EtOAc , dried over anhydrous sodium sulfate, concentrated the mixture under vacuum and then purified by flash column chromatography with PE/EA (10:1, v/v) to afford the colorless oil **9** in 56% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.49 (d, *J* = 8.0 Hz, 1H), 7.36-7.28 (m, 4H), 7.27 (dd, *J* = 6.5, 3.0 Hz, 1H), 7.19 (t, *J* = 7.5 Hz, 1H), 7.09 (dd, *J* = 17.5, 11.0 Hz, 1H), 6.93 (t, *J* = 7.5 Hz, 1H), 6.77 (d, *J* = 8.5 Hz, 1H), 5.73 (d, *J* = 18.0 Hz, 1H), 5.25 (d, *J* = 11.0 Hz, 1H), 5.19 (s, 1H), 5.03 (s, 1H), 4.52-4.35 (m, 2H), 3.91 (dd, *J* = 9.0, 7.0 Hz, 1H), 3.64 (s, 3H), 2.98 (dd, *J* = 15.0, 9.0 Hz, 1H), 2.62 (dd, *J* = 15.0, 6.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.8, 155.6, 141.9, 138.5, 131.6, 128.7, 127.9, 127.4, 127.1, 126.4, 120.9, 114.4, 112.2, 71.1, 52.0, 50.0, 36.9 ppm. IR (KBr, cm^{-1}): 3358, 3195, 2920, 2850, 1738, 1658, 1469, 1383, 721. HRMS (ESI) $[M+Na]^+$ calcd for $C_{21}H_{22}O_3Na$: 345.1461, found: 345.1466

I) Synthesis of reduction product 10



The compound **5a** was dissolved in THF (0.25 M), and the resulting solution was cooled to 0 ℃. $LiAlH_4$ (1.5 equiv) was added portion wise, and the resulting mixture was allowed to stir for 2h. The reaction was quenched using the Fieser method, filtered through celite, and concentrated in vacuo. The residue was purified by column chromatography with PE/EA (2:1, v/v) to afford the colorless oil **10** in 70% yield (dr = 1:1). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.37 (dd, *J* = 7.5, 3.5 Hz, 2H), 7.30 (t, *J* = 7.5 Hz, 5H), 7.25-7.17 (m, 3H), 7.13 (t, *J* = 7.0 Hz, 2H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.72 (t, *J* = 8.0 Hz, 1H), 6.08 (d, *J* = 10.0 Hz, 1H), 5.00 (s, 1H), 4.90 (s, 1H), 4.43-4.23 (m, 2H), 3.64 (t, *J* = 10.0 Hz, 2H), 3.15 (d, *J* = 30.0Hz, 1H), 3.04-2.88 (m, 1H), 2.52 (ddd, *J* = 20.5, 15.0, 6.0 Hz, 1H), 2.31 (dt, *J* = 14.5, 10.0 Hz, 1H), 1.52 (d, *J* = 28.5 Hz, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 155.7, 155.6, 143.5, 143.4, 142.1, 141.4, 131.9, 128.6, 128.1, 128.0, 127.1, 126.9, 126.5, 120.9, 114.9, 111.7, 72.0, 70.9, 67.3, 67.2, 46.7, 46.6, 35.3 ppm. IR (KBr, cm^{-1}): 3358, 3028, 2920, 2850, 1657, 1489, 1452, 1235, 1020, 906, 754, 699. HRMS (ESI) $[M+Na]^+$ calcd for $C_{25}H_{26}O_3Na$: 397.1774, found: 397.1776

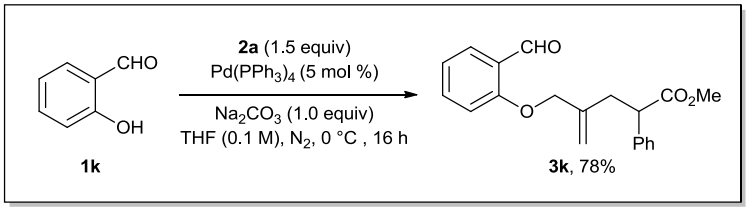
J) General Procedure for the Synthesis of 11



To a round-bottom flask was charged with compounds **5a** (0.1 mmol) in DCM (2 mL), Li_2CO_3 (0.02 mmol), TMSCN (0.45 mmol), and I_2 (0.18 mmol) in sequence successively. Then the resulting mixture was stirred overnight under closed conditions at room temperature. The reaction was quenched with saturated solution of $Na_2S_2O_3$. The organic phase was separated, and the aqueous layer was extracted with DCM. The combined organic solution was dried with Na_2SO_4 and concentrated in vacuo. The resulting residue was purified by a column chromatography with PE/EA (6:1, v/v) to give the corresponding colorless oil **11** in 83% yield and 1:1 dr. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.37-7.30 (m, 4H), 7.30-7.27 (m, 4H), 7.26-7.19 (m, 4H), 6.96 (t, *J* = 7.5 Hz, 1H), 6.78 (d, *J* = 8.0 Hz, 1H), 5.55 (s, 1H), 5.10 (s, 1H), 5.02 (s, 1H), 4.48-4.35 (m, 2H), 3.89-3.79 (m, 1H), 3.62 (d, *J* = 2.0 Hz, 3H), 2.90 (dt, *J* = 15.0, 9.0 Hz, 1H), 2.58-2.44 (m, 1H) ppm. ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.6, 155.0, 141.3, 138.2, 135.5, 129.6, 129.0, 128.8, 128.7, 127.8, 127.6, 127.5,124.5, 124.4, 121.2, 119.9, 114.7, 114.6, 111.9, 71.1, 52.1, 50.0, 49.9 36.4, 36.3 ppm. IR (KBr, cm^{-1}): 3029, 2945, 2360, 1734, 1653, 1491, 1451, 1241, 1159, 1010, 911, 752, 732, 697. HRMS (ESI) $[M+Na]^+$ calcd for $C_{27}H_{25}NO_3Na$: 434.1727, found: 434.1731.

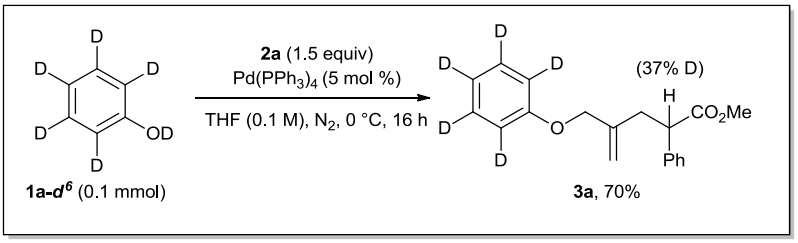
III. Control Experiments

A) Base Effect

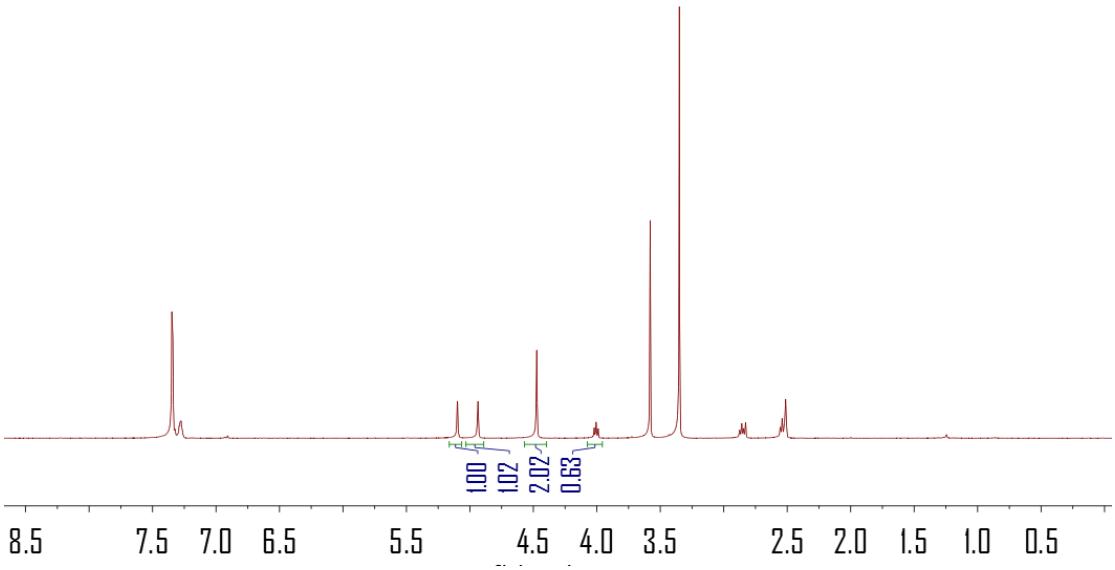


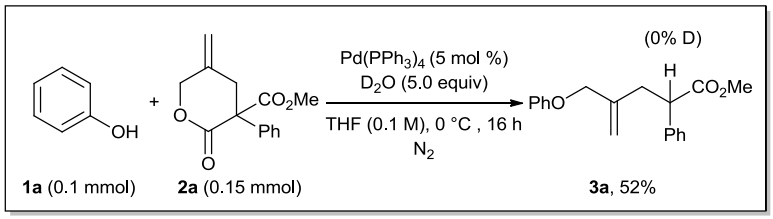
Reaction procedure A: Under a nitrogen atmosphere, to an oven dried 10 mL Schlenck flask equipped with a stirring bar was added phenol **1k** (0.1 mmol), GMDVs **2a** (0.15 mmol), Na_2CO_3 (0.1 mmol), $Pd(PPh_3)_4$ (5 mol %) and dry THF (1.0 mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred at 0 ℃ for 16 h. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (15;1), giving the corresponding product **3k** (25.3 mg, 78%).

B) Deuterium-labelling Experiments

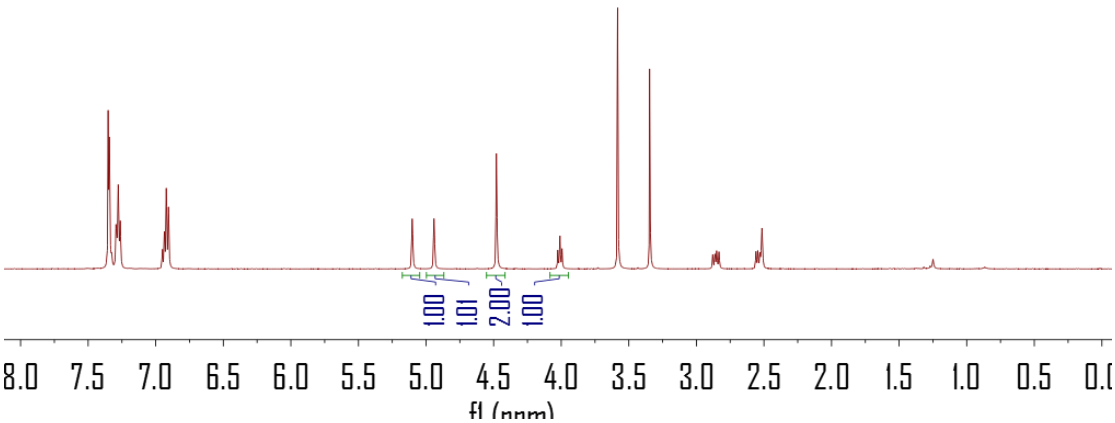


Reaction procedure A: Under a nitrogen atmosphere, to an oven dried 10 mL Schlenck flask equipped with a stirring bar was added phenol **1a-*d*^{6}** (0.1 mmol), GMDVs **2a** (0.15 mmol), $Pd(PPh_3)_4$ (5 mol %) and dry THF (1.0 mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred at 0 ℃ for 16 h. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (15;1), giving the corresponding product **3a** (37% D, determined by ^{1}H NMR) in 78% yield.



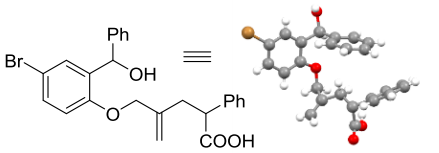


Reaction procedure B: Under a nitrogen atmosphere, to an oven dried 10 mL Schlenck flask equipped with a stirring bar was added phenol **1a** (0.1 mmol), GMDVs **2a** (0.15 mmol), $Pd(PPh_3)_4$ (5 mol %), D_2O (0.5 mmol) and dry THF (1.0 mL). The resultant mixture was degassed three times by freeze-pump-thaw cycles. The reaction mixture was stirred at 0 ℃ for 16 h. And then the reaction mixture was purified by flash column chromatography on silica gel eluting with petroleum ether/ethyl acetate (15;1), giving the corresponding product **3a** (0% D, determined by ^1H NMR) in 52% yield.



IV. X-ray Crystal Data

A) X-Ray Structure of product 8 (CCDC 2141499)



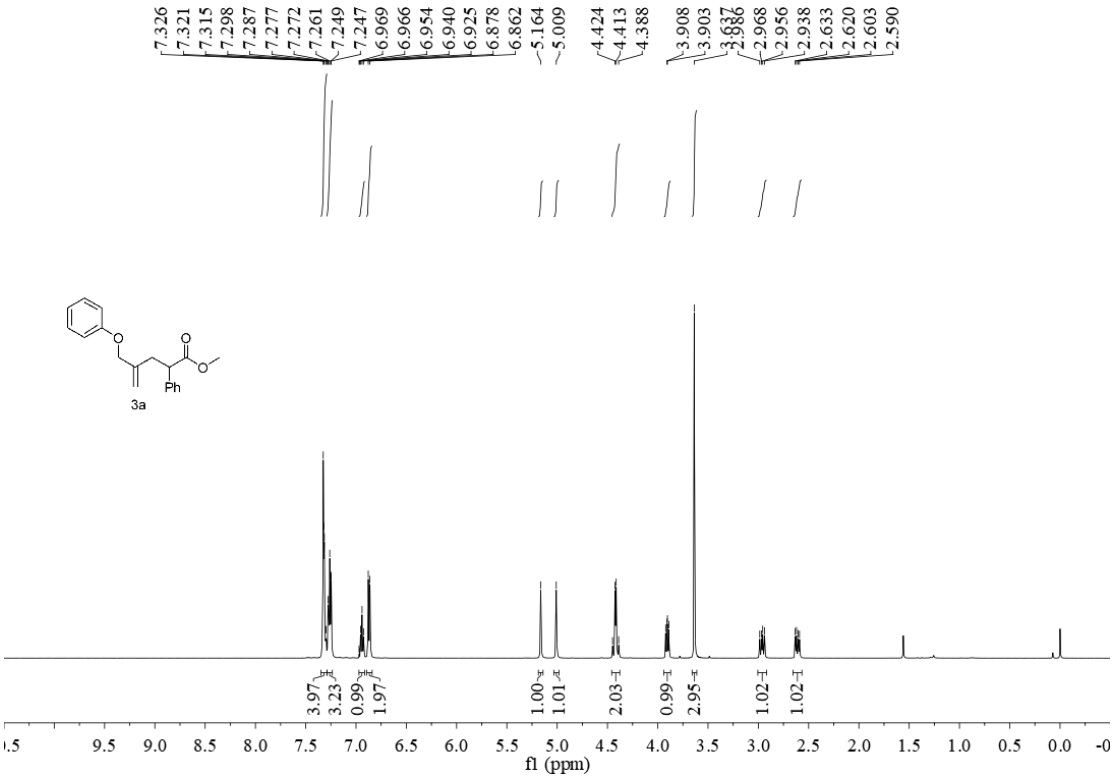
8 **CCDC 2141499**

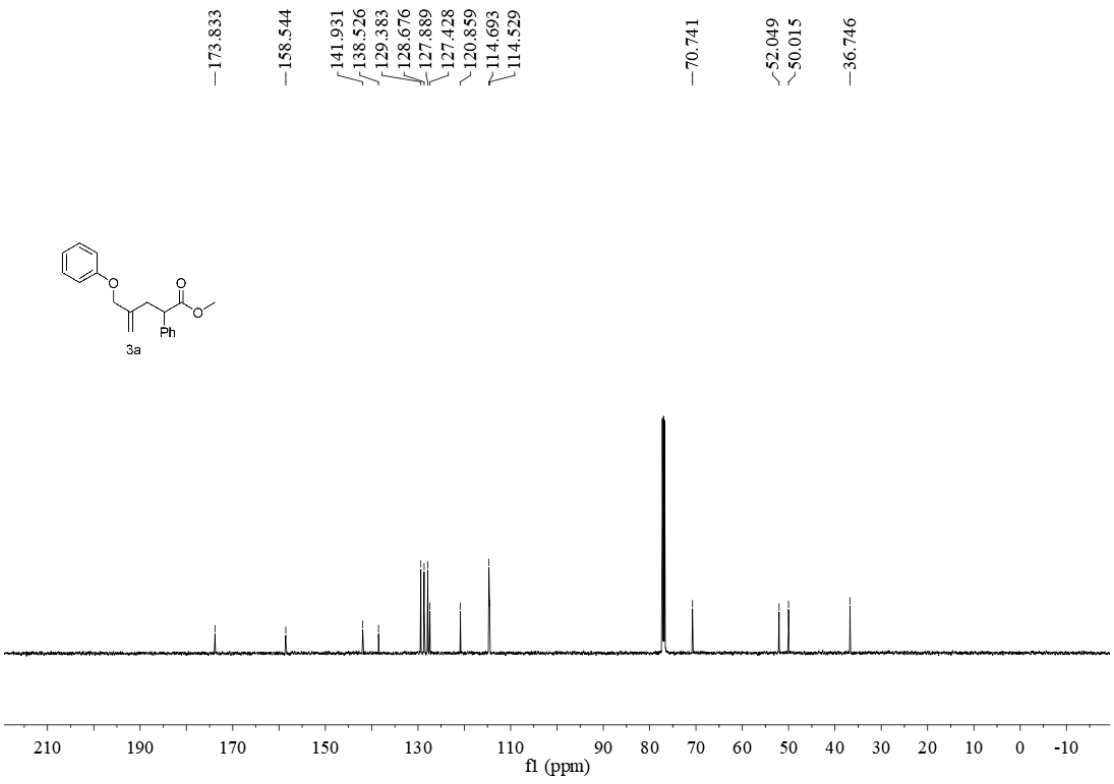
Table S1 Crystal data and structure refinement for **8**

Empirical formula	$C_{25}H_{22}BrNO_4$
Formula weight	466.33
Temperature/K	170(2)
Crystal system	orthorhombic
Space group	$P2_12_12_1$
a/Å	5.772(3)
b/Å	17.482(10)
c/Å	21.743(12)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	2194(2)
Z	4
ρ_{calc}g/cm^3	1.412
μ/mm^{-1}	1.902
F(000)	956.0
Crystal size/mm^3	0.18 ×0.12 ×0.06
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	4.412 to 50.236
Index ranges	-6 ≤ h ≤ 6, -18 ≤ k ≤ 20, -23 ≤ l ≤ 25
Reflections collected	9178
Independent reflections	3787 [R_{int} = 0.1828, R_{sigma} = 0.2797]
Data/restraints/parameters	3787/21/273
Goodness-of-fit on F^2	0.985
Final R indexes [I>=2σ (I)]	R_1 = 0.0919, wR_2 = 0.1836
Final R indexes [all data]	R_1 = 0.2435, wR_2 = 0.2669
Largest diff. peak/hole / e Å^{-3}	0.61/-0.57
Flack parameter	0.47(2)

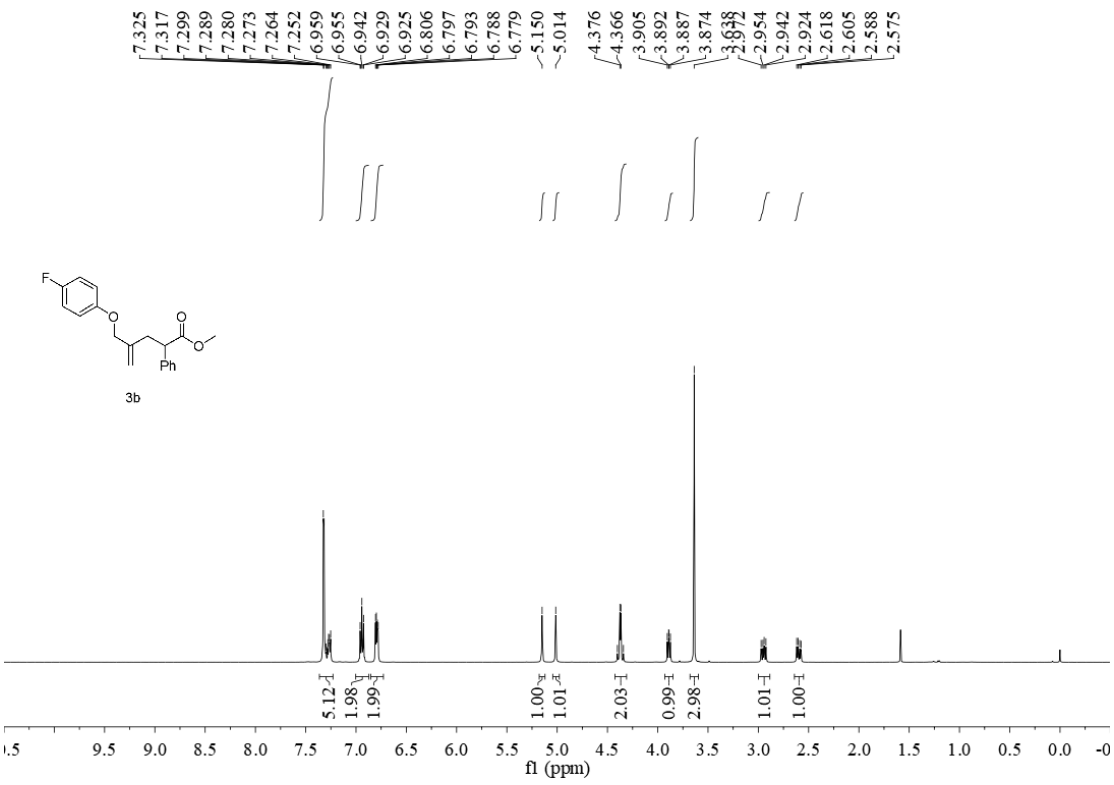
VI. NMR Spectrum

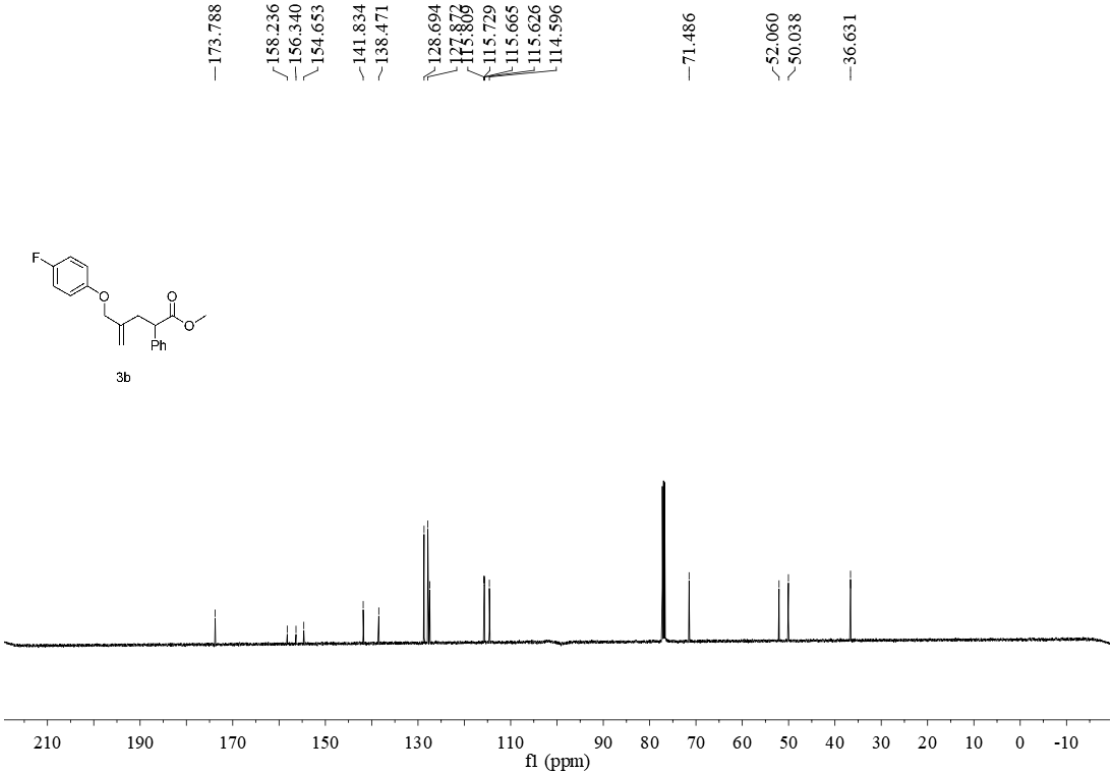
3a:



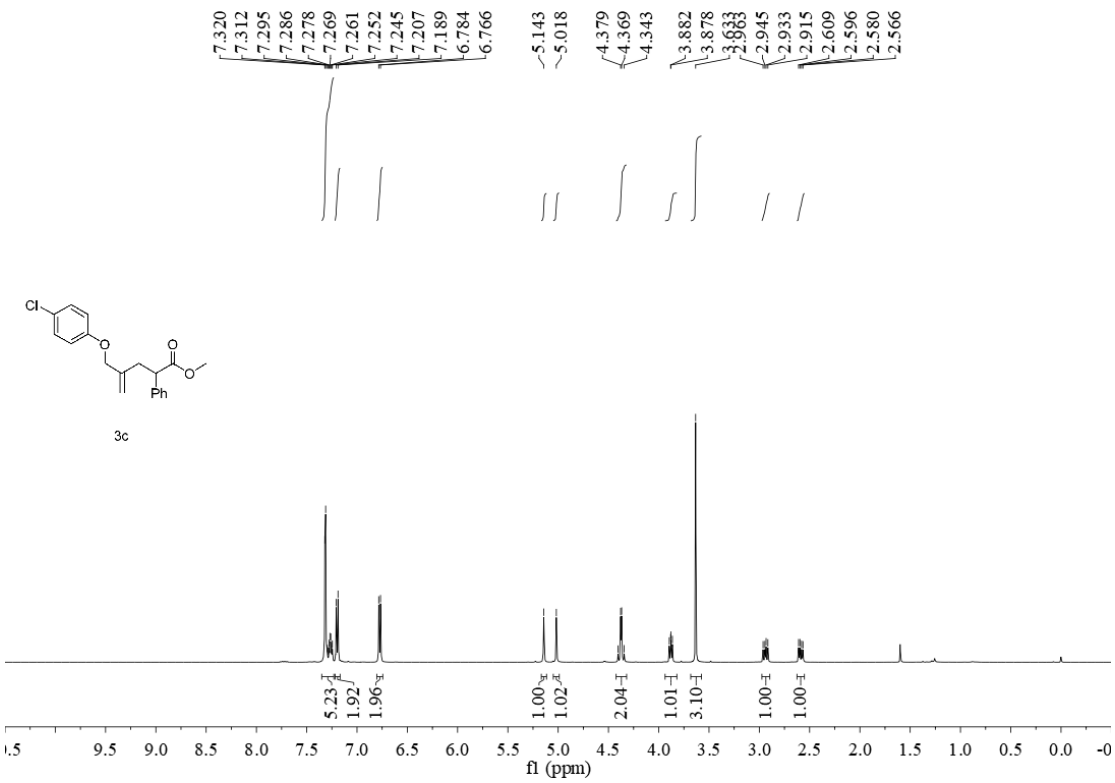


3b:


7.325
7.317
7.299
7.289
7.280
7.273
7.264
7.252
6.959
6.955
6.942
6.929
6.925
6.806
6.797
6.793
6.788
6.779
5.150
5.014
4.376
4.366
3.905
3.892
3.887
3.874
2.954
2.942
2.924
2.618
2.605
2.588
2.575
F
O
O
O
Ph
3b
5.12
1.98
1.99
1.00
1.01
2.03
0.99
2.98
1.01
1.00
fl (ppm)


173.788
158.236
156.340
154.653
141.834
138.471
128.694
127.872
115.809
115.729
115.665
115.626
114.596
71.486
52.060
50.038
36.631
F
O
O
O
Ph
3b
fl (ppm)

3c: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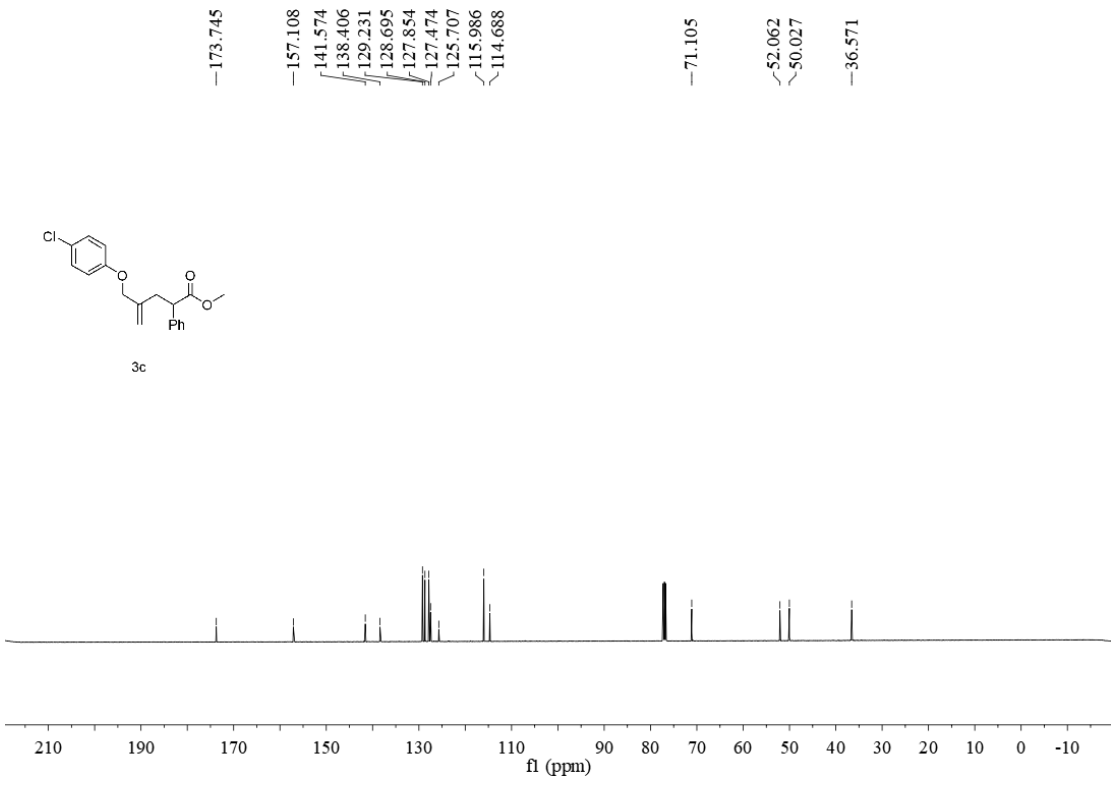
7.295
7.286
7.278
7.269
7.261
7.252
7.245
7.207
7.189
6.784
6.766
5.143
5.018
4.379
4.369
4.343
3.882
3.878
3.633
3.963
2.945
2.933
2.915
2.609
2.596
2.580
2.566
Cl
O
O
O
Ph
3c
5.23
1.92
1.96
1.00
1.02
2.04
1.01
3.10
1.00
1.00
fl (ppm)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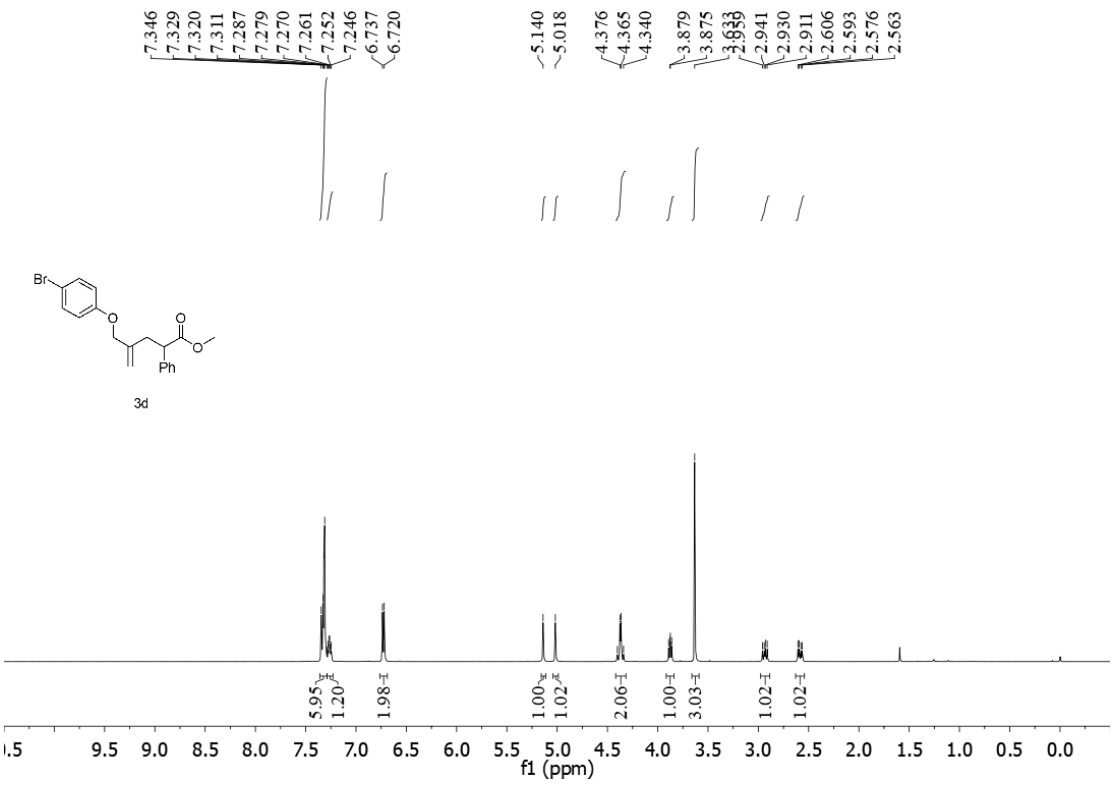
157.108
141.574
138.406
129.231
128.695
127.854
127.474
125.707
115.986
114.688
71.105
52.062
50.027
36.571
Cl
O
O
O
Ph
3c
fl (ppm)

3d: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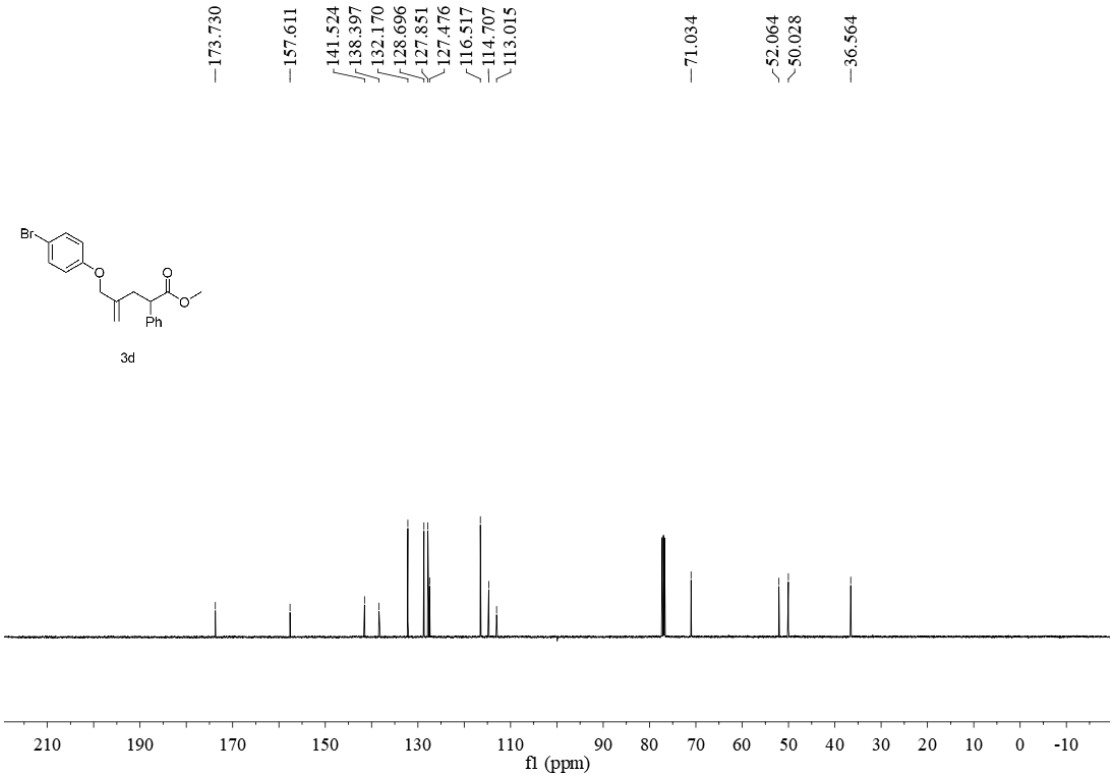
7.329
7.320
7.311
7.287
7.279
7.270
7.261
7.252
7.246
6.737
6.720
5.140
5.018
4.376
4.365
4.340
3.879
3.875
2.941
2.930
2.911
2.606
2.593
2.576
2.563
Br
O
O
O
Ph
3d
5.95
1.20
1.98
1.00
1.02
2.06
1.00
3.03
1.02
1.02
f1 (ppm)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141.524
138.397
132.170
128.696
127.851
127.476
116.517
114.707
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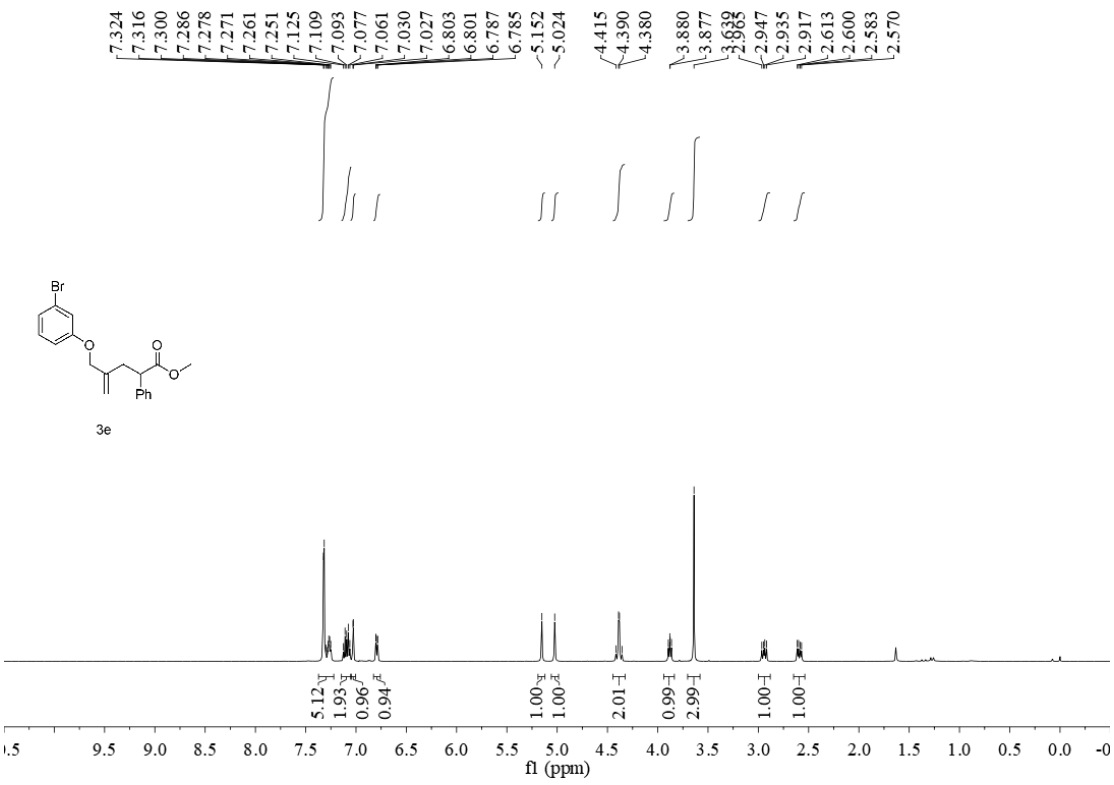
50.028
36.564
Br
O
O
O
Ph
3d
f1 (ppm)

3e: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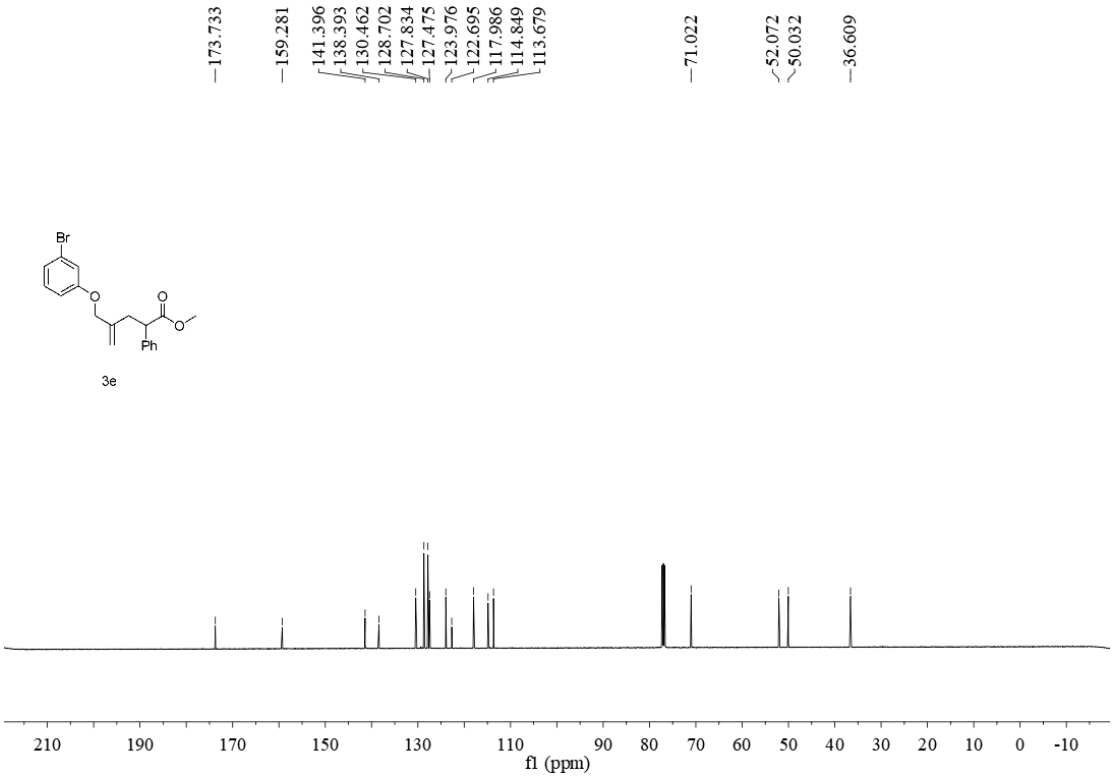
7.316
7.300
7.286
7.278
7.271
7.261
7.251
7.125
7.109
7.093
7.077
7.061
7.030
7.027
6.803
6.801
6.787
6.785
5.152
5.024
4.415
4.390
4.380
3.880
3.877
3.639
3.635
2.947
2.935
2.917
2.613
2.600
2.583
2.570
Br
O
O
O
Ph
3e
5.12
1.93
0.96
0.94
1.00
1.00
2.01
0.99
2.99
1.00
1.00
f1 (ppm)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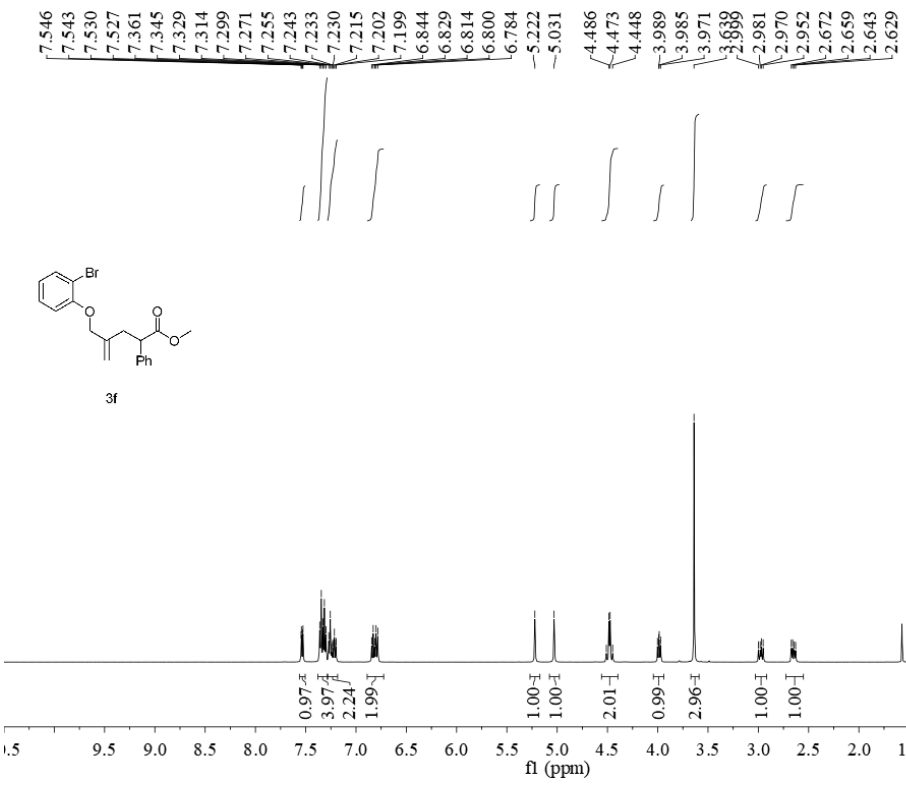
159.281
141.396
138.393
130.462
128.702
127.834
127.475
123.976
122.695
117.986
114.849
113.679
71.022
52.072
50.032
36.609
Br
O
O
O
Ph
3e
f1 (ppm)

3f: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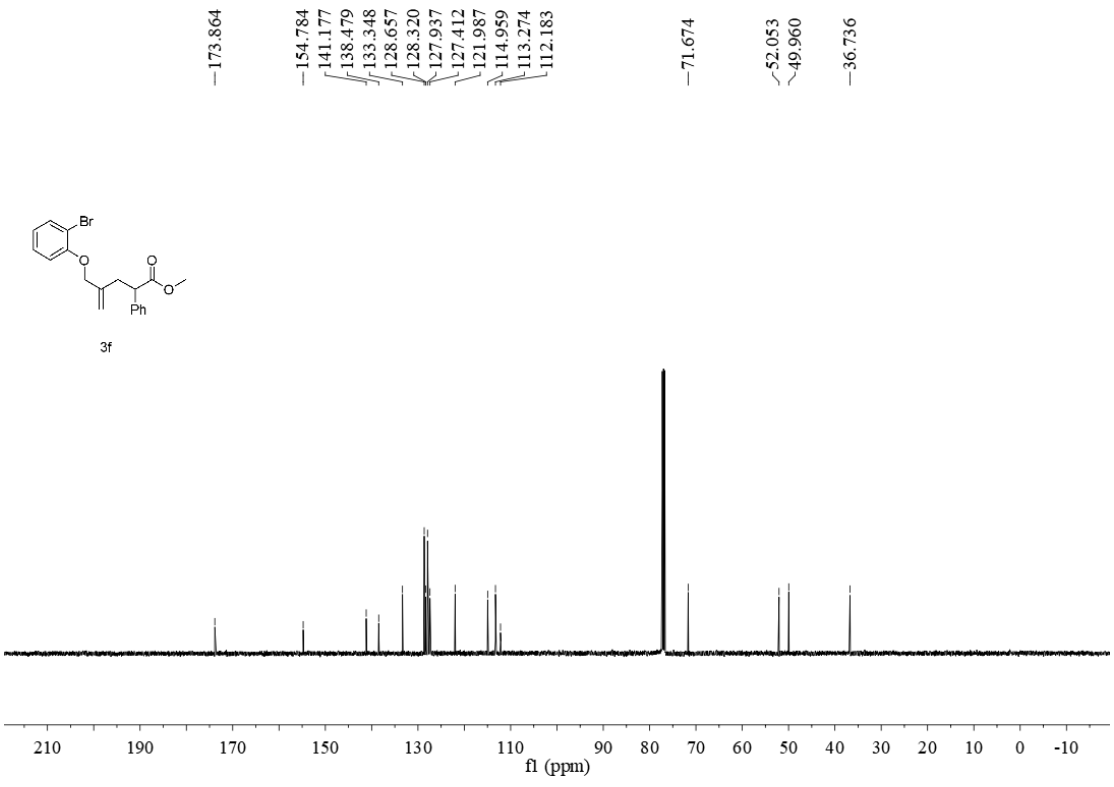
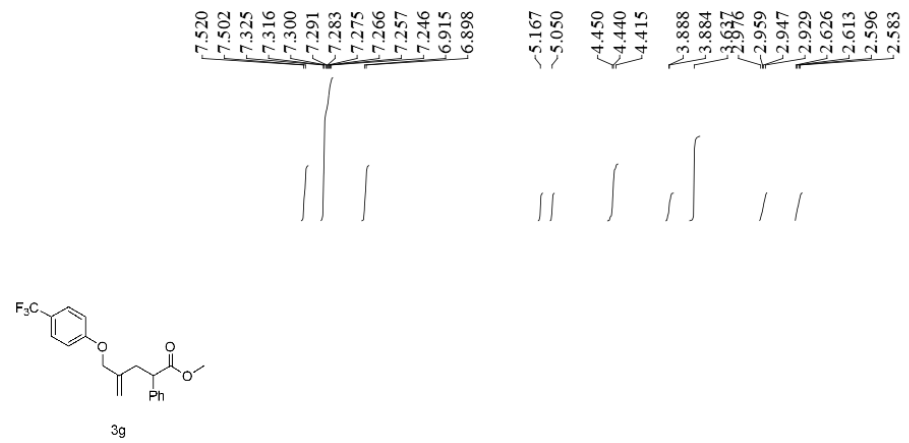
7.543
7.530
7.527
7.361
7.345
7.329
7.314
7.299
7.271
7.255
7.243
7.233
7.230
7.215
7.202
7.199
6.844
6.829
6.814
6.800
6.784
5.222
5.031
4.486
4.473
4.448
3.989
3.985
3.971
2.981
2.970
2.952
2.672
2.659
2.643
2.629
Br
O
O
O
Ph
3f
0.97
3.97
2.24
1.99
1.00
1.00
2.01
0.99
2.96
1.00
1.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

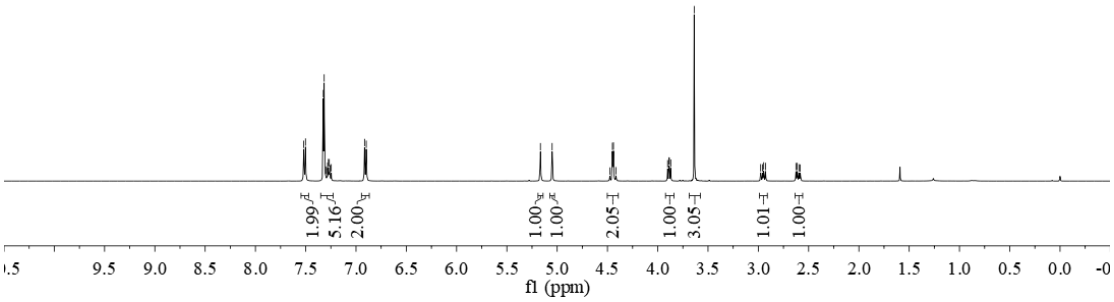

173.864
154.784
141.177
138.479
133.348
128.657
128.320
127.937
127.412
121.987
114.959
113.274
112.183
71.674
52.053
49.960
36.736
Br
O
O
O
Ph
3f
210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

3g:

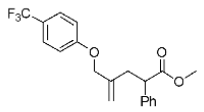

7.520
7.502
7.325
7.316
7.300
7.291
7.283
7.275
7.266
7.257
7.246
6.915
6.898
5.167
5.050
4.450
4.440
4.415
3.888
3.884
3.637
2.976
2.959
2.947
2.929
2.626
2.613
2.596
2.583

F3C
O
O
O
Ph

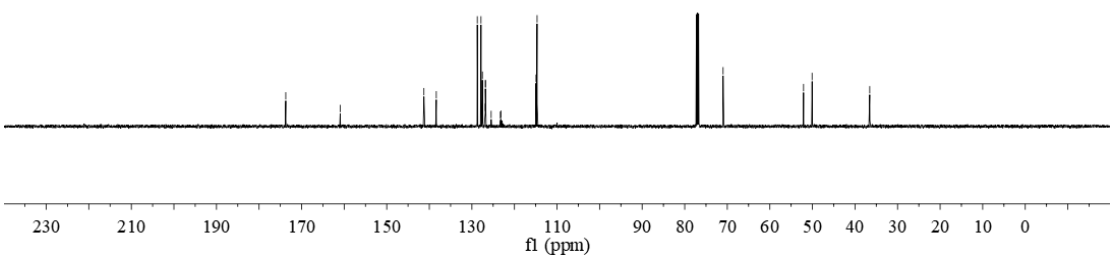
3g


1.99
5.16
2.00
1.00
1.00
2.05
1.00
3.05
1.01
1.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

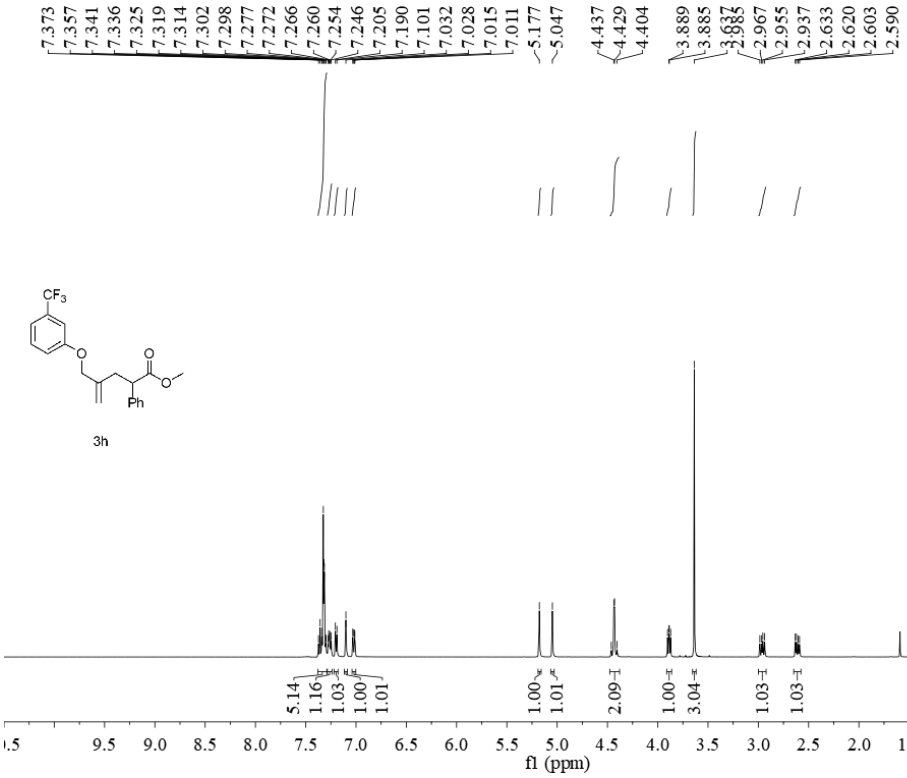

173.721
160.937
141.269
138.360
128.731
127.858
127.528
126.860
126.832
126.802
126.773
125.467
123.311
123.156
114.931
114.683
70.982
52.082
50.077
36.535


F3C
O
O
O
Ph

3g


230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3h: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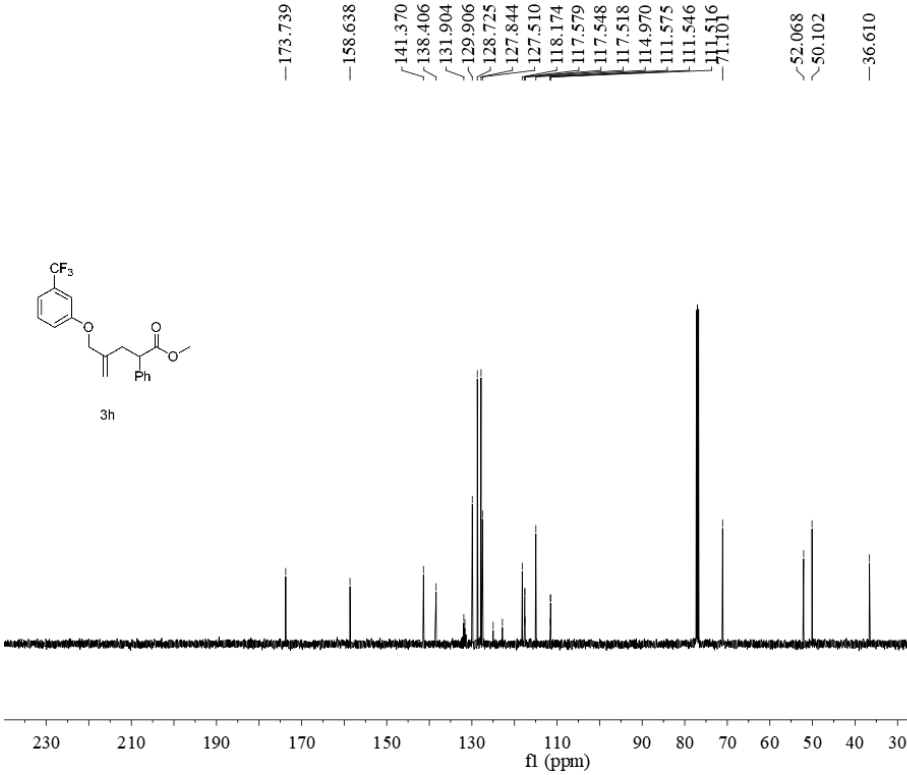
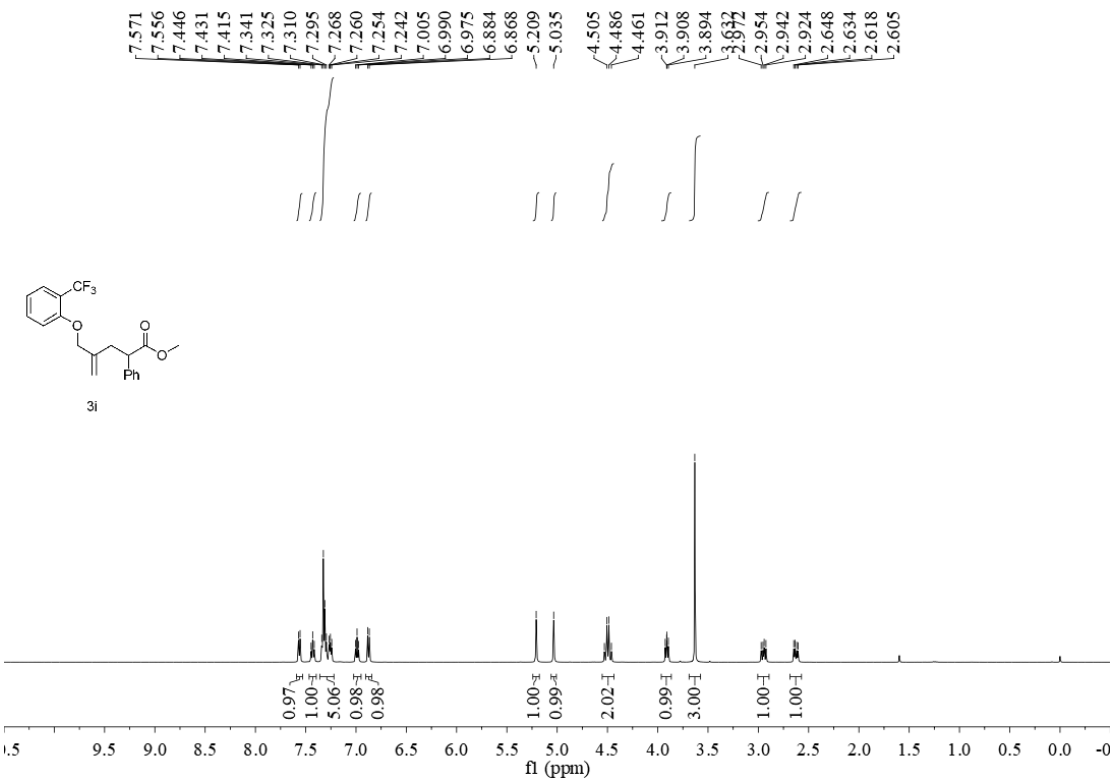
7.357
7.341
7.336
7.325
7.319
7.314
7.302
7.298
7.277
7.272
7.266
7.260
7.254
7.246
7.205
7.190
7.101
7.032
7.028
7.015
7.011
5.177
5.047
4.437
4.429
4.404
3.889
3.885
3.637
3.633
2.967
2.955
2.937
2.633
2.620
2.603
2.590
CF3
O
O
O
Ph
3h
5.14
1.16
1.03
1.00
1.01
1.00
1.01
2.09
1.00
3.04
1.03
1.03
fl (ppm)


173.739
158.638
141.370
138.406
131.904
129.906
128.725
127.844
127.510
118.174
117.579
117.548
117.518
114.970
111.575
111.546
111.516
71.101
52.068
50.102
36.610
CF3
O
O
O
Ph
3h
fl (ppm)

3i: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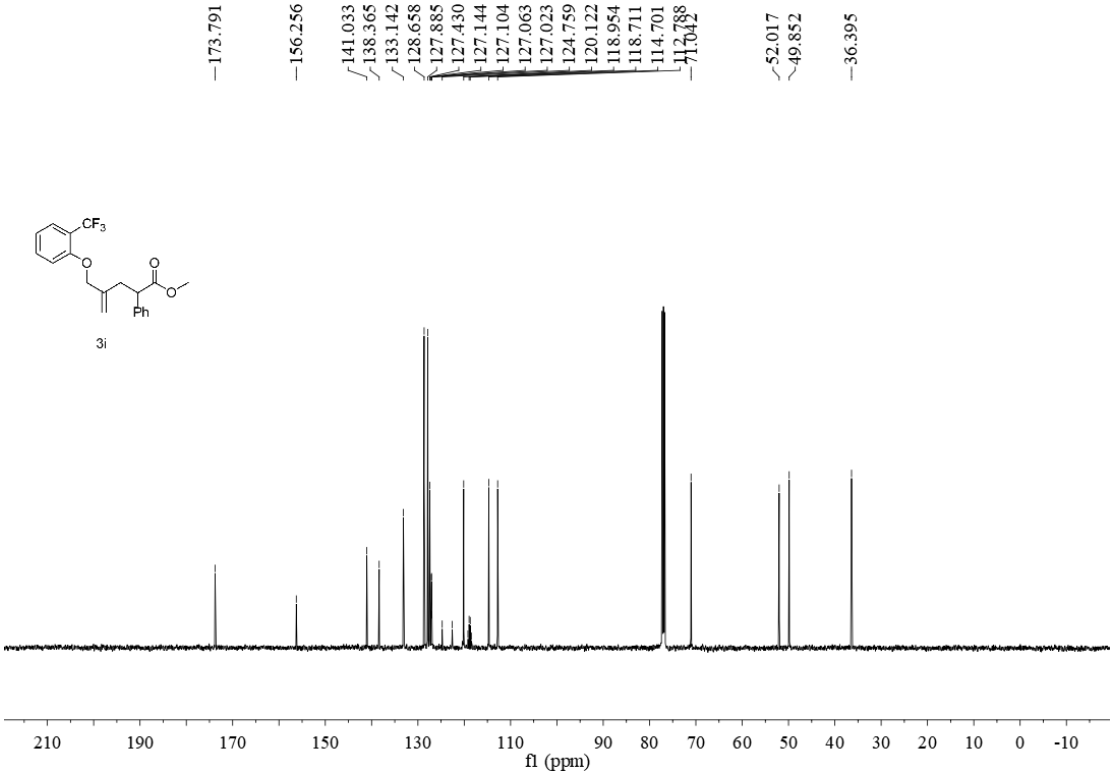
7.446
7.431
7.415
7.341
7.325
7.310
7.295
7.268
7.260
7.254
7.242
7.005
6.990
6.975
6.884
6.868
5.209
5.035
4.505
4.486
4.461
3.912
3.908
3.894
3.632
2.954
2.942
2.924
2.648
2.634
2.618
2.605
CF3
O
O
O
Ph
3i
0.97
1.00
5.06
0.98
0.98
1.00
0.99
2.02
0.99
3.00
1.00
1.00
f1 (ppm)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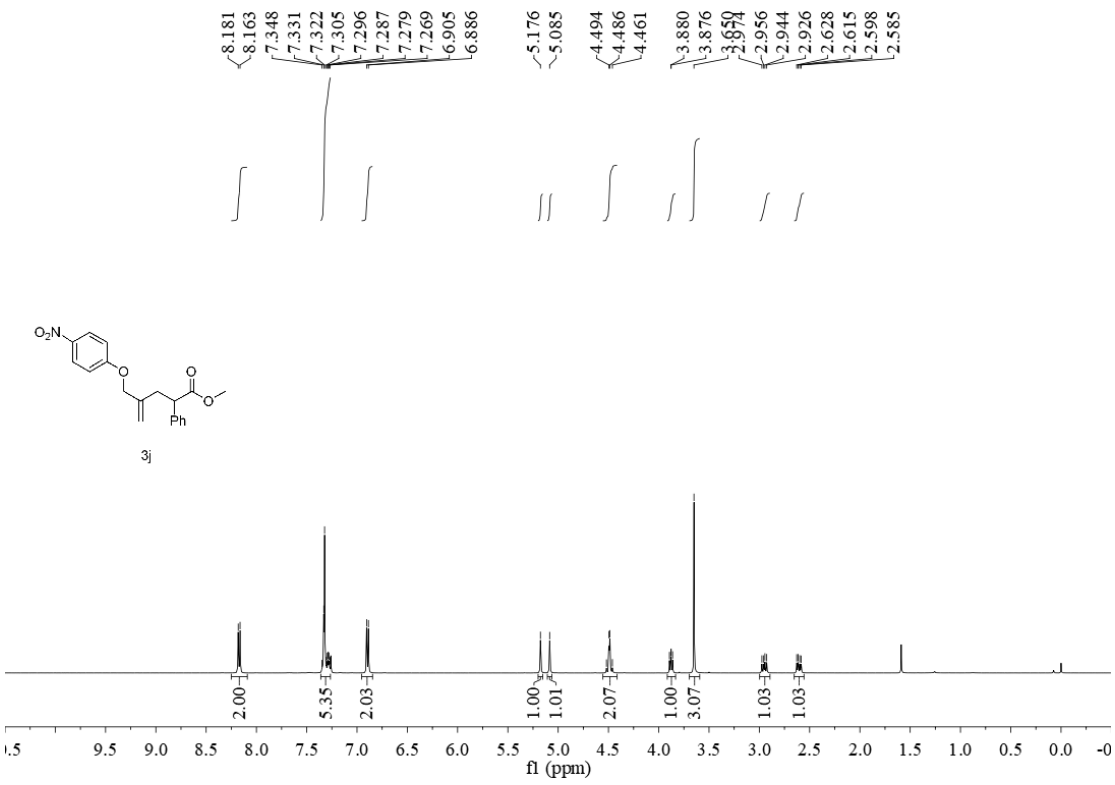
138.365
133.142
128.658
127.885
127.430
127.144
127.104
127.063
127.023
124.759
120.122
118.954
118.711
114.701
112.788
71.042
52.017
49.852
36.395
CF3
O
O
O
Ph
3i
f1 (ppm)

3j: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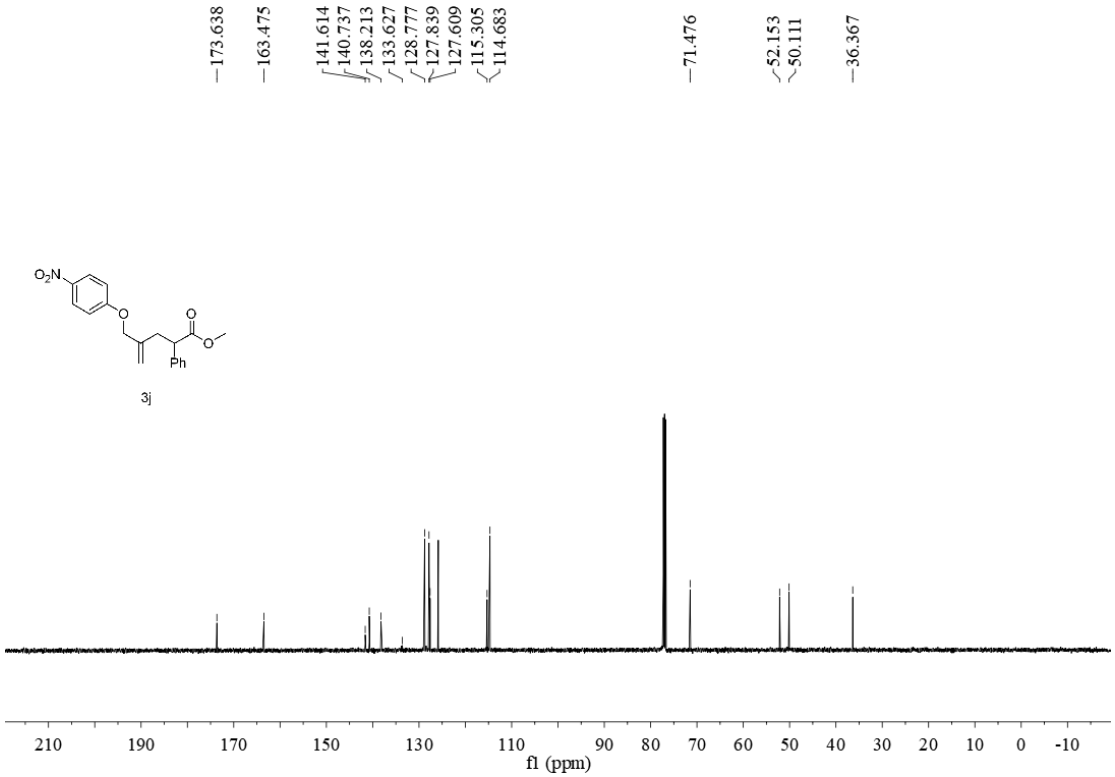
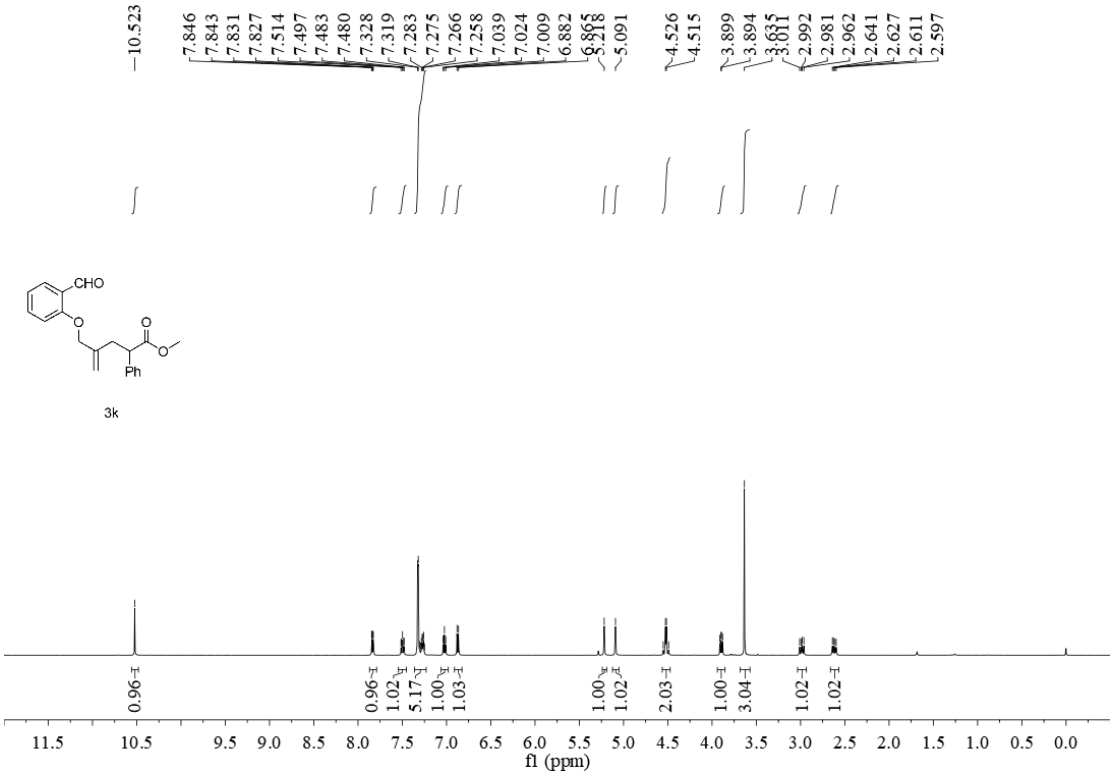
8.163
7.348
7.331
7.322
7.305
7.296
7.287
7.279
7.269
6.905
6.886
5.176
5.085
4.494
4.486
4.461
3.880
3.876
3.650
2.974
2.956
2.944
2.926
2.628
2.615
2.598
2.585
O2N
O
O
O
Ph
3j
2.00
5.35
2.03
1.00
1.01
2.07
1.00
3.07
1.03
1.03
f1 (ppm)


173.638
163.475
141.614
140.737
138.213
133.627
128.777
127.839
127.609
115.305
114.683
71.476
52.153
50.111
36.367
O2N
O
O
O
Ph
3j
f1 (ppm)

3k:


10.523
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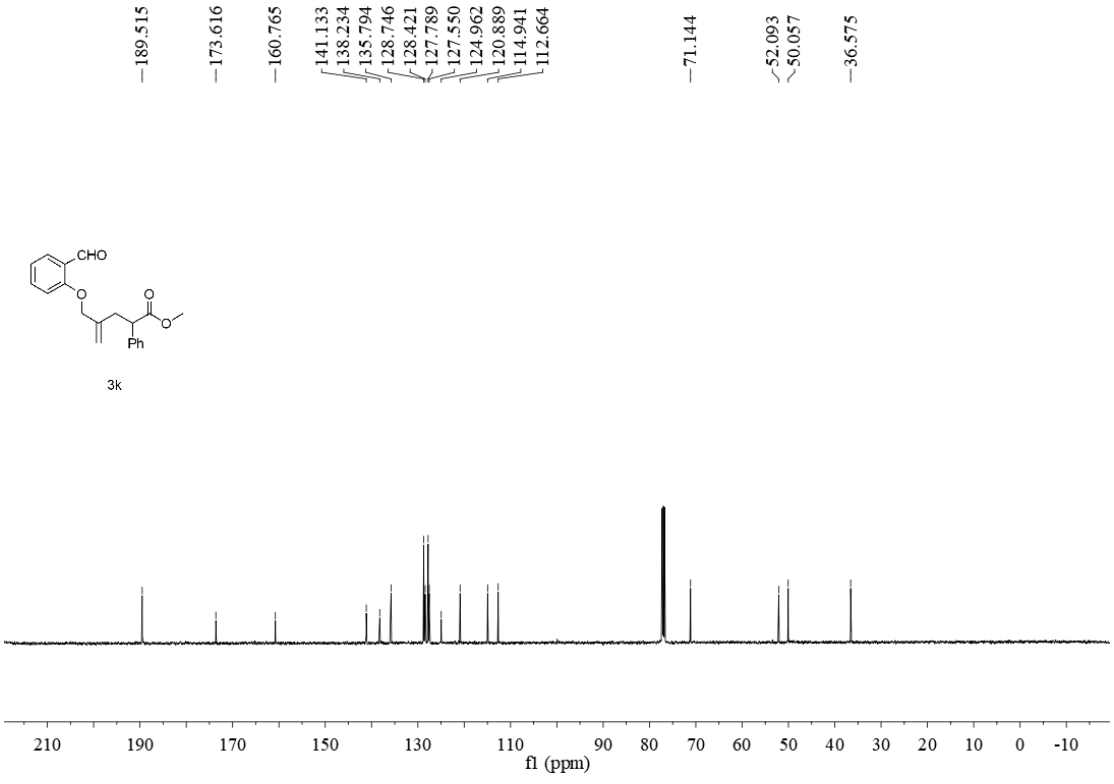
7.831
7.827
7.514
7.497
7.483
7.480
7.328
7.319
7.283
7.275
7.266
7.258
7.039
7.024
7.009
6.882
6.865
5.218
5.091
4.526
4.515
3.899
3.894
3.635
3.611
2.992
2.981
2.962
2.641
2.627
2.611
2.597
CHO
O
O
O
Ph
3k
0.96
0.96
1.02
5.17
1.00
1.03
1.00
1.02
2.03
1.00
3.04
1.02
1.02
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


189.515
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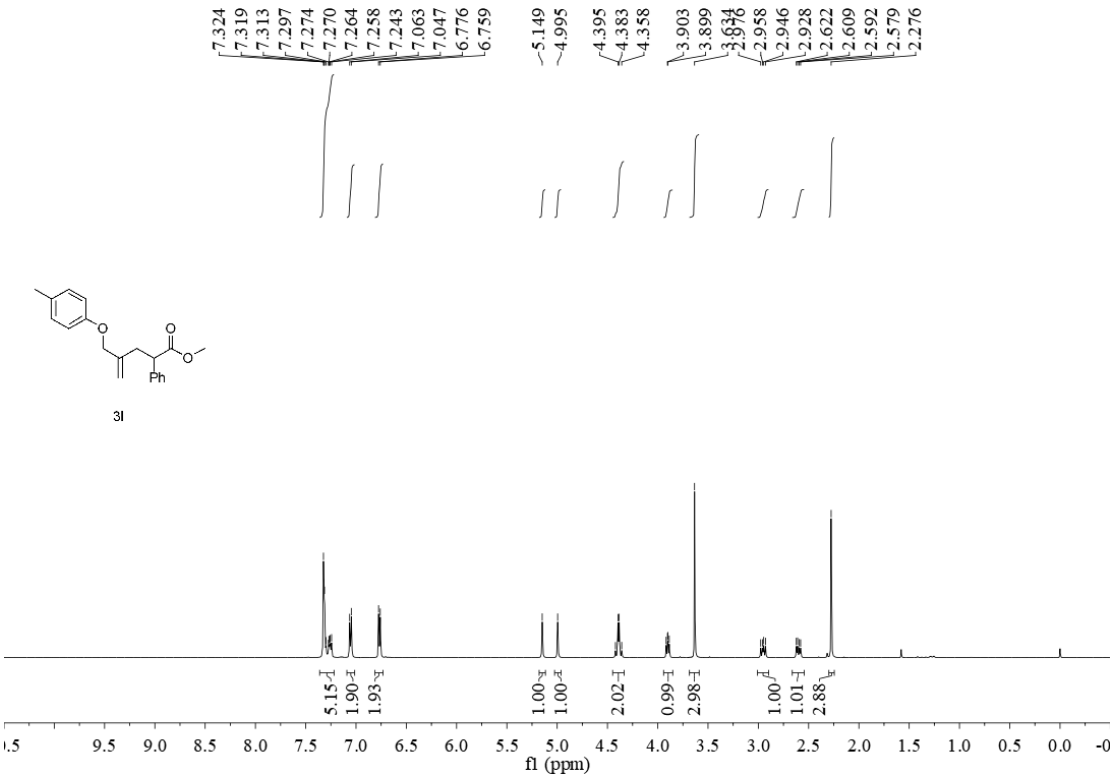
160.765
141.133
138.234
135.794
128.746
128.421
127.789
127.550
124.962
120.889
114.941
112.664
71.144
52.093
50.057
36.575
CHO
O
O
O
Ph
3k
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

3l:


7.324
7.319
7.313
7.297
7.274
7.270
7.264
7.258
7.243
7.063
7.047
6.776
6.759
5.149
4.995
4.395
4.383
4.358
3.903
3.899
3.634
2.958
2.946
2.928
2.622
2.609
2.592
2.579
2.276
O
O
O
Ph
3l
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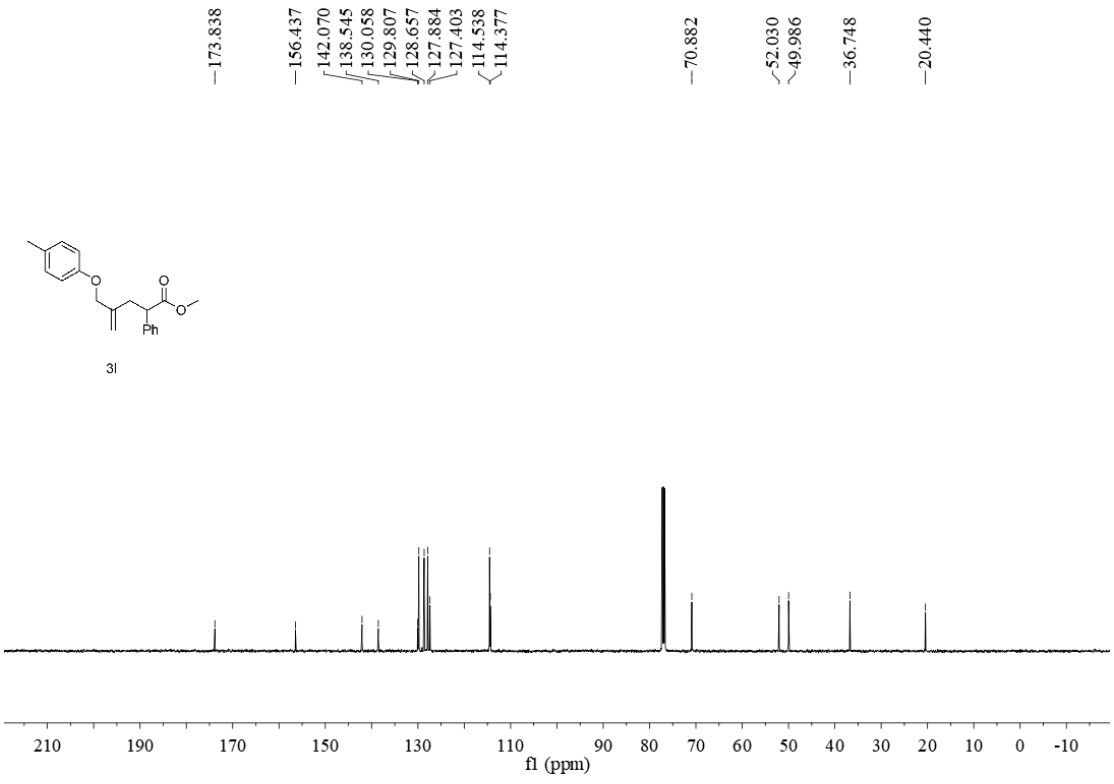
1.00
1.00
2.02
0.99
2.98
1.00
1.01
2.88
fl (ppm)


173.838
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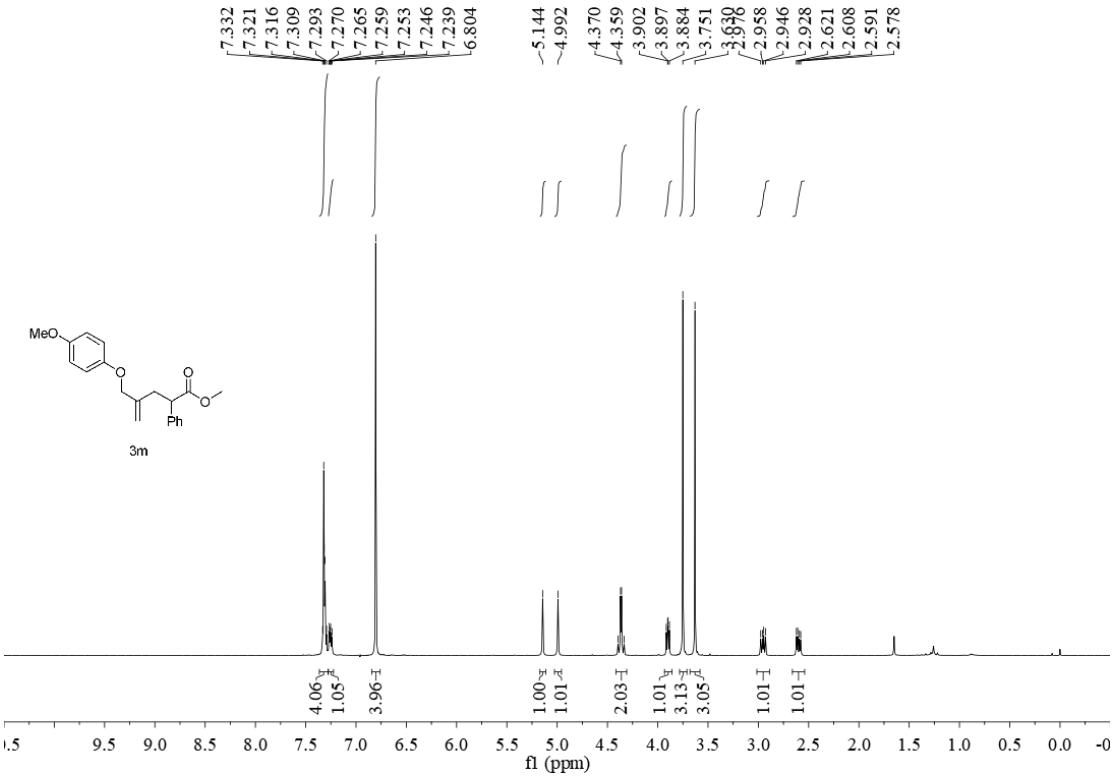
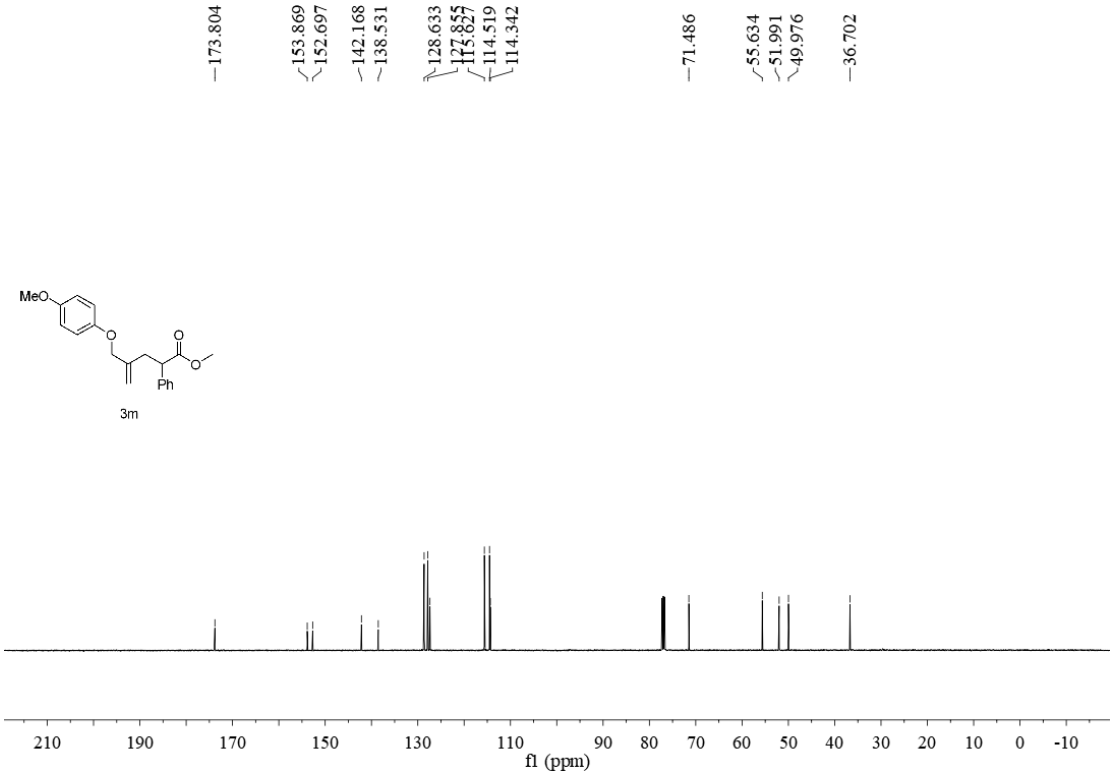
142.070
138.545
130.058
129.807
128.657
127.884
127.403
114.538
114.377
70.882
52.030
49.986
36.748
20.440
O
O
O
Ph
3l
fl (ppm)

3m:


7.332
7.321
7.316
7.309
7.293
7.270
7.265
7.259
7.253
7.246
7.239
6.804
5.144
4.992
4.370
4.359
3.902
3.897
3.884
3.751
2.958
2.946
2.928
2.621
2.608
2.591
2.578
MeO
O
O
O
Ph
3m
4.06
1.05
3.96
1.00
1.01
2.03
1.01
3.13
3.05
1.01
1.01
f1 (ppm)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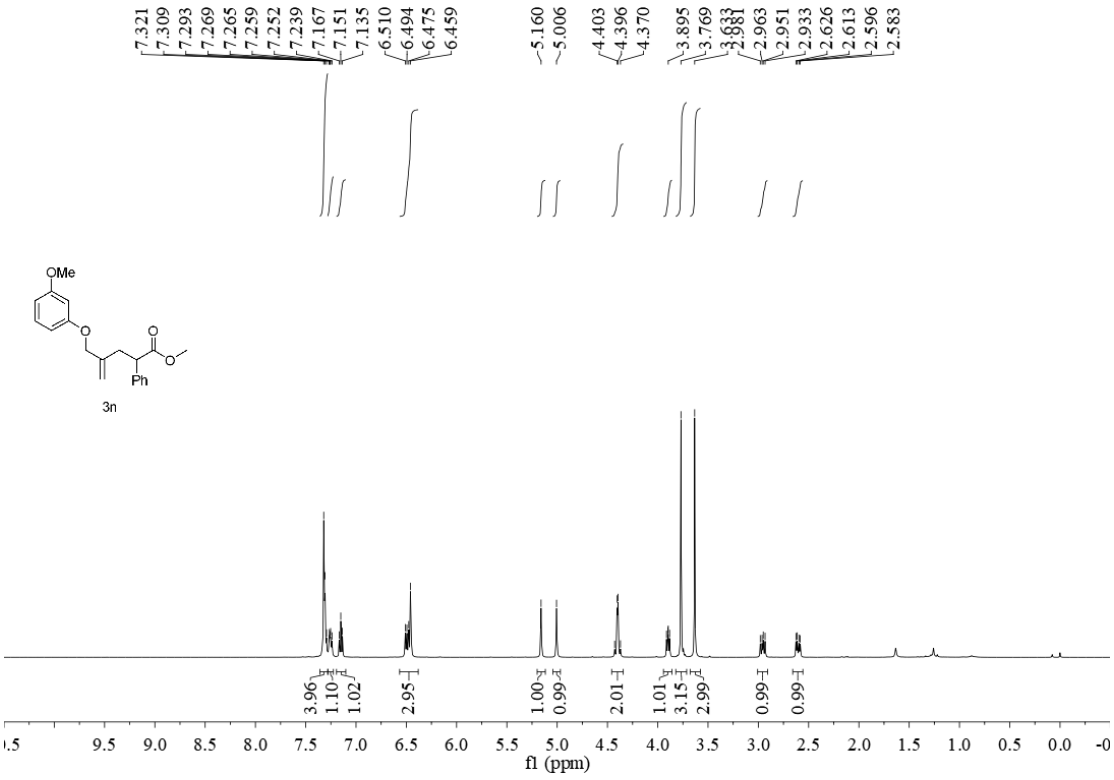
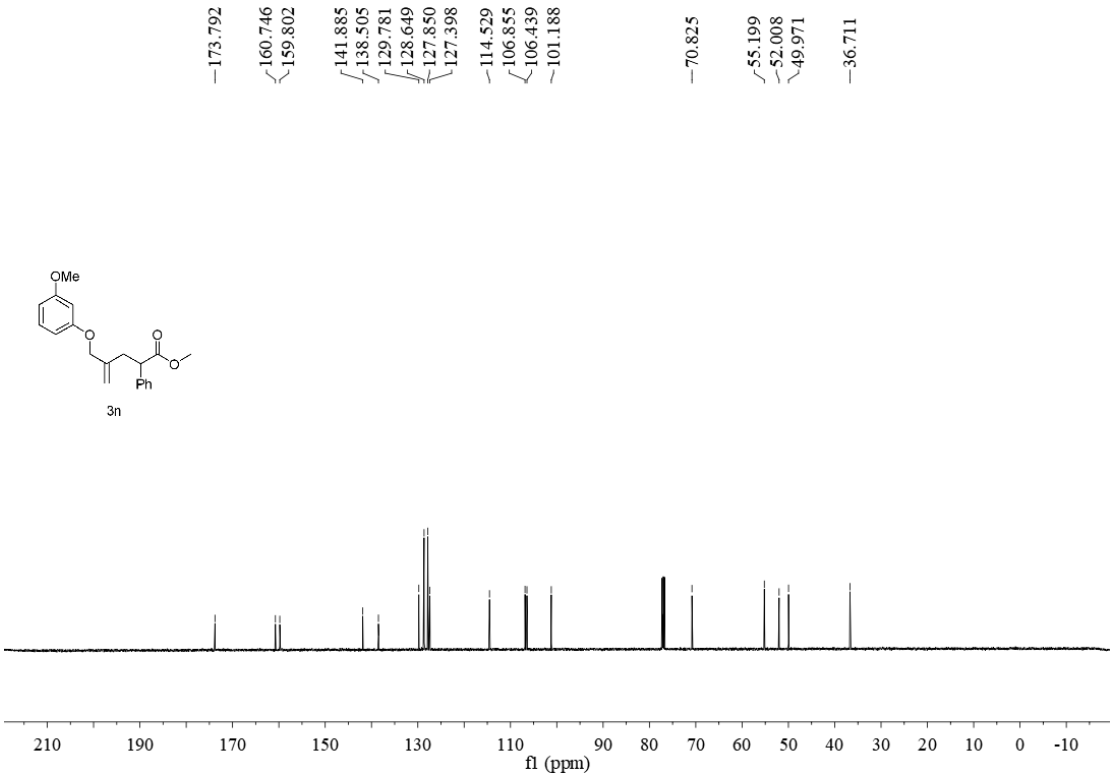
152.697
142.168
138.531
128.633
127.855
115.627
114.519
114.342
71.486
55.634
51.991
49.976
36.702
MeO
O
O
O
Ph
3m
f1 (ppm)

3n:


7.321
7.309
7.293
7.269
7.265
7.259
7.252
7.239
7.167
7.151
7.135
6.510
6.494
6.475
6.459
5.160
5.006
4.403
4.396
4.370
3.895
3.769
3.633
3.981
2.963
2.951
2.933
2.626
2.613
2.596
2.583
OMe
O
O
O
Ph
3n
3.96
1.10
1.02
2.95
1.00
0.99
2.01
1.01
3.15
2.99
0.99
0.99
f1 (ppm)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127.850
127.398
114.529
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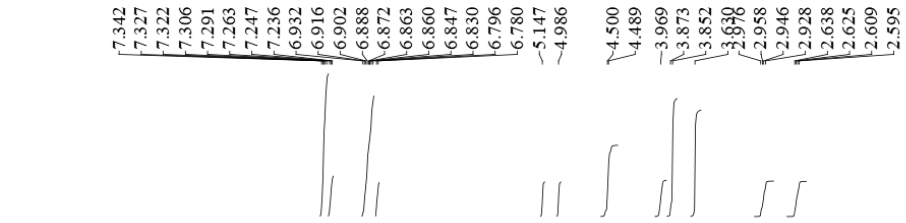
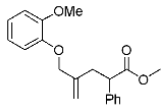
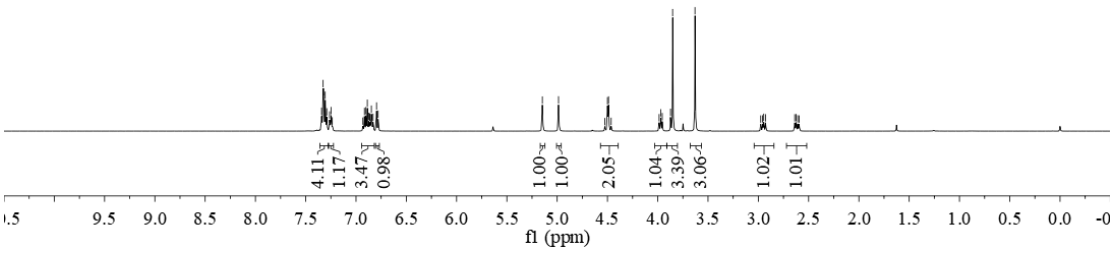
106.439
101.188
70.825
55.199
52.008
49.971
36.711
OMe
O
O
O
Ph
3n
f1 (ppm)

3o:

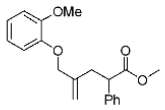

7.342
7.327
7.322
7.306
7.291
7.263
7.247
7.236
6.932
6.916
6.902
6.888
6.872
6.863
6.860
6.847
6.830
6.796
6.780
5.147
4.986
4.500
4.489
3.969
3.873
3.852
2.958
2.946
2.928
2.638
2.625
2.609
2.595


OMe
O
O
O
Ph

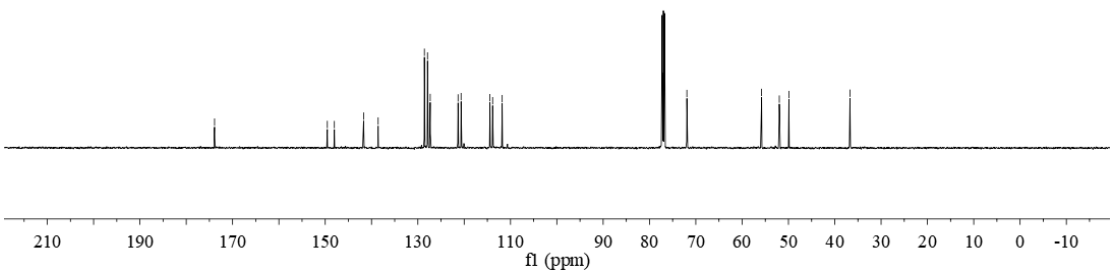
3o


4.11
1.17
3.47
0.98
1.00
1.00
2.05
1.04
3.39
3.06
1.02
1.01
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

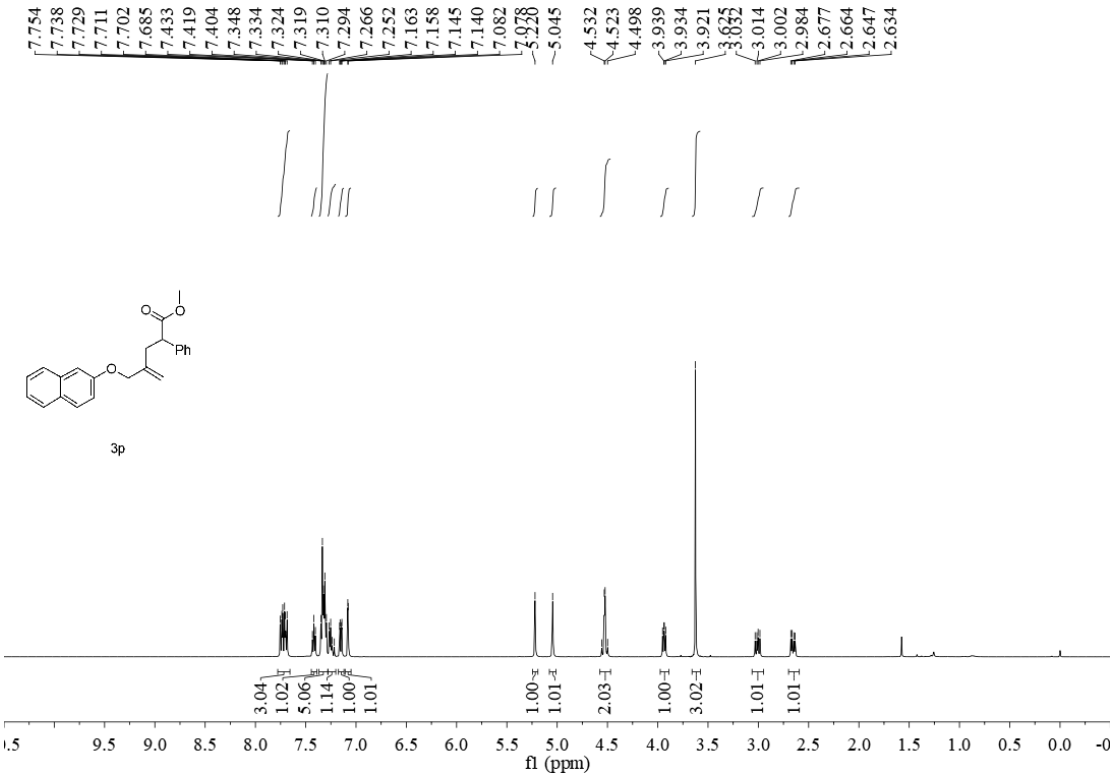

173.889
149.547
148.026
141.711
138.569
128.592
127.916
127.331
121.322
120.669
114.440
113.858
111.799
71.928
55.794
51.972
49.903
36.716

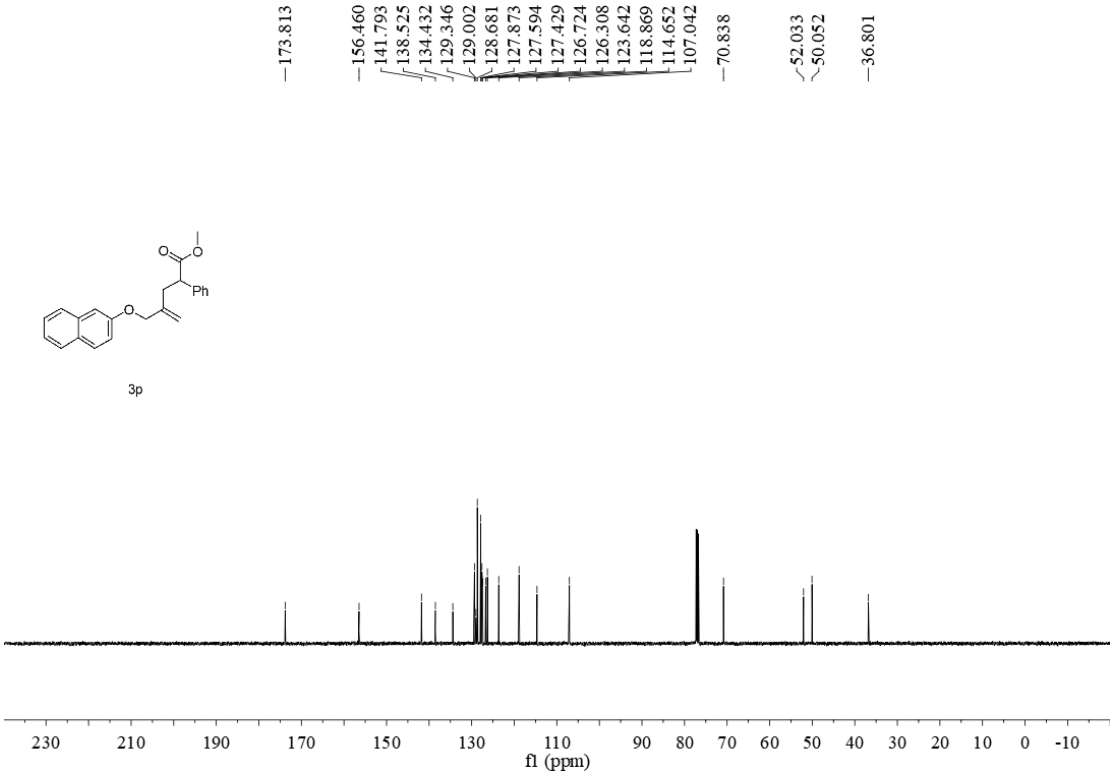

OMe
O
O
O
Ph

3o

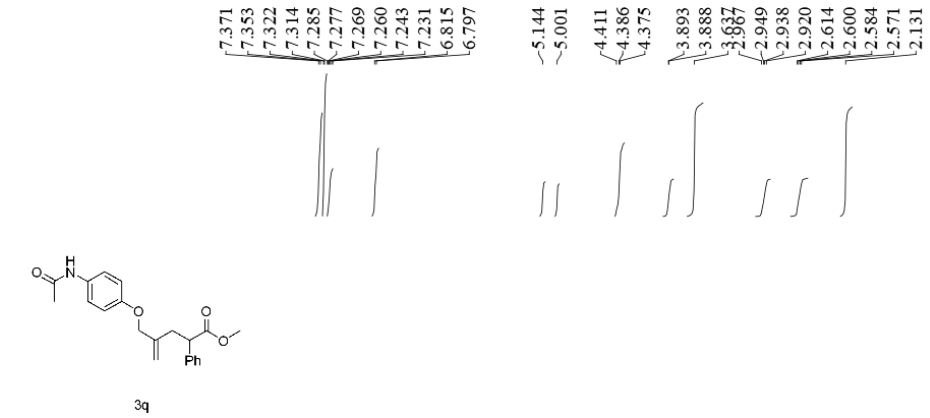

210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

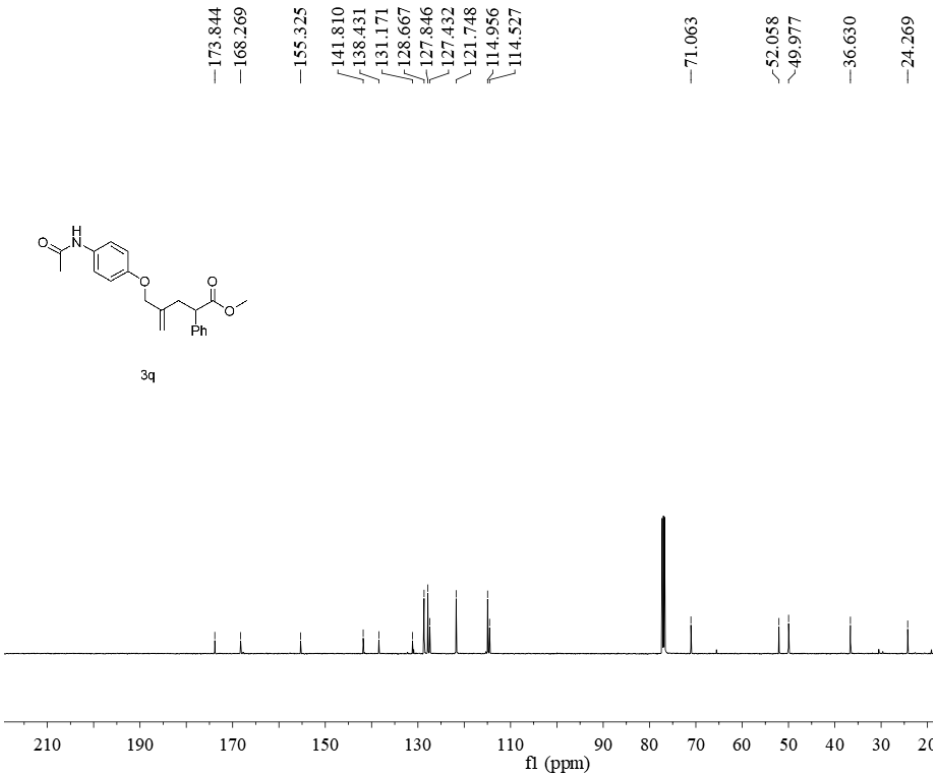
3p:


7.754
7.738
7.729
7.711
7.702
7.685
7.433
7.419
7.404
7.348
7.334
7.324
7.319
7.310
7.294
7.266
7.252
7.163
7.158
7.145
7.140
7.082
5.045
4.532
4.523
4.498
3.939
3.934
3.921
3.014
3.002
2.984
2.677
2.664
2.647
2.634
O
O
Ph
O
3p
3.04
1.02
5.06
1.14
1.00
1.01
1.00
1.01
2.03
1.00
3.02
1.01
1.01
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

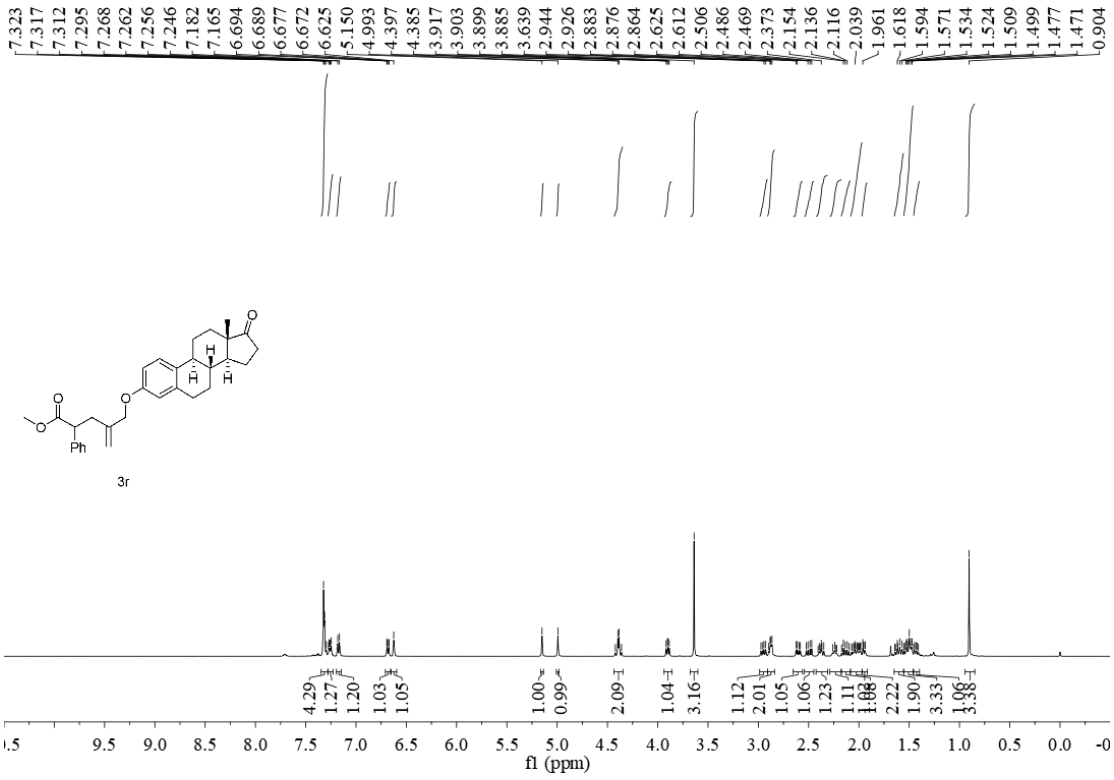

173.813
156.460
141.793
138.525
134.432
129.346
129.002
128.681
127.873
127.594
127.429
126.724
126.308
123.642
118.869
114.652
107.042
70.838
52.033
50.052
36.801
O
O
Ph
O
3p
230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

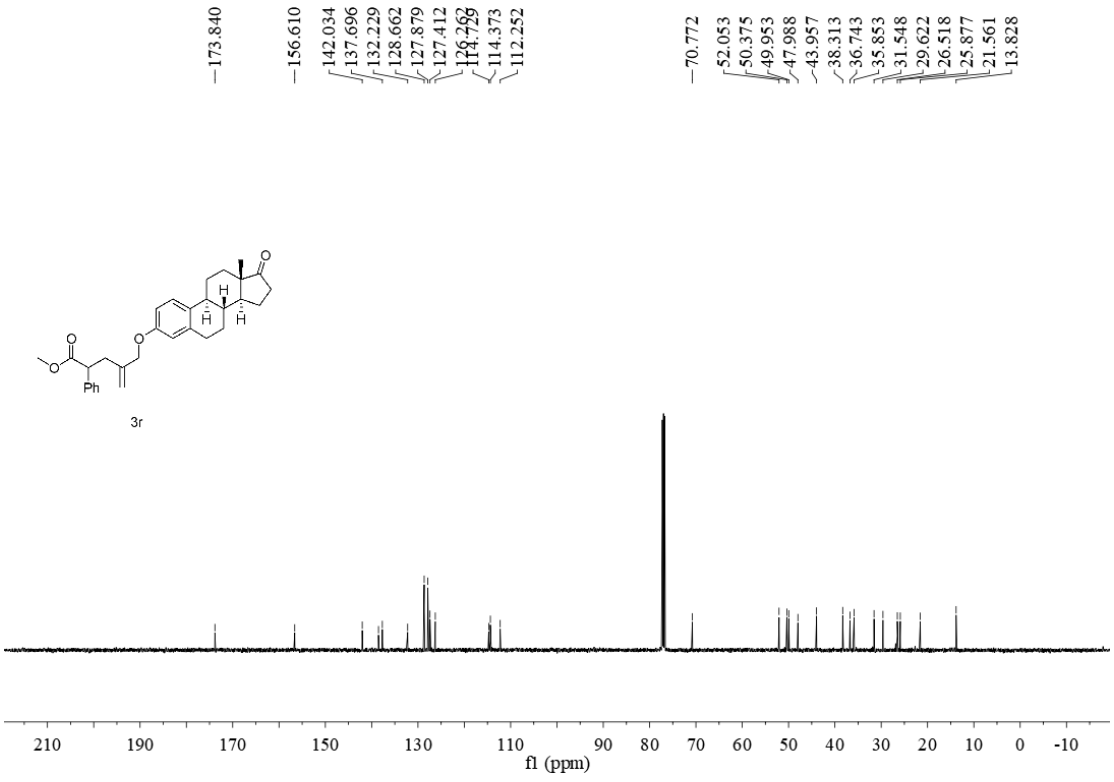
3q:


7.371
7.353
7.322
7.314
7.285
7.277
7.269
7.260
7.243
7.231
6.815
6.797
5.144
5.001
4.411
4.386
4.375
3.893
3.888
3.637
3.607
2.949
2.938
2.920
2.614
2.600
2.584
2.571
2.131
Ph
3q
2.98
4.11
1.38
1.97
1.00
0.94
2.12
1.08
3.26
1.07
1.10
3.15
f1 (ppm)

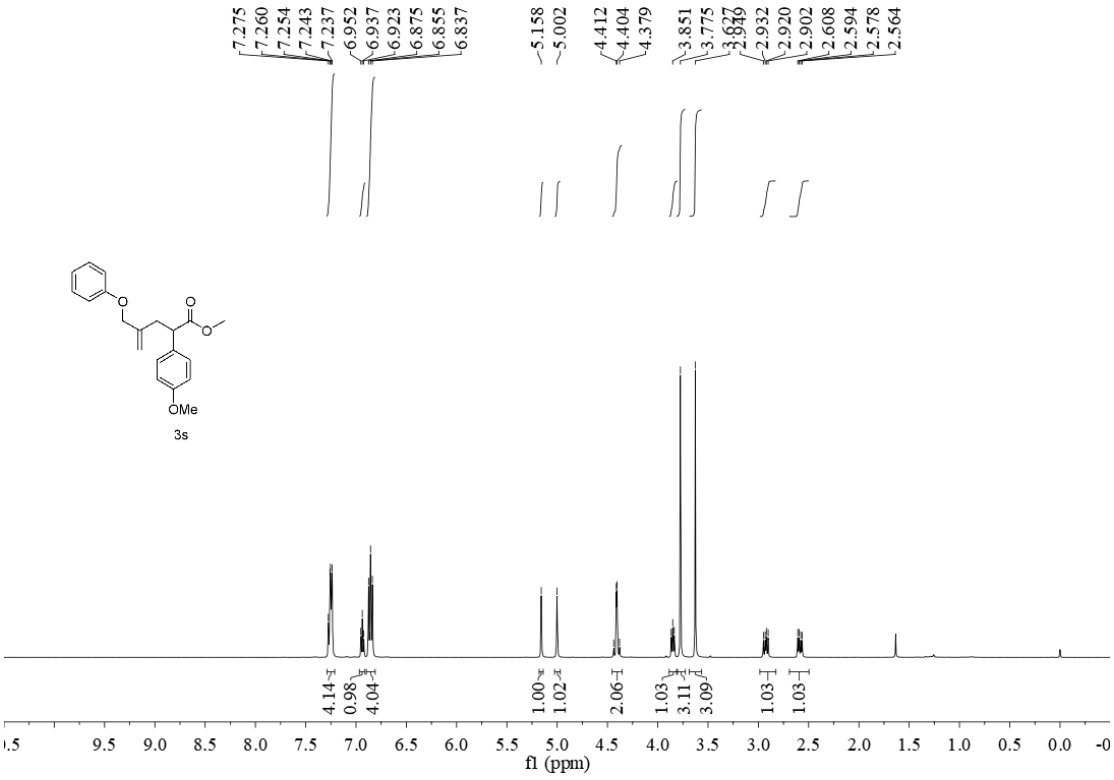

173.844
168.269
155.325
141.810
138.431
131.171
128.667
127.846
127.432
121.748
114.956
114.527
71.063
52.058
49.977
36.630
24.269
Ph
3q
f1 (ppm)

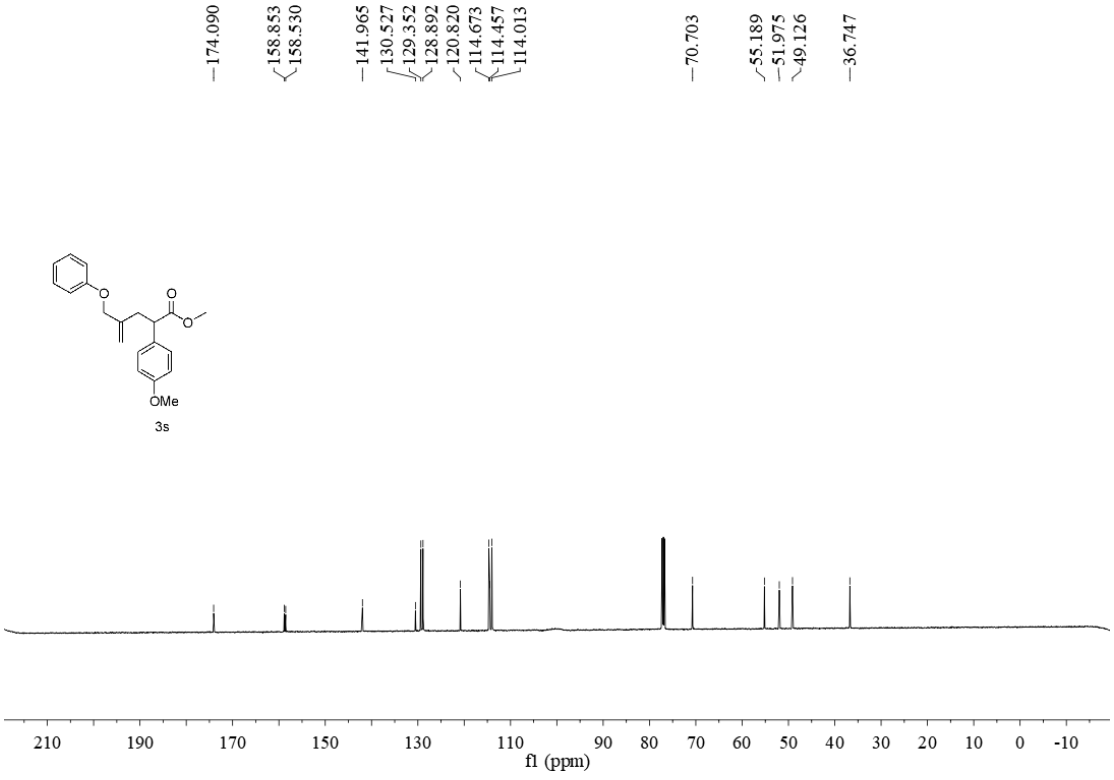
3r:


7.323
7.317
7.312
7.295
7.268
7.262
7.256
7.246
7.182
7.165
6.694
6.689
6.677
6.672
6.625
5.150
4.993
4.397
4.385
3.917
3.903
3.899
3.885
3.639
2.944
2.926
2.883
2.876
2.864
2.625
2.612
2.506
2.486
2.469
2.373
2.154
2.136
2.116
2.039
1.961
1.618
1.594
1.571
1.534
1.524
1.509
1.499
1.477
1.471
0.904
Ph
3r
4.29
1.27
1.20
1.03
1.05
1.00
0.99
2.09
1.04
3.16
1.12
2.01
1.05
1.06
1.23
1.11
1.08
2.22
1.90
3.33
1.06
3.38
f1 (ppm)

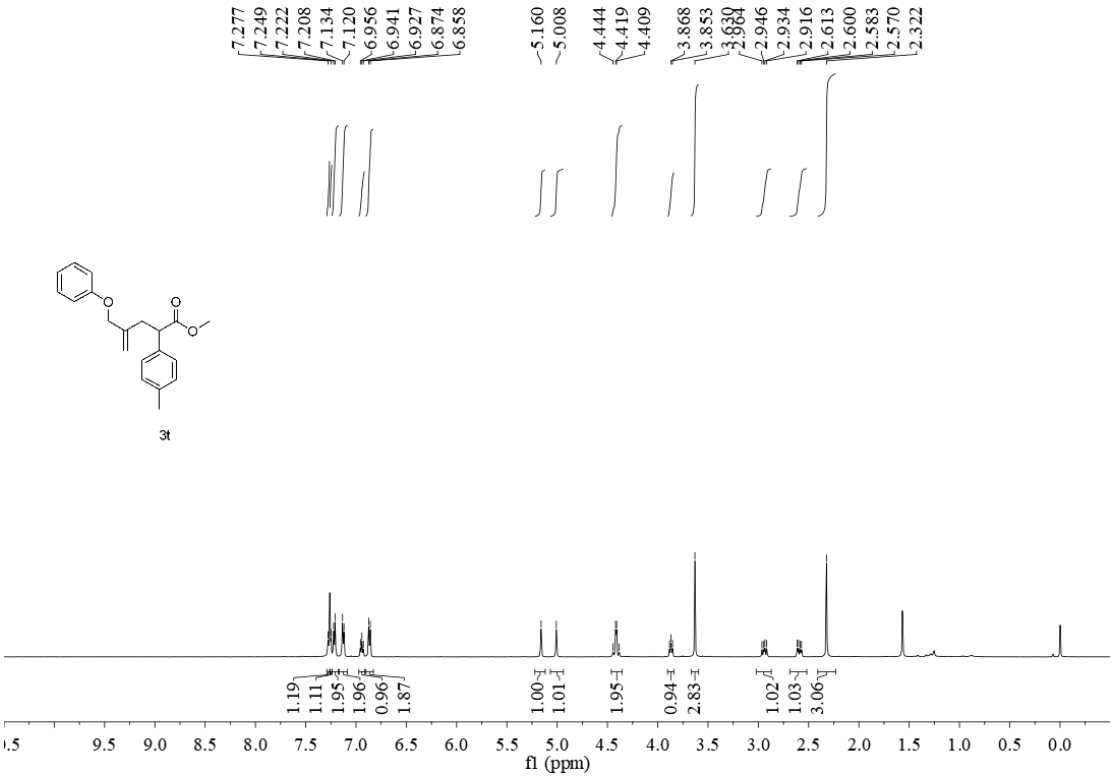

173.840
156.610
142.034
137.696
132.229
128.662
127.879
127.412
114.373
112.252
70.772
52.053
50.375
49.953
47.988
43.957
38.313
36.743
35.853
31.548
29.622
26.518
25.877
21.561
13.828
Ph
3r
f1 (ppm)

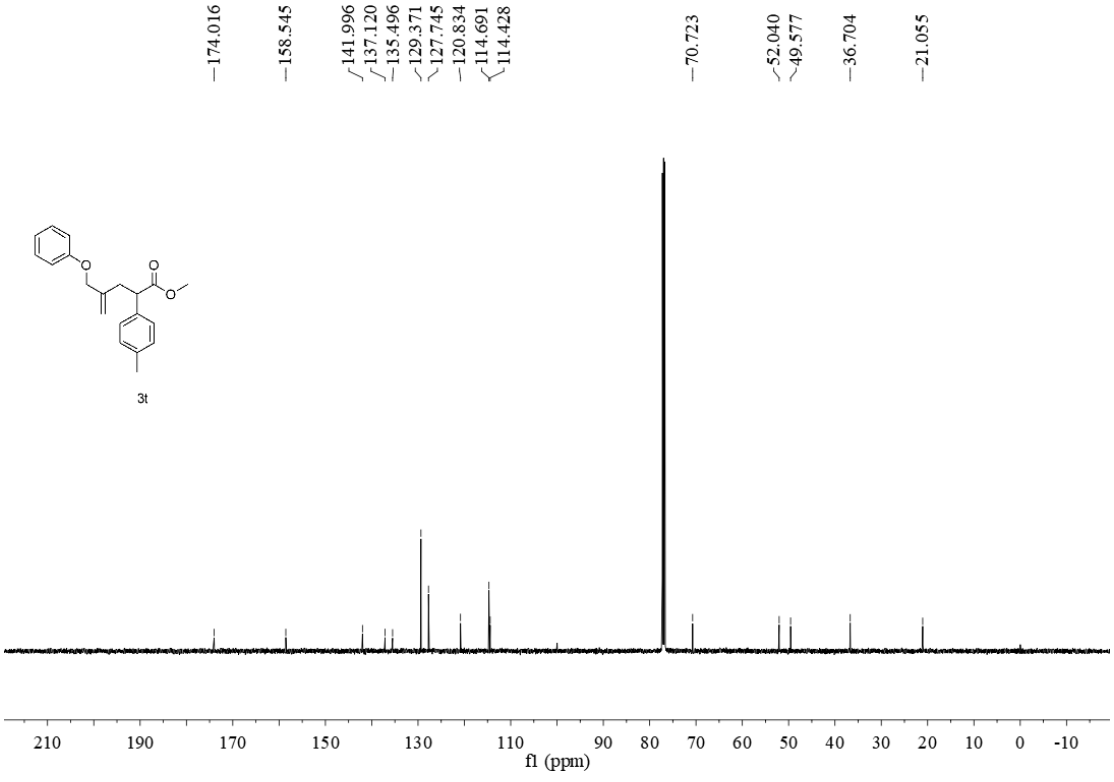
3s:


7.275
7.260
7.254
7.243
7.237
6.952
6.937
6.923
6.875
6.855
6.837
5.158
5.002
4.412
4.404
4.379
3.851
3.775
2.932
2.920
2.902
2.608
2.594
2.578
2.564
OMe
3s
4.14
0.98
4.04
1.00
1.02
2.06
1.03
3.11
3.09
1.03
1.03
fl (ppm)

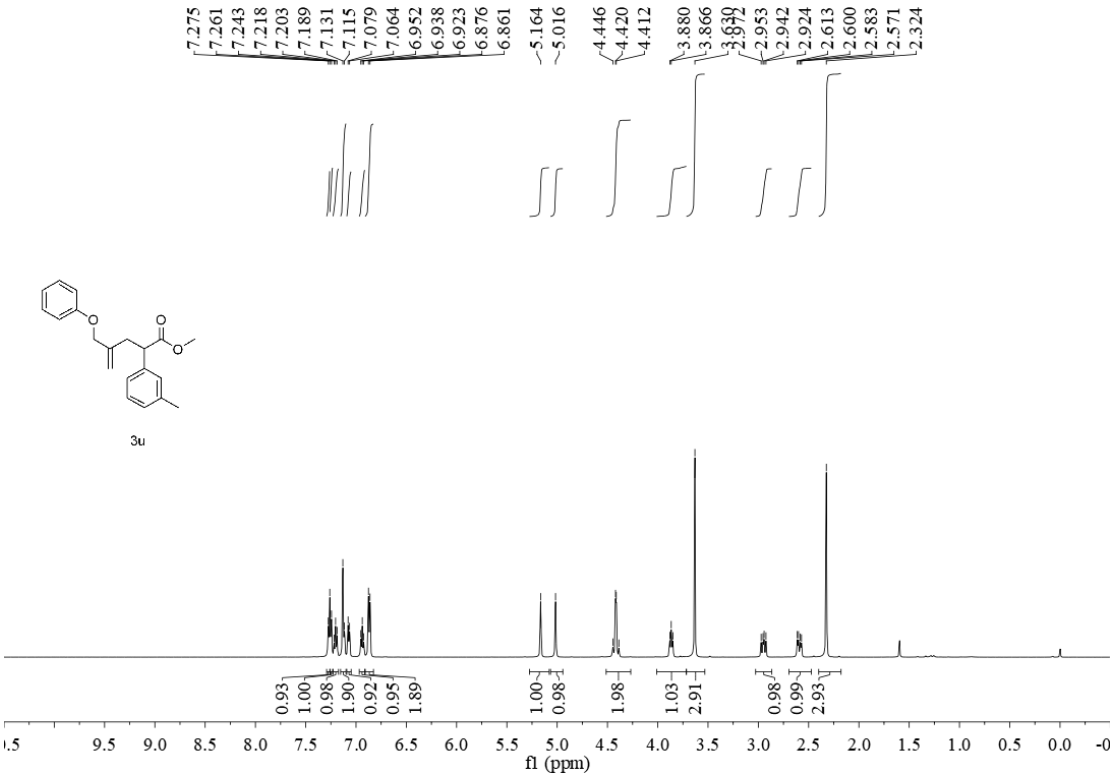

174.090
158.853
158.530
141.965
130.527
129.352
128.892
120.820
114.673
114.457
114.013
70.703
55.189
51.975
49.126
36.747
OMe
3s
fl (ppm)

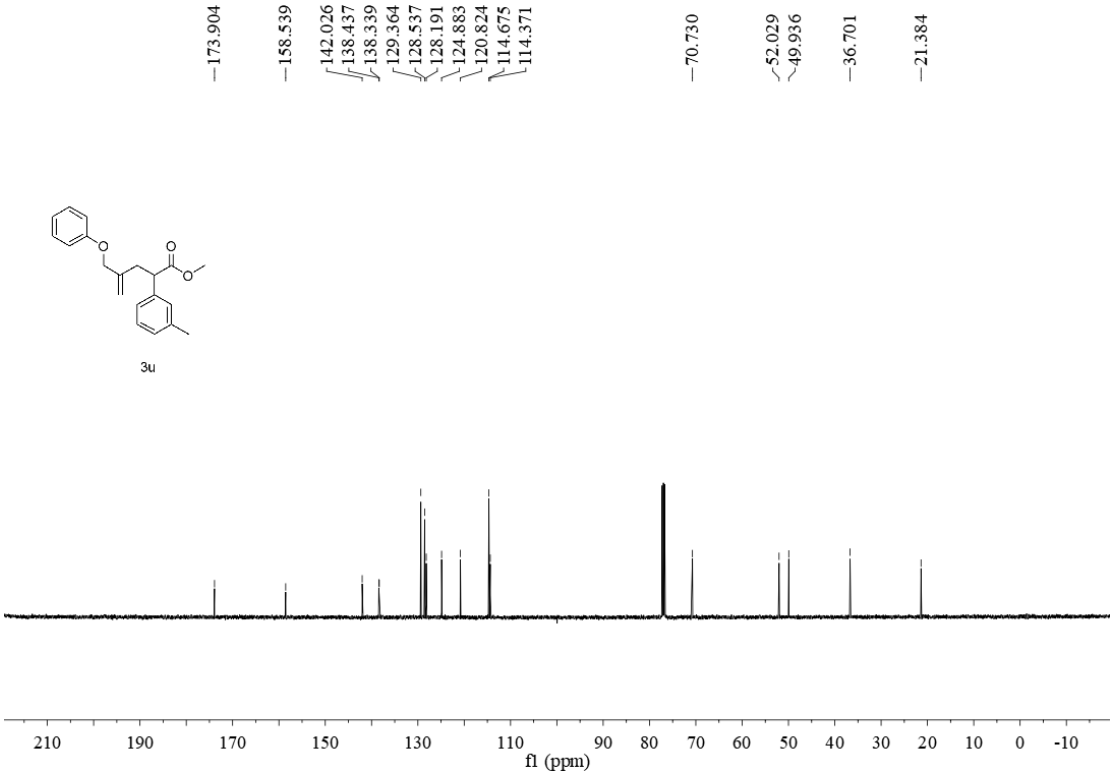
3t:


7.277
7.249
7.222
7.208
7.134
7.120
6.956
6.941
6.927
6.874
6.858
5.160
5.008
4.444
4.419
4.409
3.868
3.853
2.946
2.934
2.916
2.613
2.600
2.583
2.570
2.322
3t
1.19
1.11
1.95
1.96
0.96
1.87
1.00
1.01
1.95
0.94
2.83
1.02
1.03
3.06
f1 (ppm)

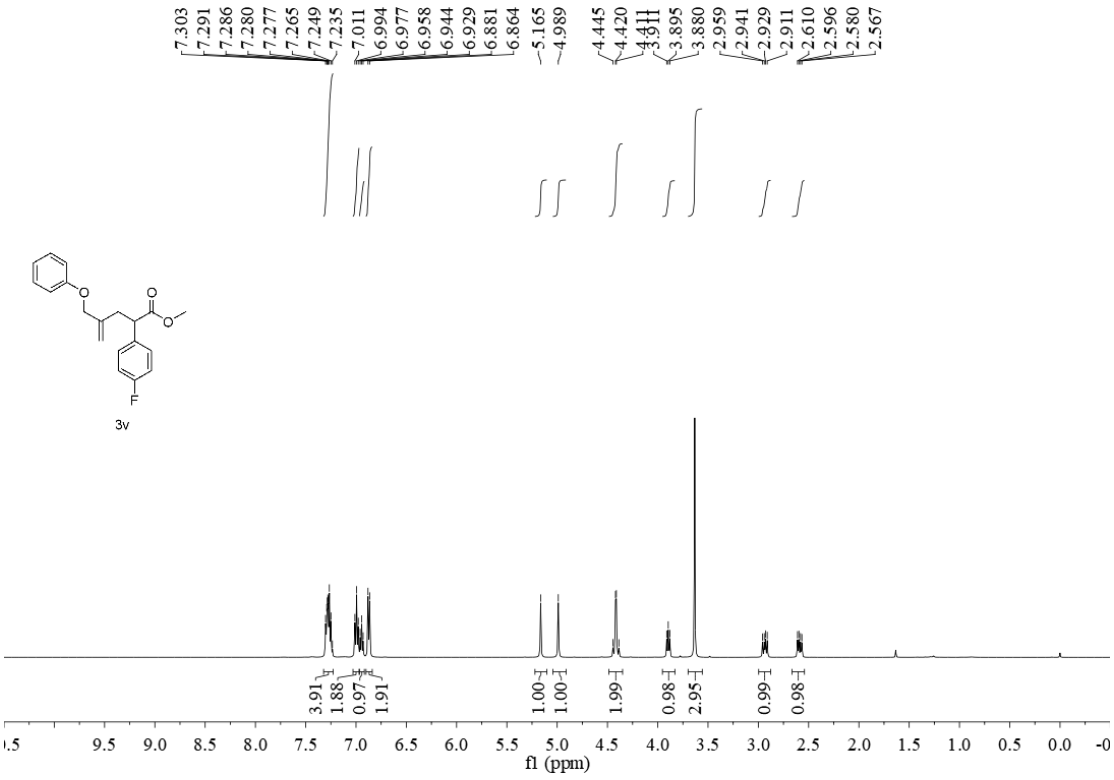

174.016
158.545
141.996
137.120
135.496
129.371
127.745
120.834
114.691
114.428
70.723
52.040
49.577
36.704
21.055
3t
f1 (ppm)

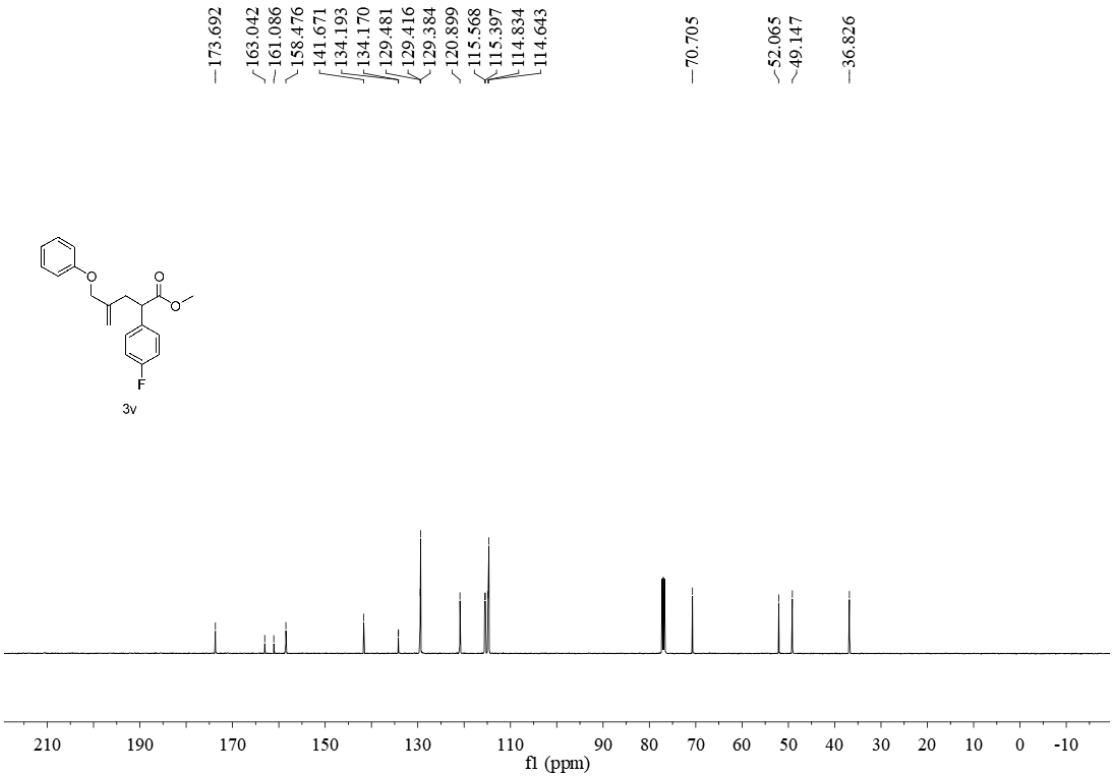
3u:


7.275
7.261
7.243
7.218
7.203
7.189
7.131
7.115
7.079
7.064
6.952
6.938
6.923
6.876
6.861
5.164
5.016
4.446
4.420
4.412
3.880
3.866
2.953
2.942
2.924
2.613
2.600
2.583
2.571
2.324
3u
0.93
1.00
0.98
1.90
0.92
0.95
1.89
1.00
0.98
1.98
1.03
2.91
0.98
0.99
2.93
f1 (ppm)

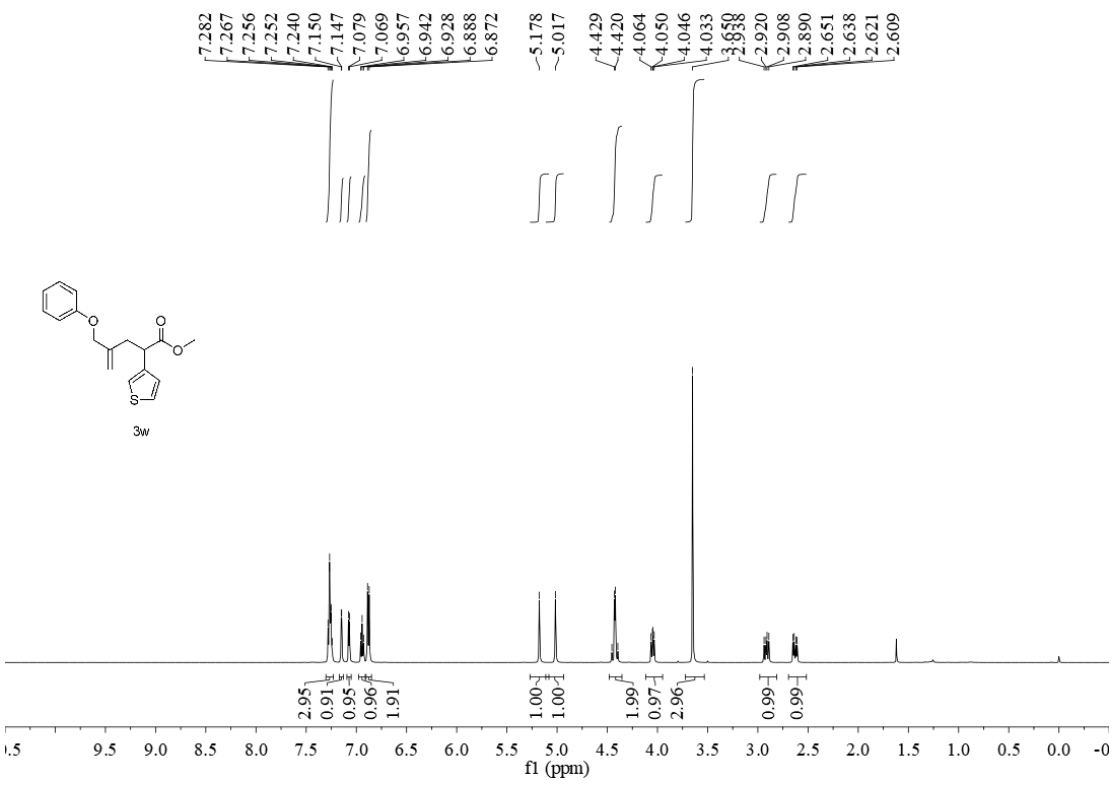

173.904
158.539
142.026
138.437
138.339
129.364
128.537
128.191
124.883
120.824
114.675
114.371
70.730
52.029
49.936
36.701
21.384
3u
f1 (ppm)

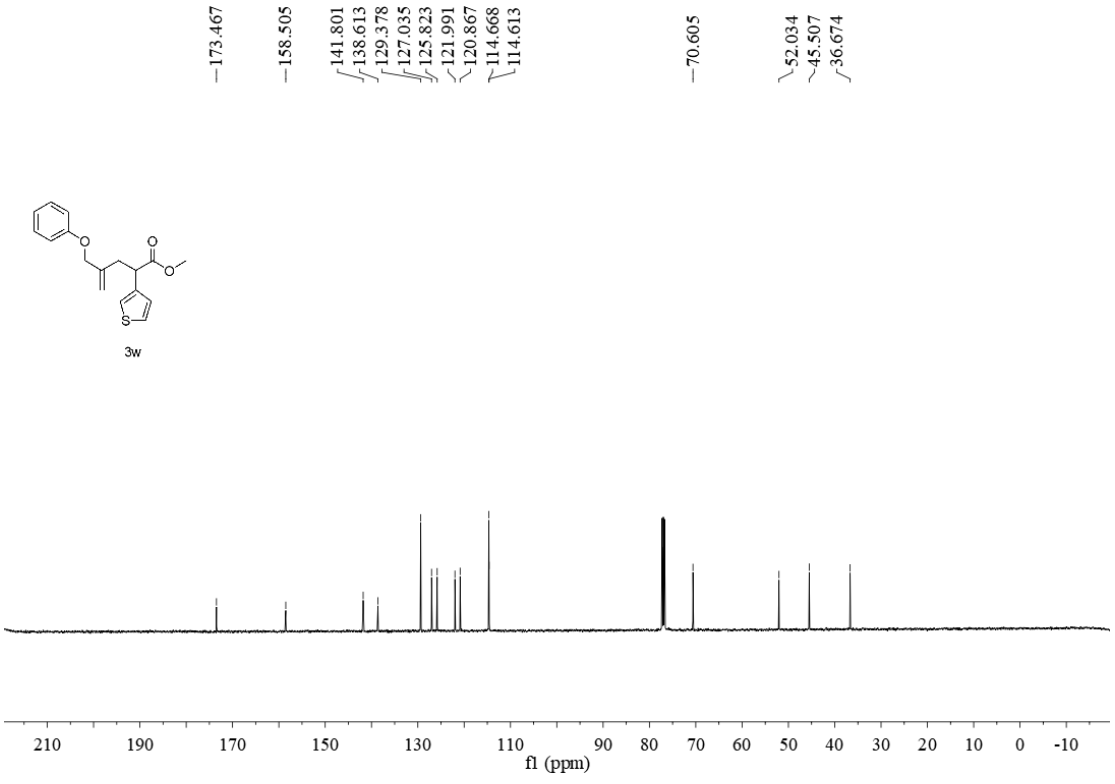
3v:


7.303
7.291
7.286
7.280
7.277
7.265
7.249
7.235
7.011
6.994
6.977
6.958
6.944
6.929
6.881
6.864
5.165
4.989
4.445
4.420
4.411
3.911
3.895
3.880
2.959
2.941
2.929
2.911
2.610
2.596
2.580
2.567
O
O
O
F
3v
3.91
1.88
0.97
1.91
1.00
1.00
1.99
0.98
2.95
0.99
0.98
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

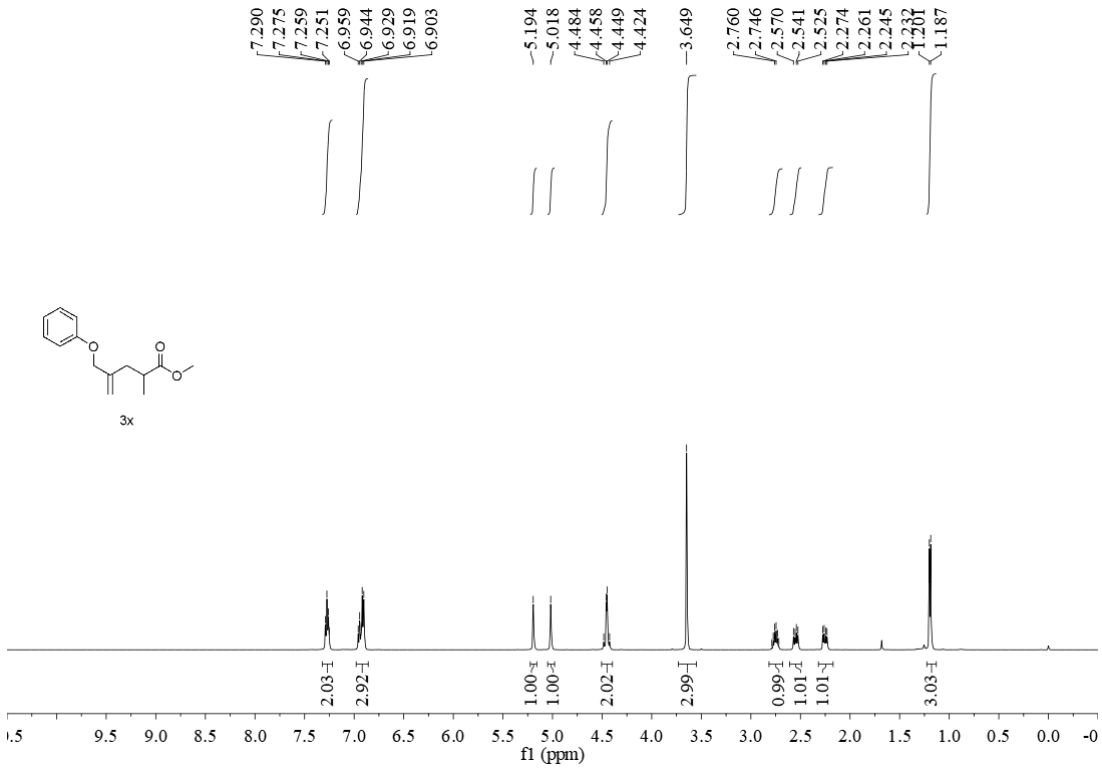

173.692
163.042
161.086
158.476
141.671
134.193
134.170
129.481
129.416
129.384
120.899
115.568
115.397
114.834
114.643
70.705
52.065
49.147
36.826
O
O
O
F
3v
210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

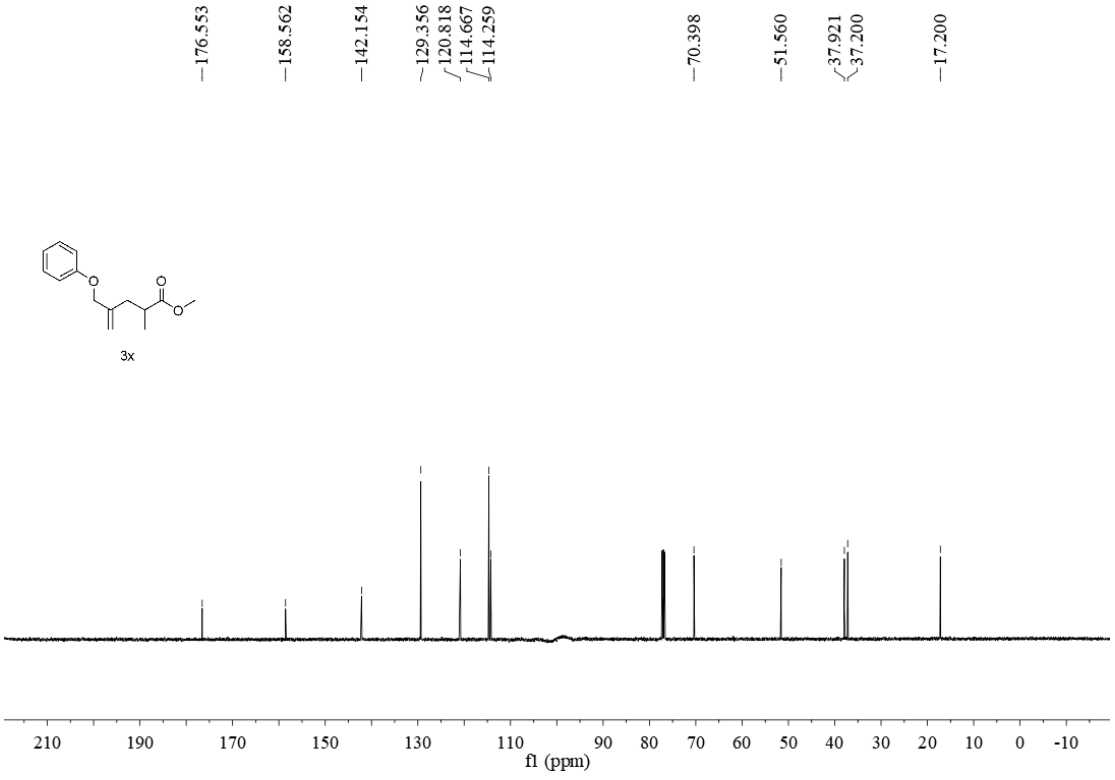
3w:


7.282
7.267
7.256
7.252
7.240
7.150
7.147
7.079
7.069
6.957
6.942
6.928
6.888
6.872
5.178
5.017
4.429
4.420
4.064
4.050
4.046
4.033
3.938
2.920
2.908
2.890
2.651
2.638
2.621
2.609
3w
2.95
0.91
0.95
0.96
1.91
1.00
1.00
1.99
0.97
2.96
0.99
0.99
f1 (ppm)

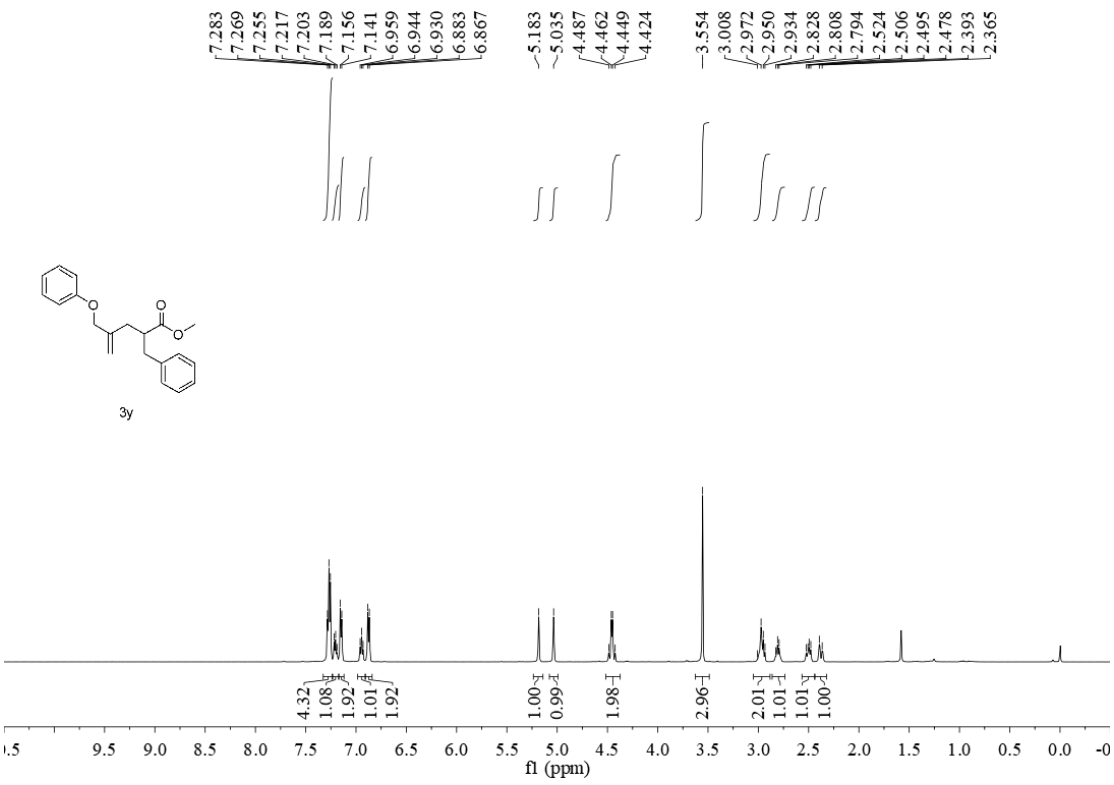

173.467
158.505
141.801
138.613
129.378
127.035
125.823
121.991
120.867
114.668
114.613
70.605
52.034
45.507
36.674
3w
f1 (ppm)

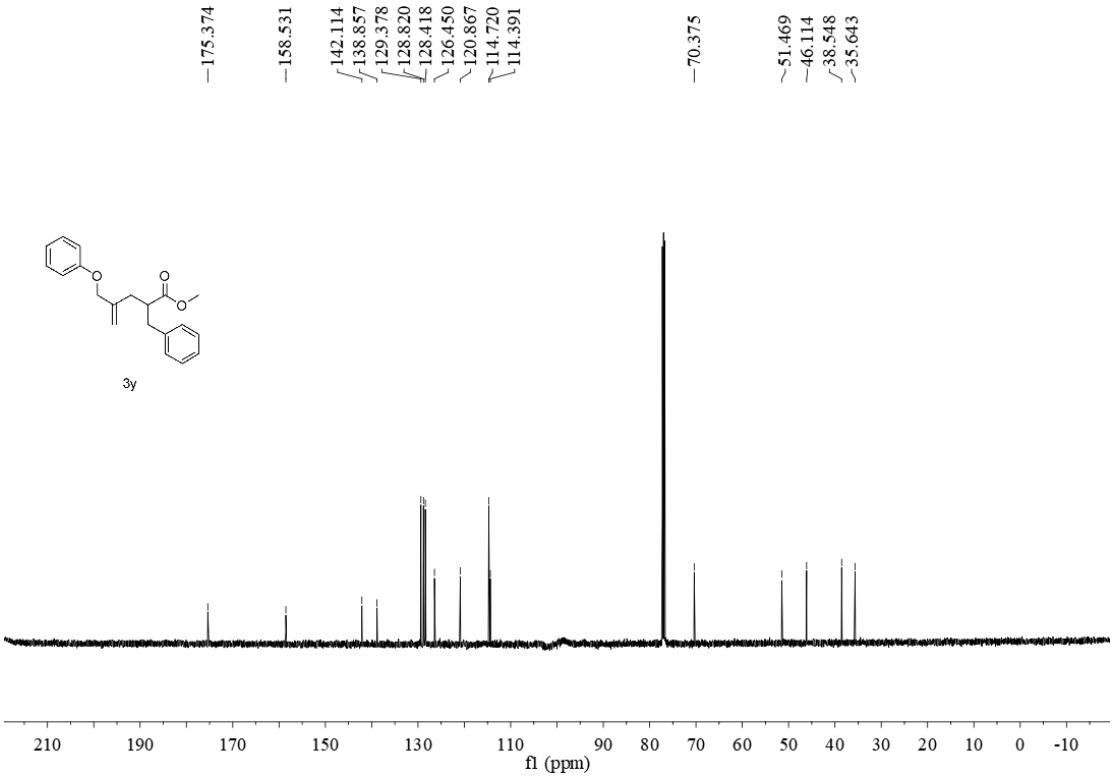
3x:


7.290
7.275
7.259
7.251
6.959
6.944
6.929
6.919
6.903
5.194
5.018
4.484
4.458
4.449
4.424
3.649
2.760
2.746
2.570
2.541
2.525
2.274
2.261
2.245
2.232
1.201
1.187
3x
2.03
2.92
1.00
1.00
2.02
2.99
0.99
1.01
1.01
3.03
f1 (ppm)

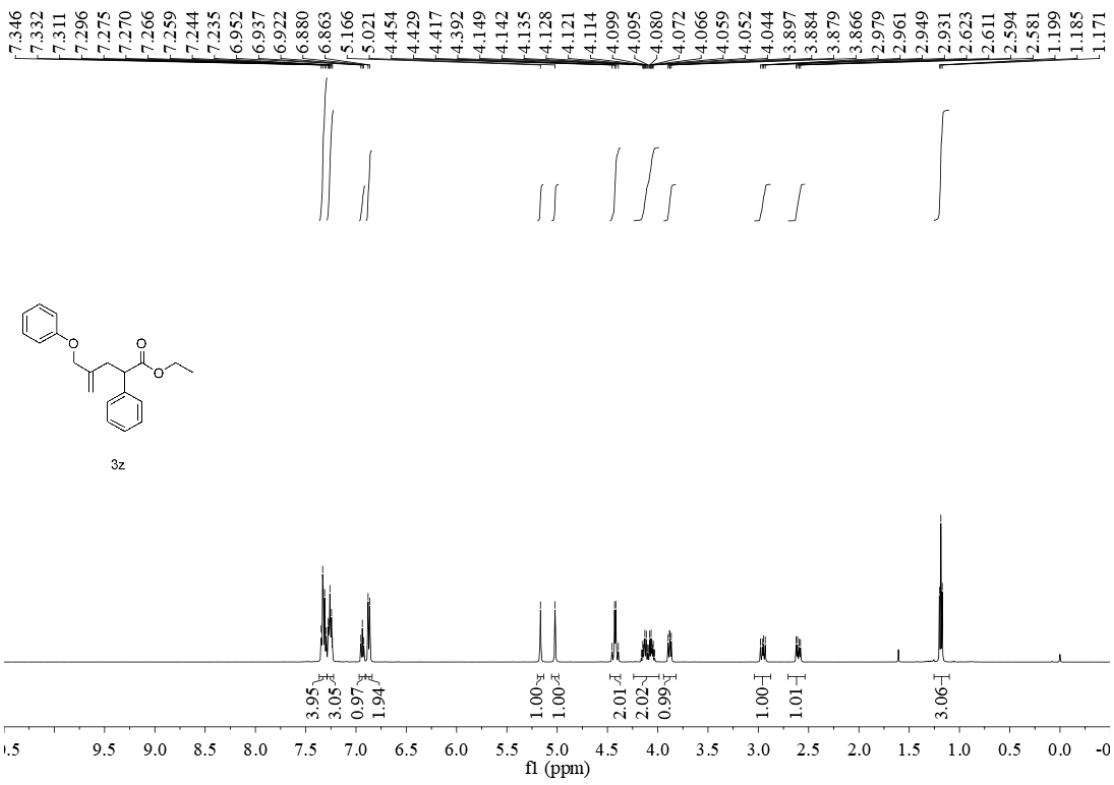

176.553
158.562
142.154
129.356
120.818
114.667
114.259
70.398
51.560
37.921
37.200
17.200
3x
f1 (ppm)

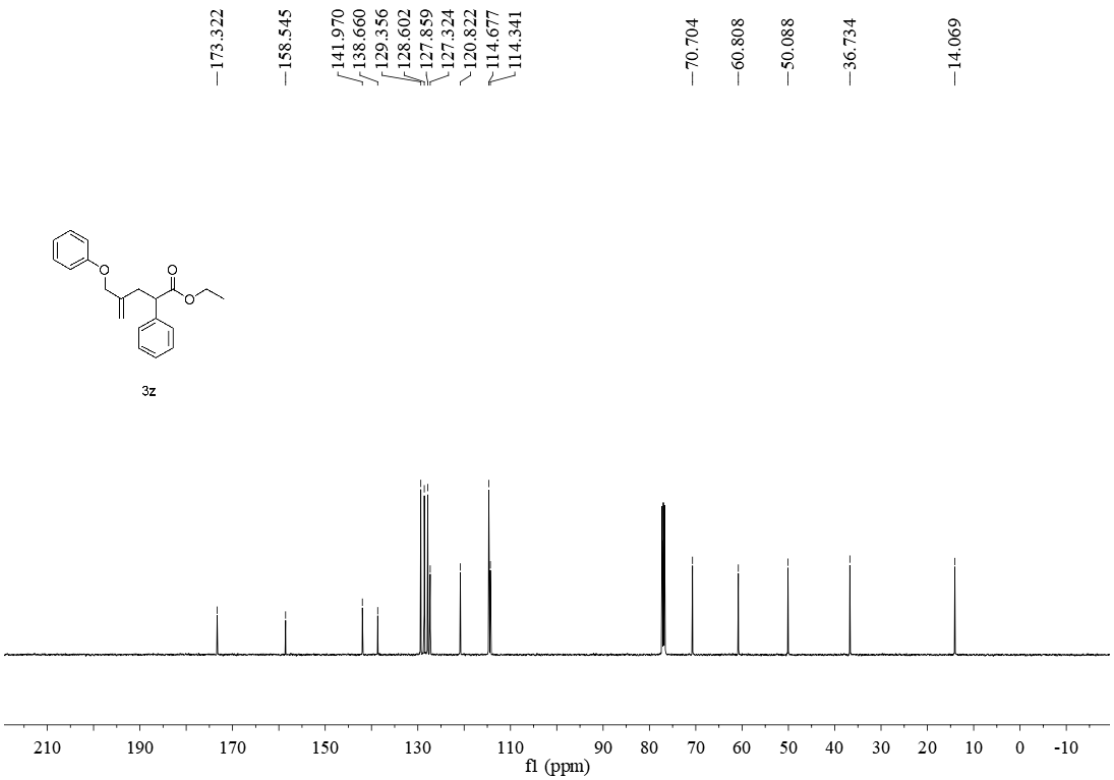
3y:


7.283
7.269
7.255
7.217
7.203
7.189
7.156
7.141
6.959
6.944
6.930
6.883
6.867
5.183
5.035
4.487
4.462
4.449
4.424
3.554
3.008
2.972
2.950
2.934
2.828
2.808
2.794
2.524
2.506
2.495
2.478
2.393
2.365
3y
4.32
1.08
1.92
1.01
1.92
1.00
0.99
1.98
2.96
2.01
1.01
1.01
1.00
fl (ppm)


175.374
158.531
142.114
138.857
129.378
128.820
128.418
126.450
120.867
114.720
114.391
70.375
51.469
46.114
38.548
35.643
3y
fl (ppm)

3z:


7.346
7.332
7.311
7.296
7.275
7.270
7.266
7.259
7.244
7.235
6.952
6.937
6.922
6.880
6.863
5.166
5.021
4.454
4.429
4.417
4.392
4.149
4.142
4.135
4.128
4.121
4.114
4.099
4.095
4.080
4.072
4.066
4.059
4.052
4.044
3.897
3.884
3.879
3.866
2.979
2.961
2.949
2.931
2.623
2.611
2.594
2.581
1.199
1.185
1.171
3z
3.95
3.05
0.97
1.94
1.00
1.00
2.01
2.02
0.99
1.00
1.01
3.06
fl (ppm)


173.322
158.545
141.970
138.660
129.356
128.602
127.859
127.324
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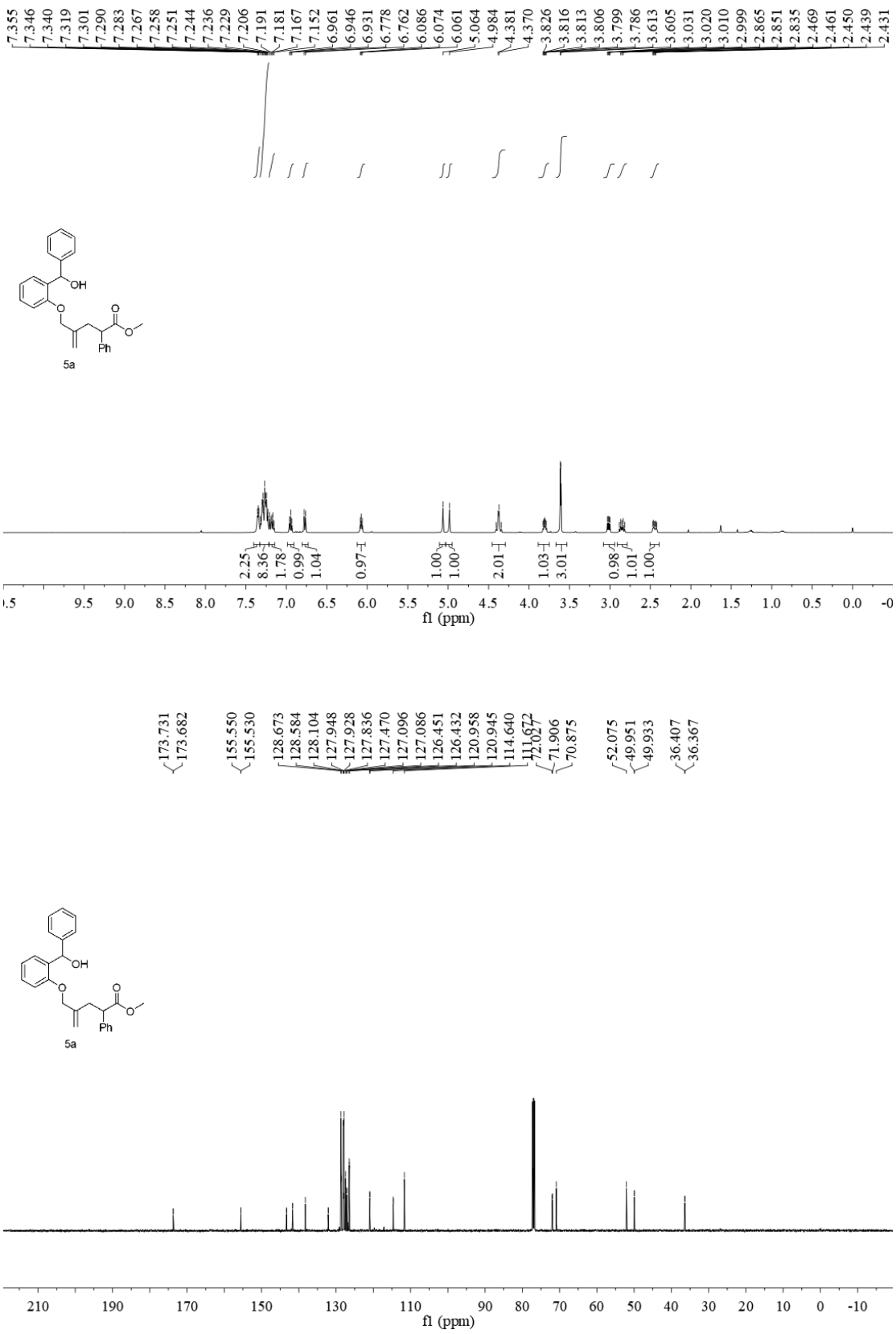
114.341
70.704
60.808
50.088
36.734
14.069
3z
fl (ppm)

5a: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7.290
7.283
7.267
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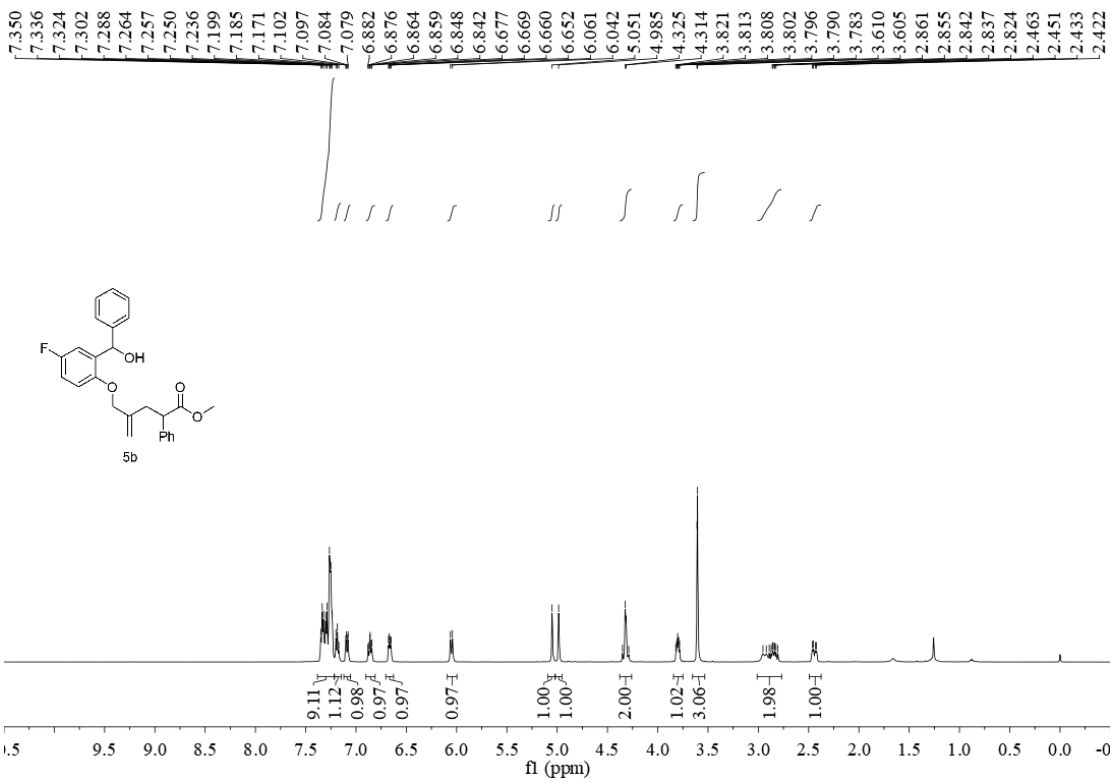
7.251
7.244
7.236
7.229
7.206
7.191
7.181
7.167
7.152
6.961
6.946
6.931
6.778
6.762
6.086
6.074
6.061
5.064
4.984
4.381
4.370
3.826
3.816
3.813
3.806
3.799
3.786
3.613
3.605
3.031
3.020
3.010
2.999
2.865
2.851
2.835
2.469
2.461
2.450
2.439
2.431
OH
O
O
O
Ph
5a
2.25
8.36
1.78
0.99
1.04
0.97
1.00
1.00
2.01
1.03
3.01
0.98
1.01
1.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
173.731
173.682
155.550
155.530
128.673
128.584
128.104
127.948
127.928
127.836
127.470
127.096
127.086
126.451
126.432
120.958
120.945
114.640
111.672
72.027
71.906
70.875
52.075
49.951
49.933
36.407
36.367
OH
O
O
O
Ph
5a
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

5b: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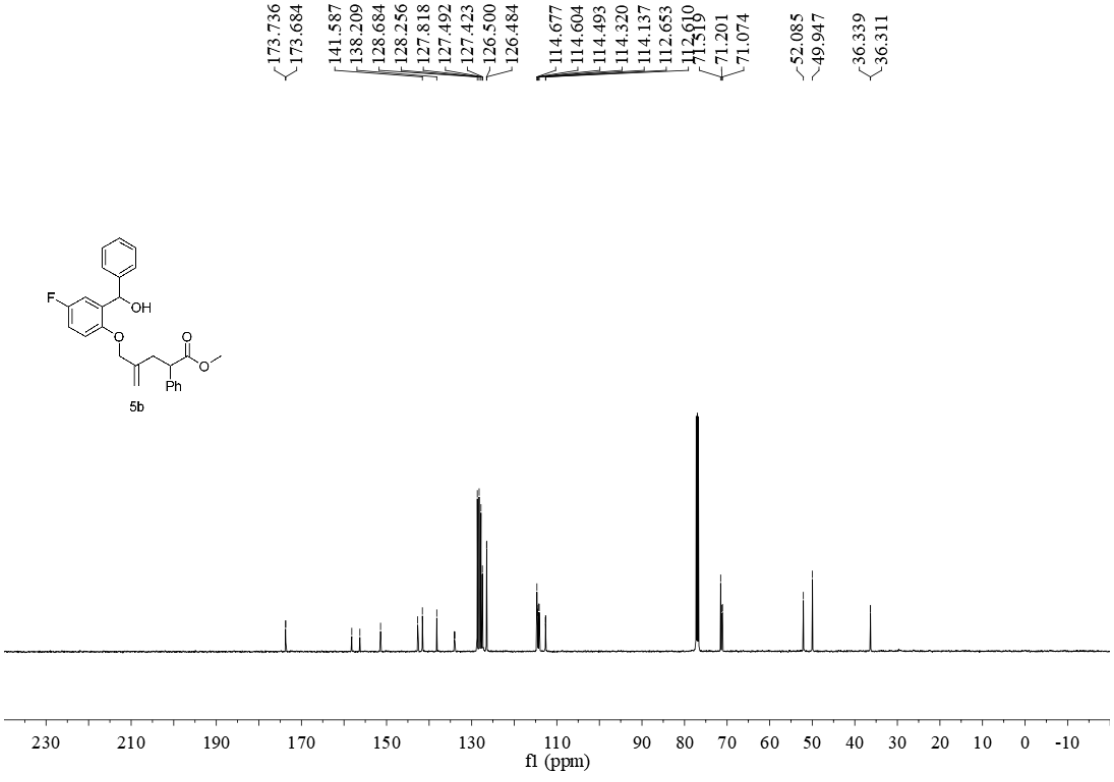
7.264
7.257
7.250
7.236
7.199
7.185
7.171
7.102
7.097
7.084
7.079
6.882
6.876
6.864
6.859
6.848
6.842
6.677
6.669
6.660
6.652
6.061
6.042
5.051
4.985
4.325
4.314
3.821
3.813
3.808
3.802
3.796
3.790
3.783
3.610
3.605
2.861
2.855
2.842
2.837
2.824
2.463
2.451
2.433
2.422
F
OH
O
O
O
Ph
5b
9.11
1.12
0.98
0.97
0.97
0.97
1.00
1.00
2.00
1.02
3.06
1.98
1.00
f1 (ppm)


173.736
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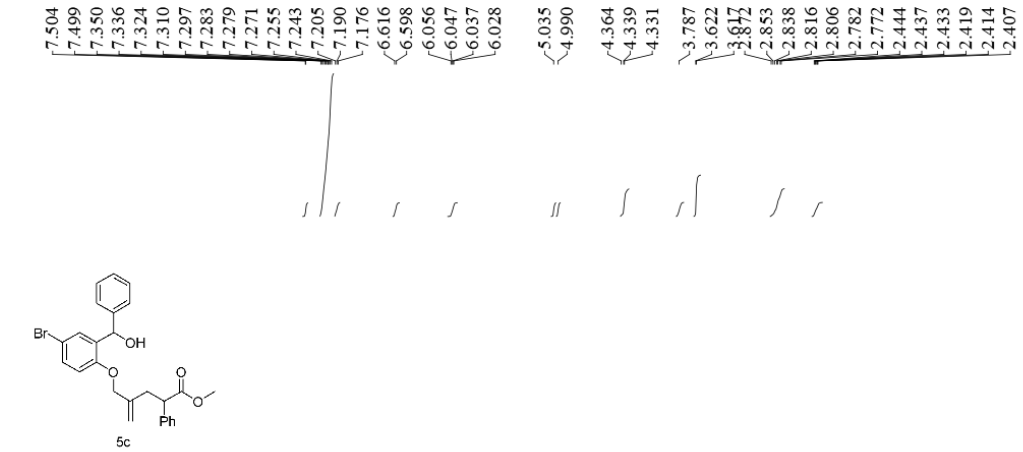
141.587
138.209
128.684
128.256
127.818
127.492
127.423
126.500
126.484
114.677
114.604
114.493
114.320
114.137
112.653
112.610
71.519
71.201
71.074
52.085
49.947
36.339
36.311
F
OH
O
O
O
Ph
5b
f1 (ppm)

5c: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7.499
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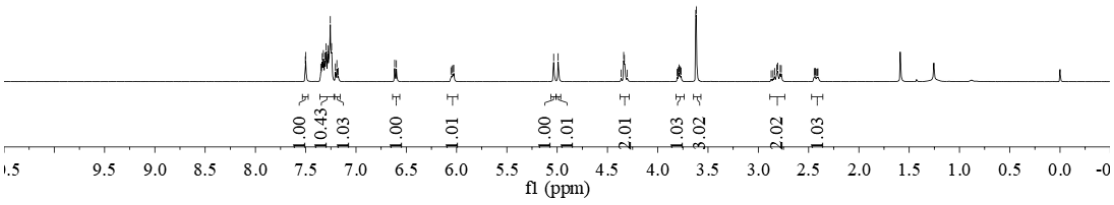
7.336
7.324
7.310
7.297
7.283
7.279
7.271
7.255
7.243
7.205
7.190
7.176
6.616
6.598
6.056
6.047
6.037
6.028
5.035
4.990
4.364
4.339
4.331
3.787
3.622
2.853
2.838
2.816
2.806
2.782
2.772
2.444
2.437
2.433
2.419
2.414
2.407
Br
OH
O
O
O
Ph
5c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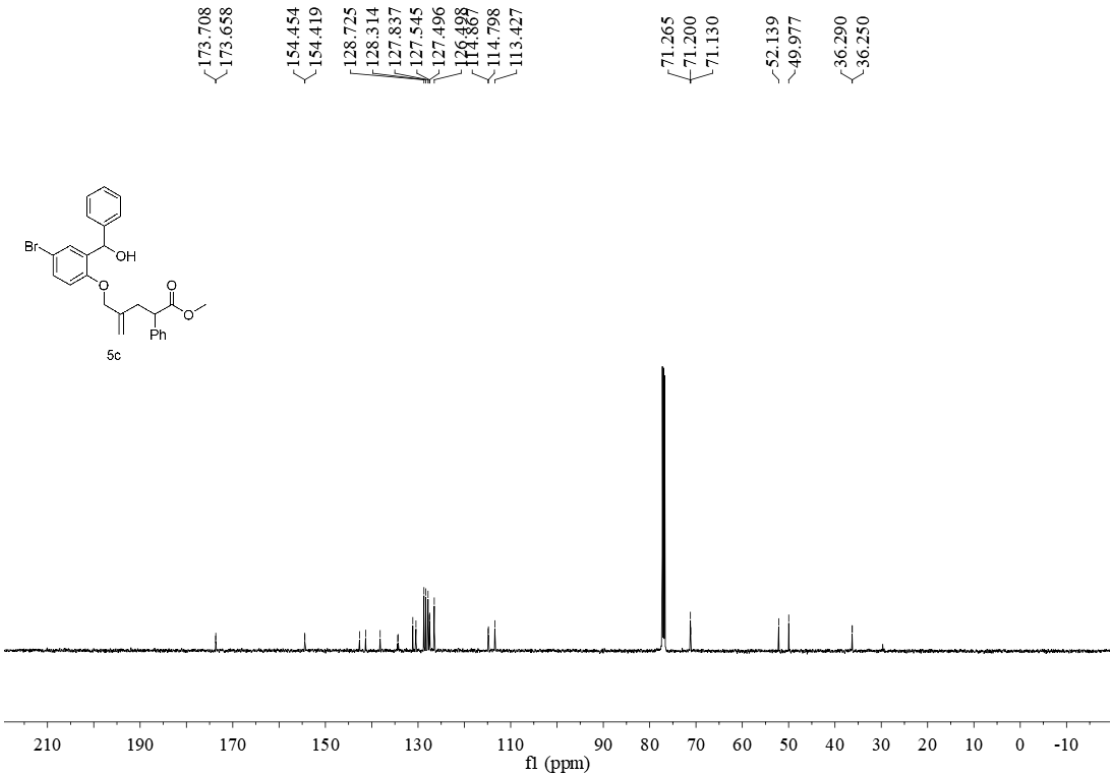
1.03
1.00
1.01
1.00
1.01
2.01
1.03
3.02
2.02
1.03
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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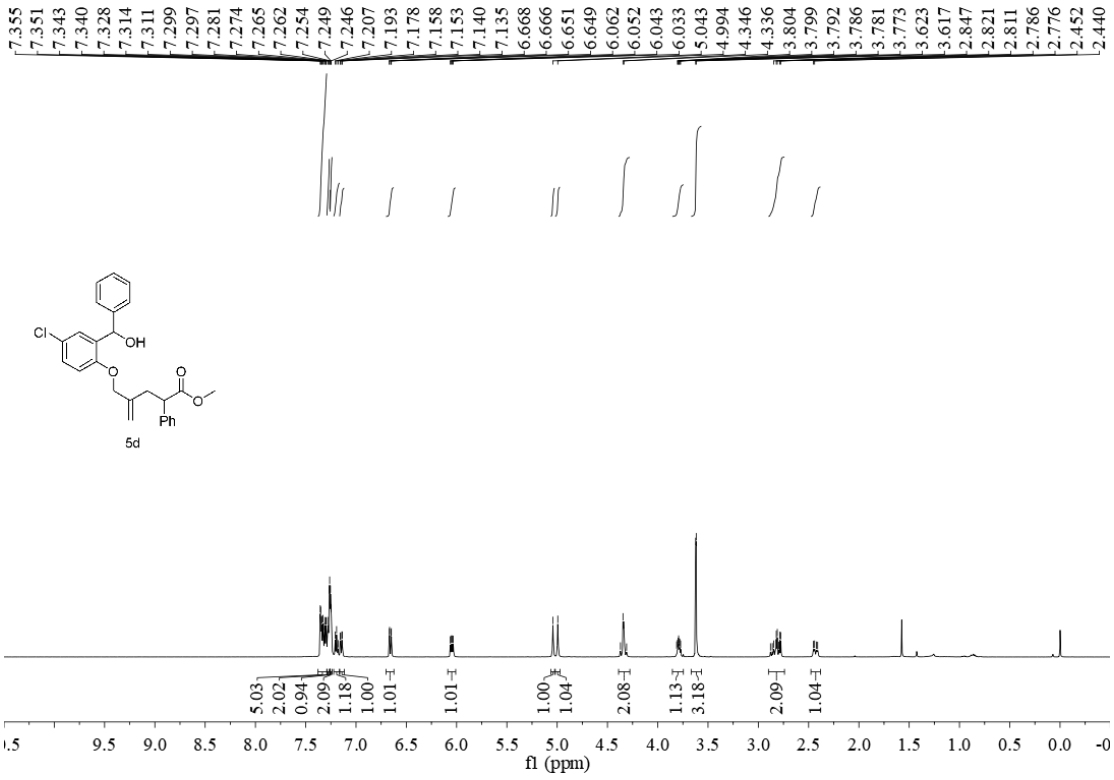
173.658
154.454
154.419
128.725
128.314
127.837
127.545
127.496
126.498
114.867
114.798
113.427
71.265
71.200
71.130
52.139
49.977
36.290
36.250
Br
OH
O
O
O
Ph
5c
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

5d: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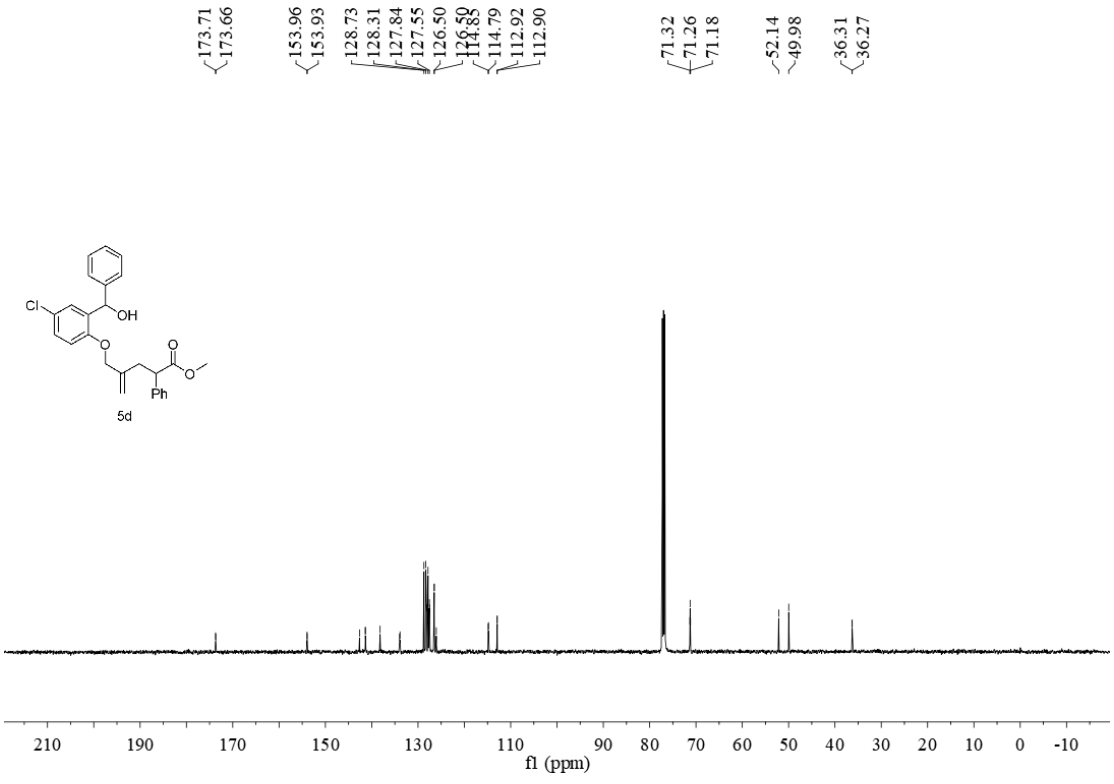
7.351
7.343
7.340
7.328
7.314
7.311
7.299
7.297
7.281
7.274
7.265
7.262
7.254
7.249
7.246
7.207
7.193
7.178
7.158
7.153
7.140
7.135
6.668
6.666
6.651
6.649
6.062
6.052
6.043
6.033
5.043
4.994
4.346
4.336
3.804
3.799
3.792
3.786
3.781
3.773
3.623
3.617
2.847
2.821
2.811
2.786
2.776
2.452
2.440
Cl
OH
O
O
O
Ph
5d
5.03
2.02
0.94
2.09
1.18
1.00
1.01
1.01
1.00
1.04
2.08
1.13
3.18
2.09
1.04
fl (ppm)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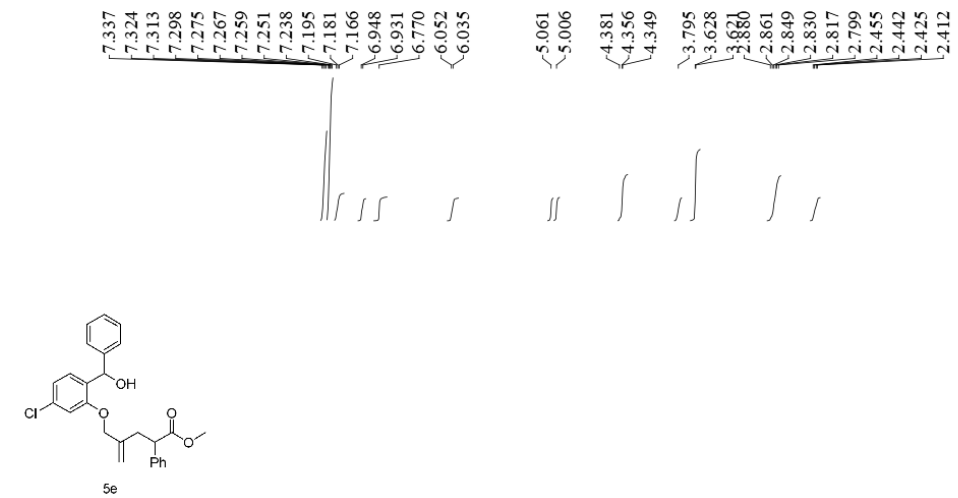
173.66
153.96
153.93
128.73
128.31
127.84
127.55
126.50
114.79
112.92
112.90
71.32
71.26
71.18
52.14
49.98
36.31
36.27
Cl
OH
O
O
O
Ph
5d
fl (ppm)

5e: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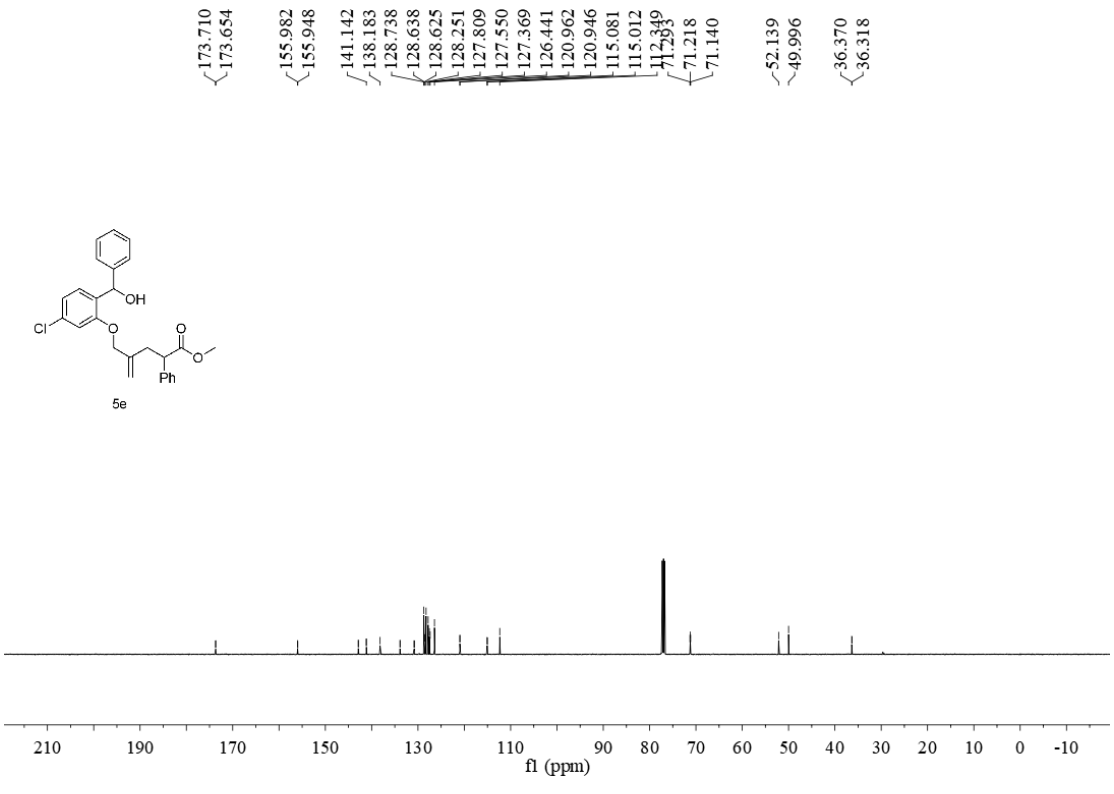
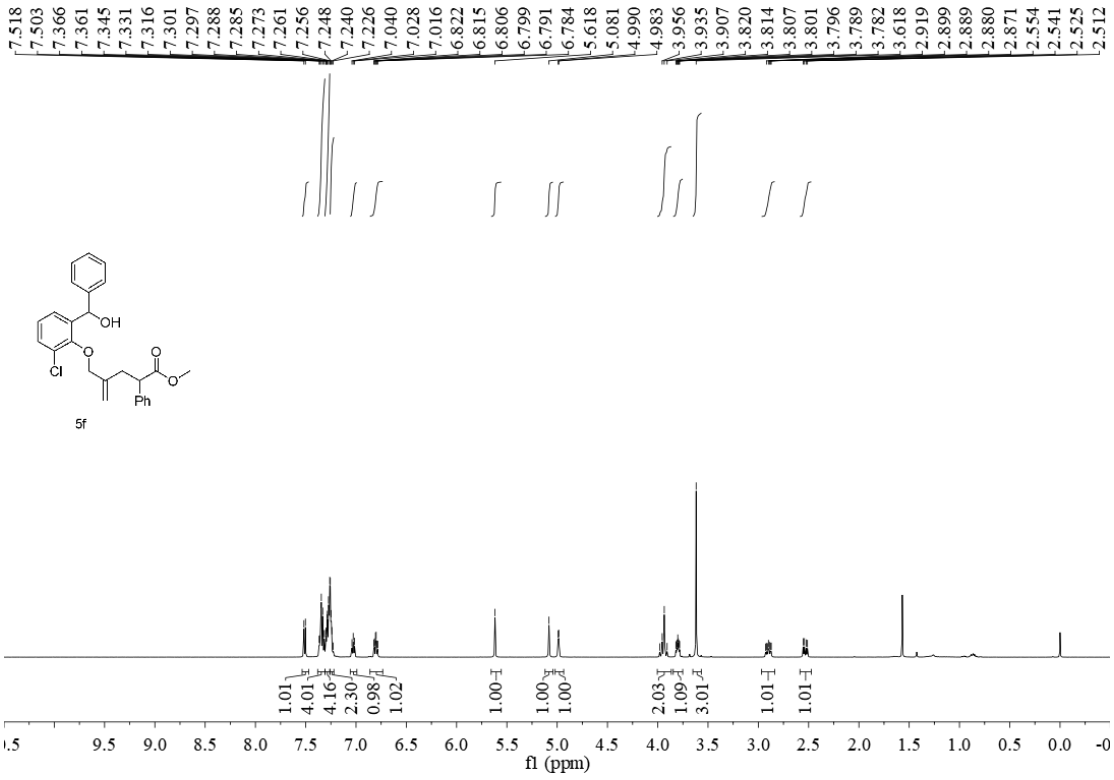
7.298
7.275
7.267
7.259
7.251
7.238
7.195
7.181
7.166
6.948
6.931
6.770
6.052
6.035
5.061
5.006
4.381
4.356
4.349
3.795
3.628
2.861
2.849
2.830
2.817
2.799
2.455
2.442
2.425
2.412
OH
Cl
O
O
O
Ph
5e
3.95
6.29
1.21
0.97
1.04
1.00
1.00
1.03
2.03
1.01
3.14
1.98
1.02
fl (ppm)


173.710
173.654
155.982
155.948
141.142
138.183
128.738
128.638
128.625
128.251
127.809
127.550
127.369
126.441
120.962
120.946
115.081
115.012
71.218
71.140
52.139
49.996
36.370
36.318
OH
Cl
O
O
O
Ph
5e
fl (ppm)

5f: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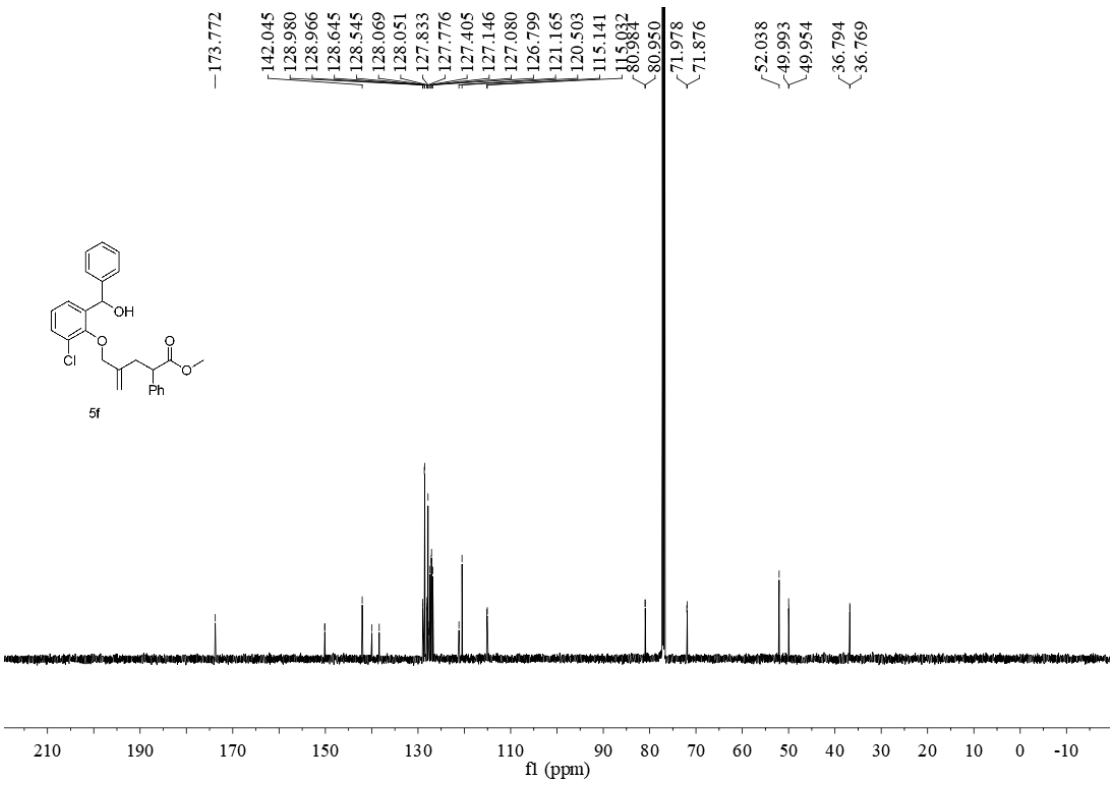
7.366
7.361
7.345
7.331
7.316
7.301
7.297
7.288
7.285
7.273
7.261
7.256
7.248
7.240
7.226
7.040
7.028
7.016
6.822
6.815
6.806
6.799
6.791
6.784
5.618
5.081
4.990
4.983
3.956
3.935
3.907
3.820
3.814
3.807
3.801
3.796
3.789
3.782
3.618
2.919
2.899
2.889
2.880
2.871
2.554
2.541
2.525
2.512
OH
O
Cl
O
O
Ph
5f
1.01
4.01
4.16
2.30
0.98
1.02
1.00
1.00
1.00
2.03
1.09
3.01
1.01
1.01
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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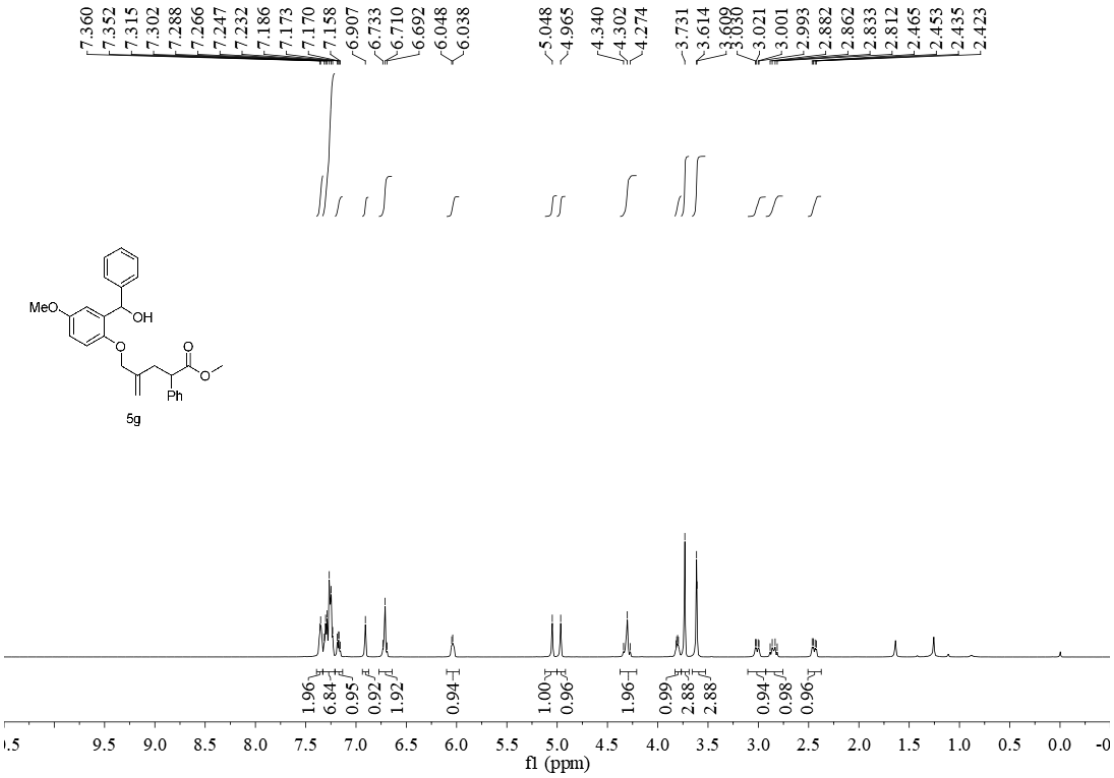
127.776
127.405
127.146
127.080
126.799
121.165
120.503
115.141
80.984
80.950
71.978
71.876
52.038
49.993
49.954
36.794
36.769
OH
O
Cl
O
O
Ph
5f
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

5g: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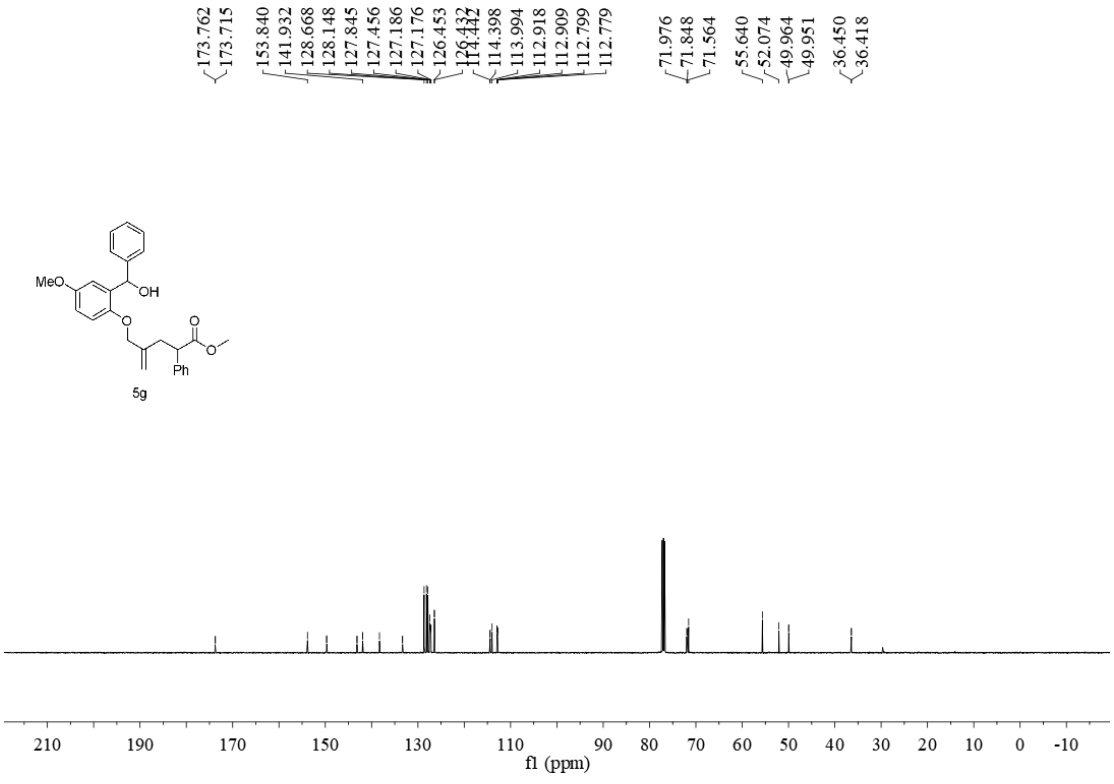
7.266
7.247
7.232
7.186
7.173
7.170
7.158
6.907
6.733
6.710
6.692
6.048
6.038
5.048
4.965
4.340
4.302
4.274
3.731
3.614
3.609
3.030
3.021
3.001
2.993
2.882
2.862
2.833
2.812
2.465
2.453
2.435
2.423
MeO
OH
O
O
O
Ph
5g
1.96
6.84
0.95
0.92
1.92
0.94
1.00
0.96
1.96
0.99
2.88
2.88
0.94
0.98
0.96
f1 (ppm)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141.932
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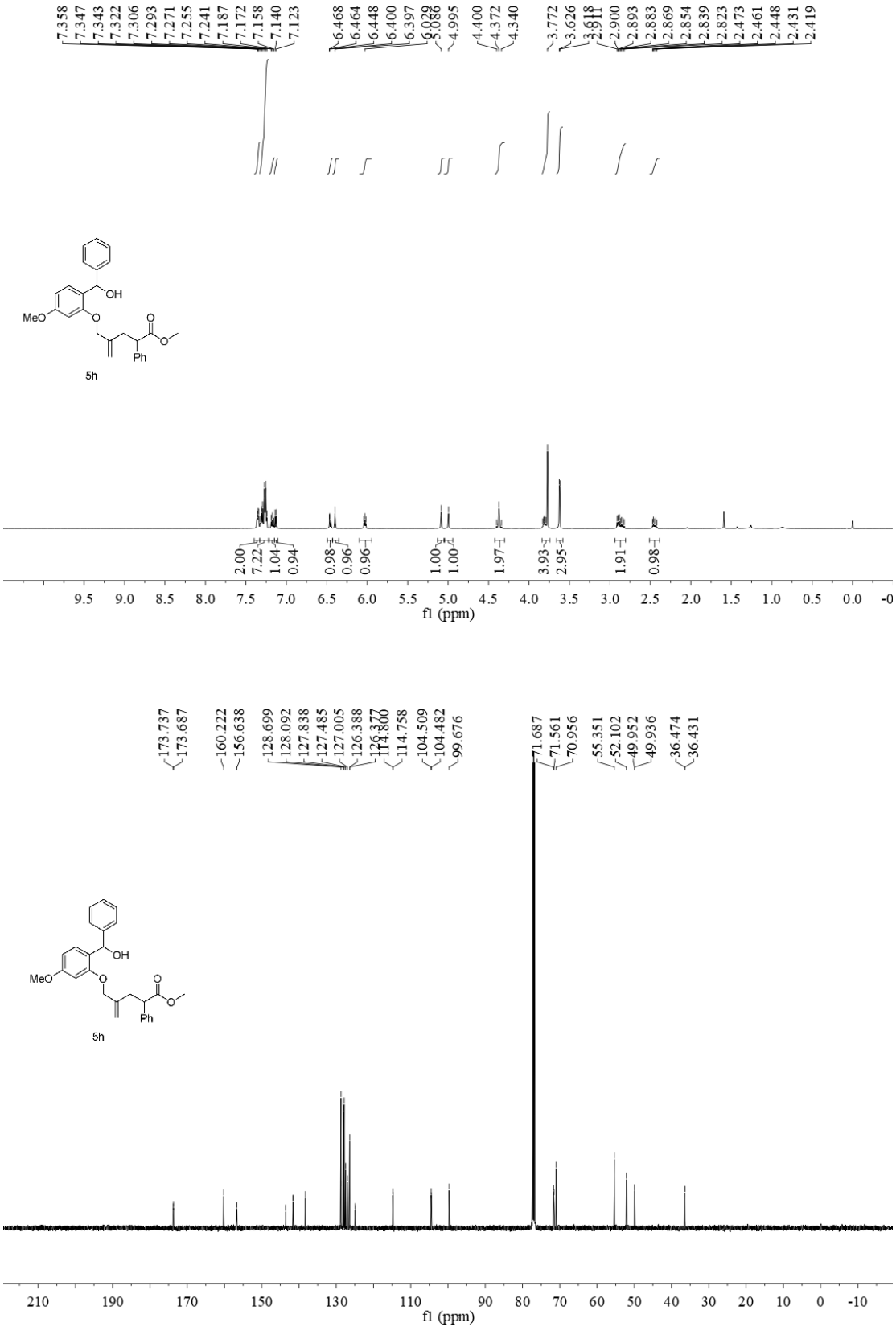
127.186
127.176
126.453
114.398
113.994
112.918
112.909
112.799
112.779
71.976
71.848
71.564
55.640
52.074
49.964
49.951
36.450
36.418
MeO
OH
O
O
O
Ph
5g
f1 (ppm)

5h: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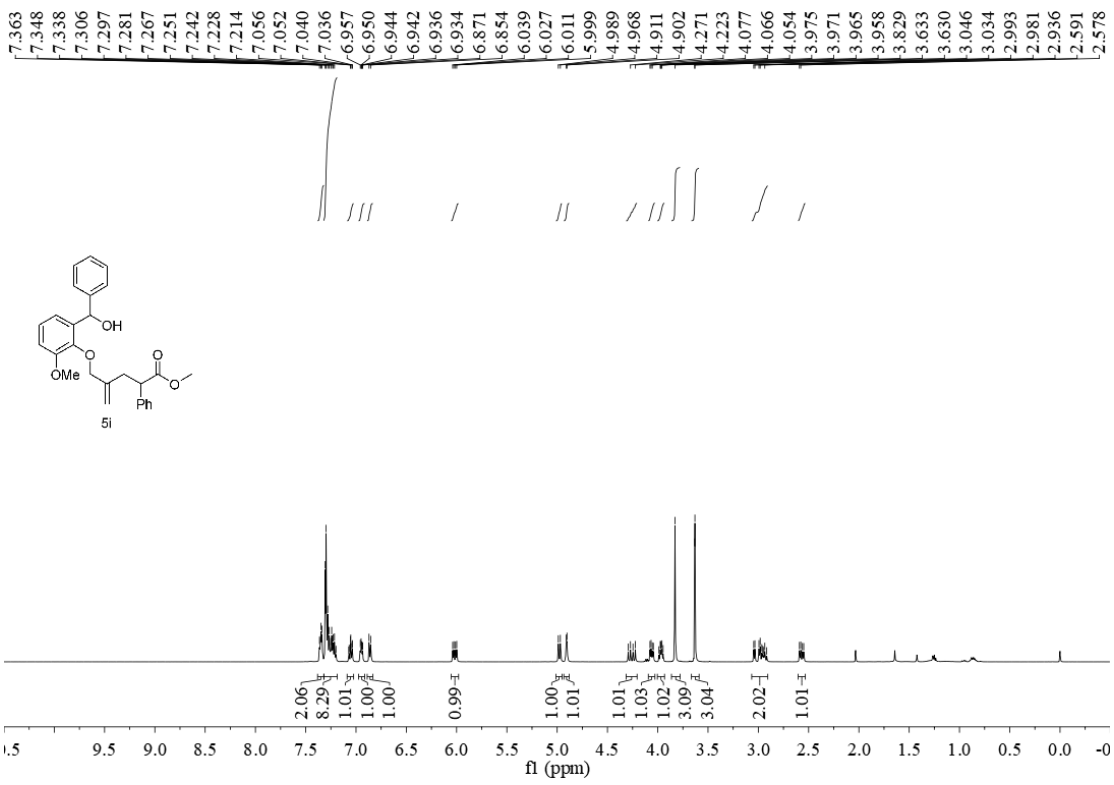
7.271
7.255
7.241
7.187
7.172
7.158
7.140
7.123
6.468
6.464
6.448
6.400
6.397
6.029
5.086
4.995
4.400
4.372
4.340
3.772
3.626
3.618
3.611
2.900
2.893
2.883
2.869
2.854
2.839
2.823
2.473
2.461
2.448
2.431
2.419
OH
MeO
O
O
O
Ph
5h
2.00
7.22
1.04
0.94
0.98
0.96
0.96
1.00
1.00
1.97
3.93
2.95
1.91
0.98
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)
173.737
173.687
160.222
156.638
128.699
128.092
127.838
127.485
127.005
126.388
114.800
114.758
104.509
104.482
99.676
71.687
71.561
70.956
55.351
52.102
49.952
49.936
36.474
36.431
OH
MeO
O
O
O
Ph
5h
210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

5i: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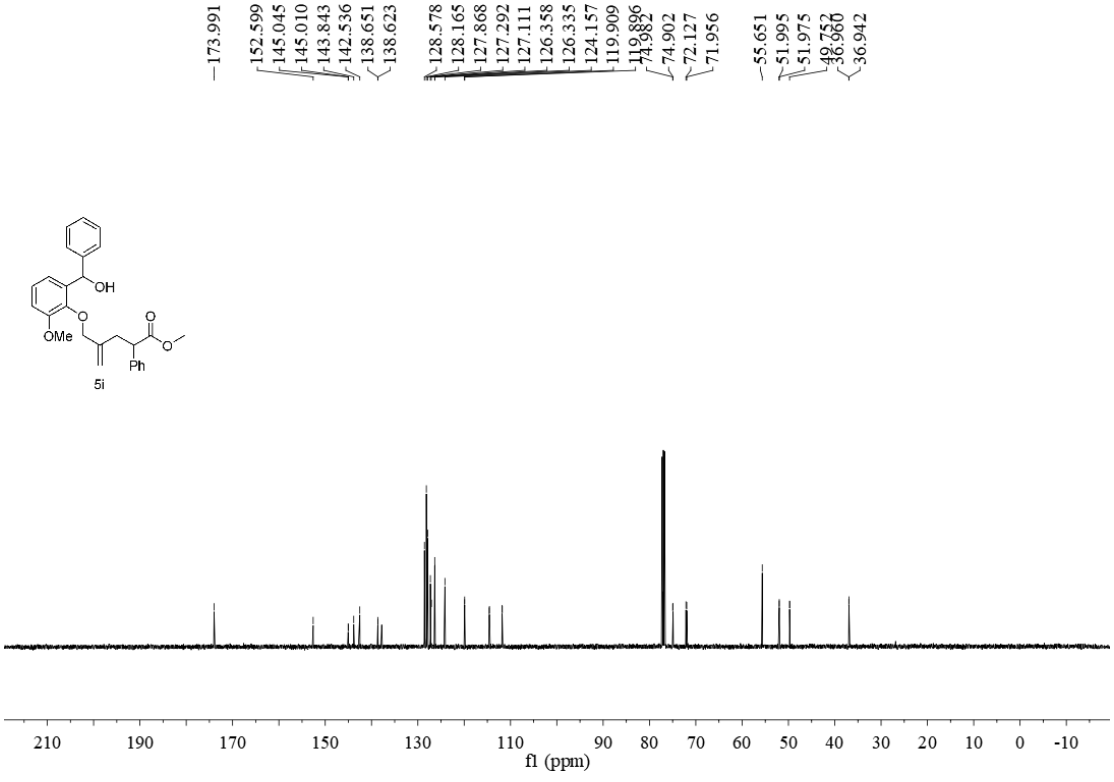
7.281
7.267
7.251
7.242
7.228
7.214
7.056
7.052
7.040
7.036
6.957
6.950
6.944
6.942
6.936
6.934
6.871
6.854
6.039
6.027
6.011
5.999
4.989
4.968
4.911
4.902
4.271
4.223
4.077
4.066
4.054
3.975
3.971
3.965
3.958
3.829
3.633
3.630
3.046
3.034
2.993
2.981
2.936
2.591
2.578
OH
O
OMe
O
O
Ph
5i
2.06
8.29
1.01
1.00
1.00
0.99
1.00
1.01
1.01
1.03
1.02
3.09
3.04
2.02
1.01
fl (ppm)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145.010
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138.623
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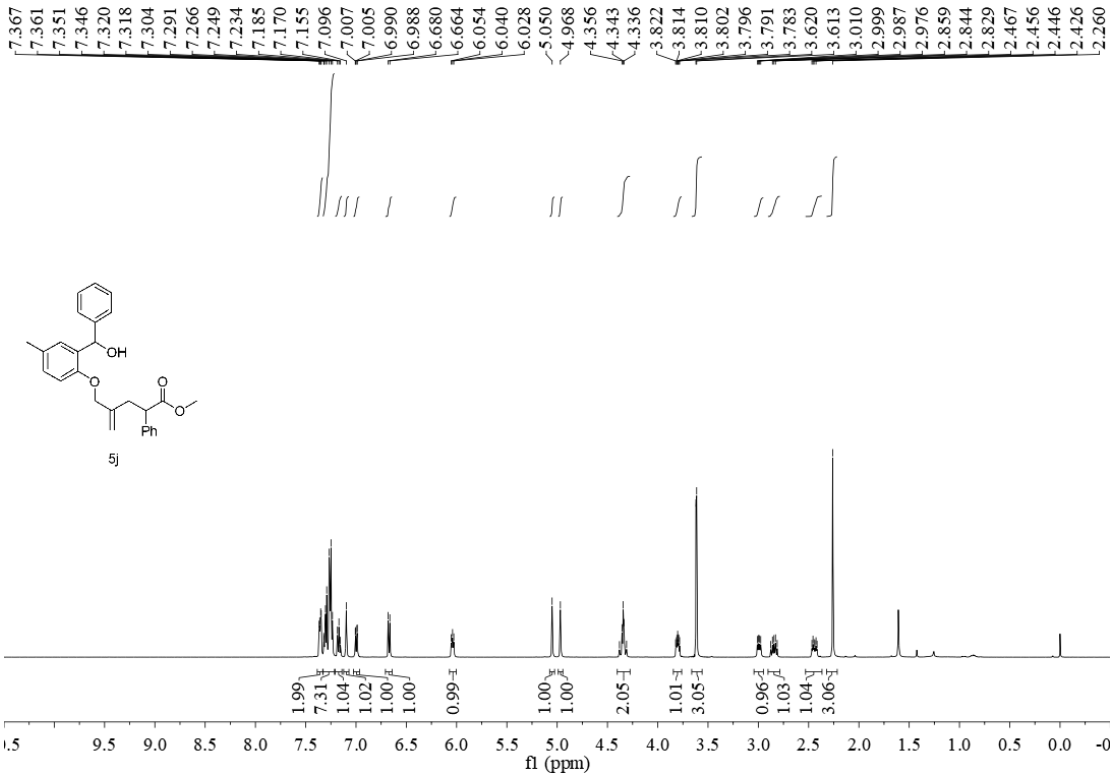
128.165
127.868
127.292
127.111
126.358
126.335
124.157
119.909
119.886
74.982
74.902
72.127
71.956
55.651
51.995
51.975
49.752
36.960
36.942
OH
O
OMe
O
O
Ph
5i
fl (ppm)

5j: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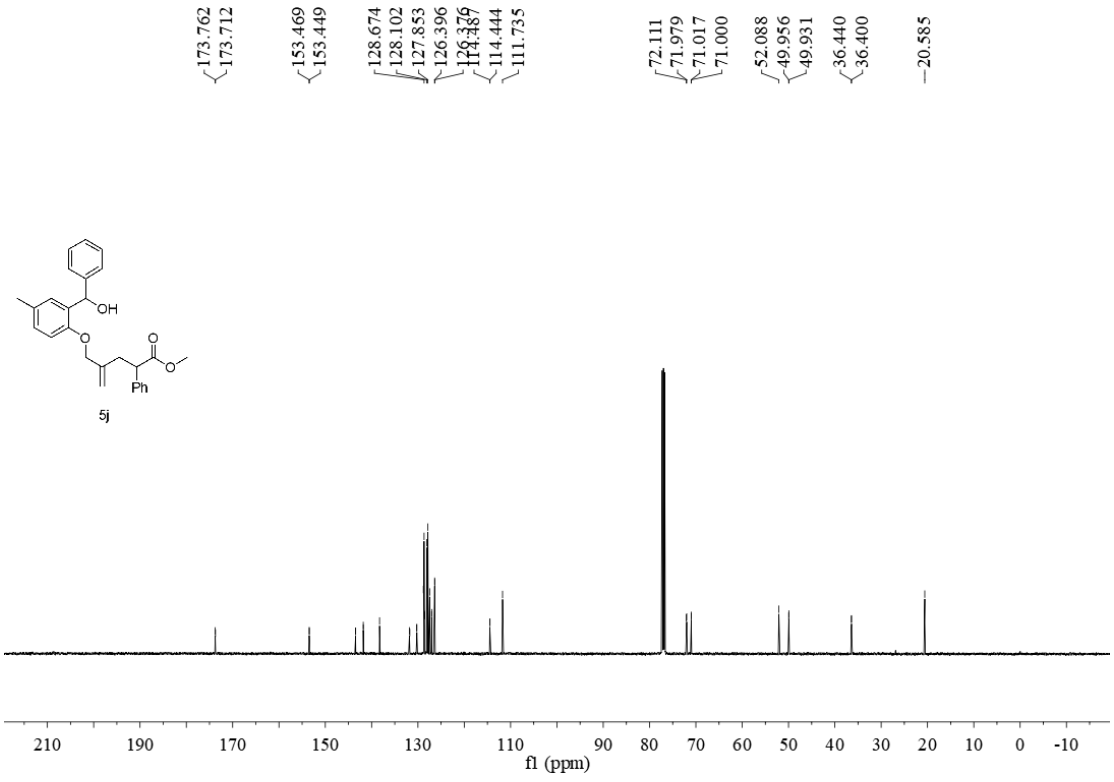
7.304
7.291
7.266
7.249
7.234
7.185
7.170
7.155
7.096
7.007
7.005
6.990
6.988
6.680
6.664
6.054
6.040
6.028
5.050
4.968
4.356
4.343
4.336
3.822
3.814
3.810
3.802
3.796
3.791
3.783
3.620
3.613
3.010
2.999
2.987
2.976
2.859
2.844
2.829
2.467
2.456
2.446
2.426
2.260
OH
O
O
O
Ph
5j
1.99
7.31
1.04
1.02
1.00
1.00
0.99
1.00
1.00
2.05
1.01
3.05
0.96
1.03
1.04
3.06
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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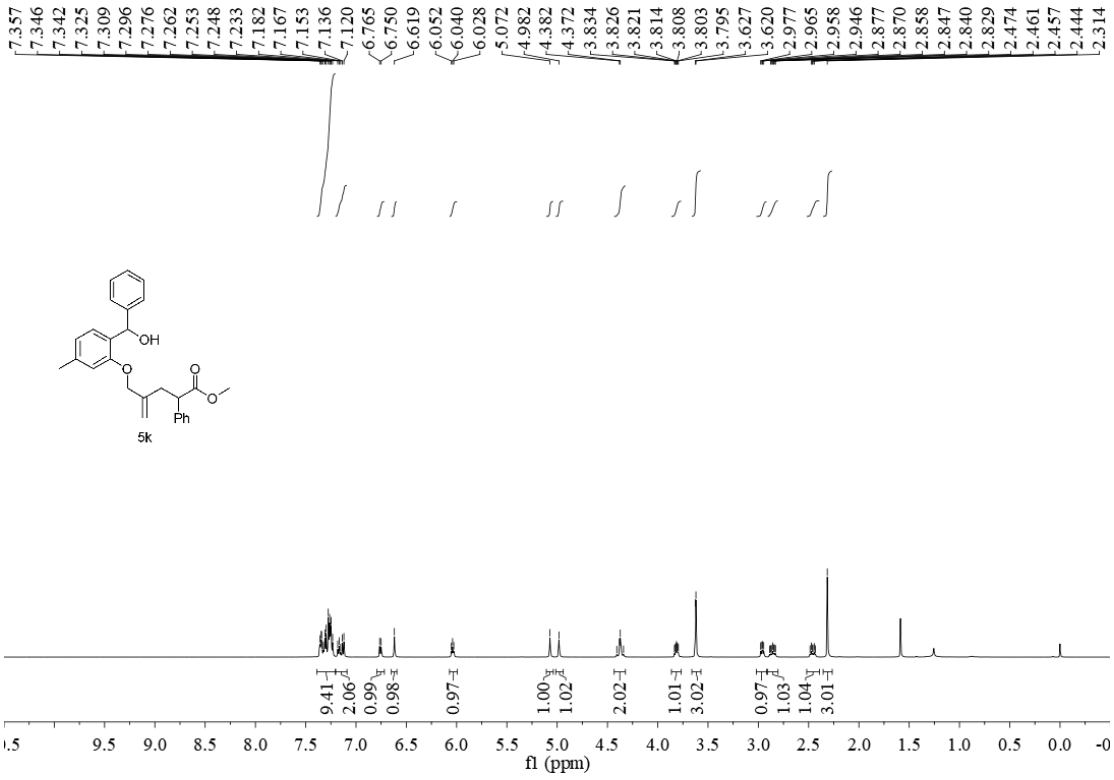
153.449
128.674
128.102
127.853
126.396
114.444
111.735
72.111
71.979
71.017
71.000
52.088
49.956
49.931
36.440
36.400
20.585
OH
O
O
O
Ph
5j
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

5k: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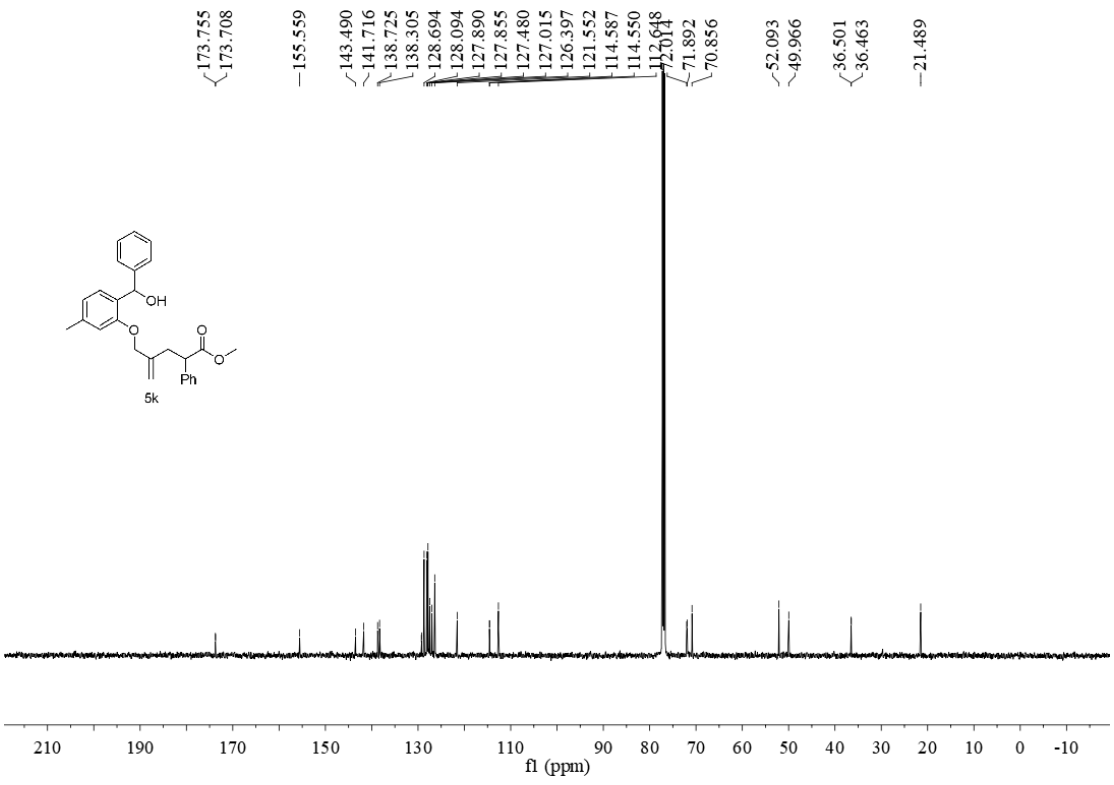
7.276
7.262
7.253
7.248
7.233
7.182
7.167
7.153
7.136
7.120
6.765
6.750
6.619
6.052
6.040
6.028
5.072
4.982
4.382
4.372
3.834
3.826
3.821
3.814
3.808
3.803
3.795
3.627
3.620
2.977
2.965
2.958
2.946
2.877
2.870
2.858
2.847
2.840
2.829
2.474
2.461
2.457
2.444
2.314
OH
O
O
O
Ph
5k
9.41
2.06
0.99
0.98
0.97
1.00
1.02
2.02
1.01
3.02
0.97
1.03
1.04
3.01
fl (ppm)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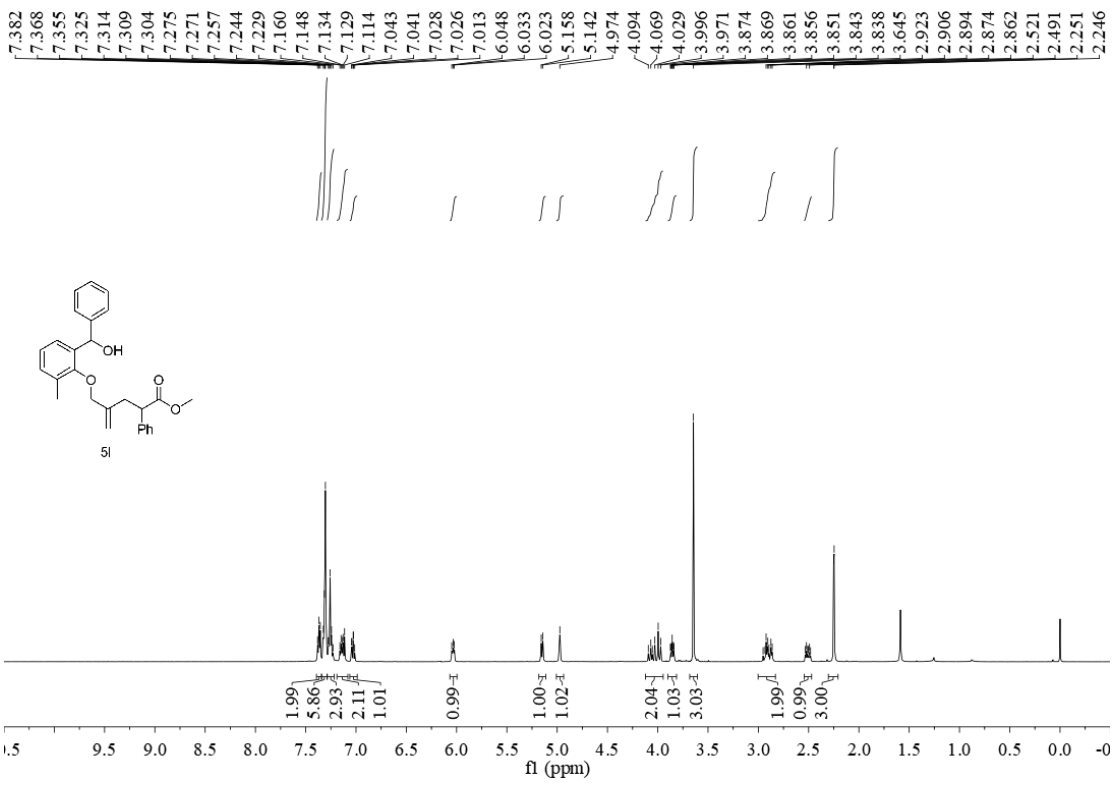
128.094
127.890
127.855
127.480
127.015
126.397
121.552
114.587
114.550
112.648
72.014
71.892
70.856
52.093
49.966
36.501
36.463
21.489
OH
O
O
O
Ph
5k
fl (ppm)

5l: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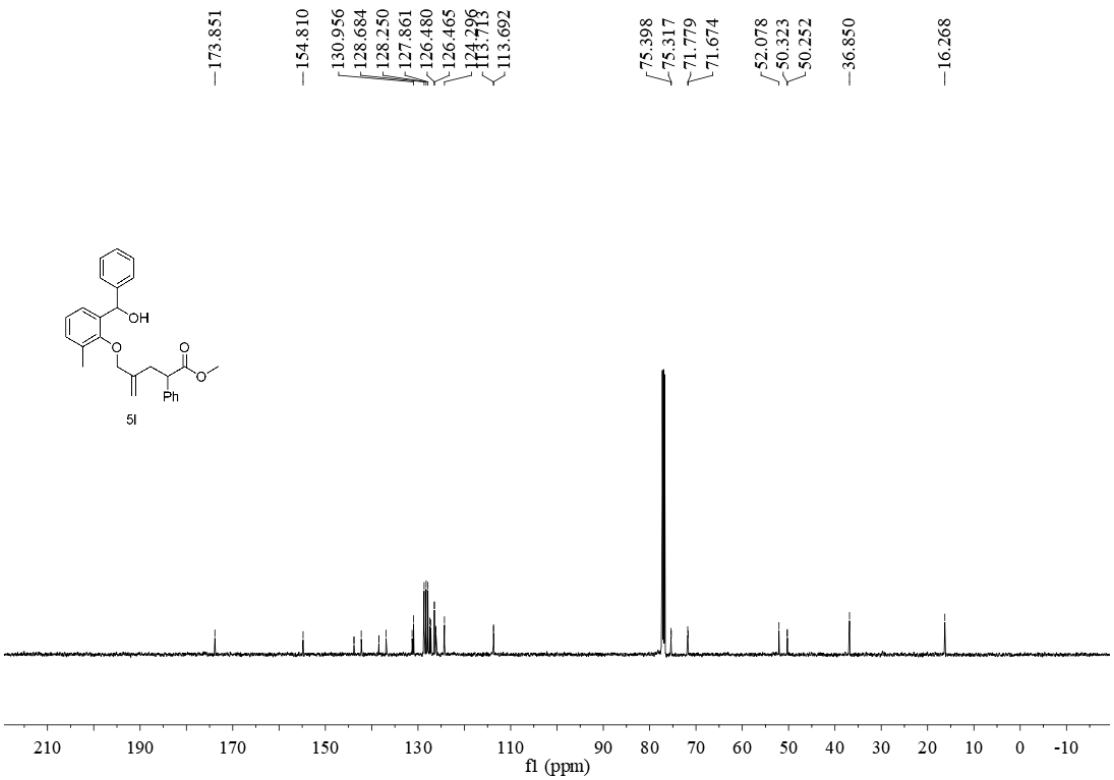
7.304
7.275
7.271
7.257
7.244
7.229
7.160
7.148
7.134
7.129
7.114
7.043
7.041
7.028
7.026
7.013
6.048
6.033
6.023
5.158
5.142
4.974
4.094
4.069
4.029
3.996
3.971
3.874
3.869
3.861
3.856
3.851
3.843
3.838
3.645
2.923
2.906
2.894
2.874
2.862
2.521
2.491
2.251
2.246
OH
O
O
O
Ph
5l
1.99
5.86
2.93
2.11
1.01
0.99
1.00
1.02
2.04
1.03
3.03
1.99
0.99
3.00
f1 (ppm)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130.956
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128.250
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126.480
126.465
124.296
113.713
113.692
75.398
75.317
71.779
71.674
52.078
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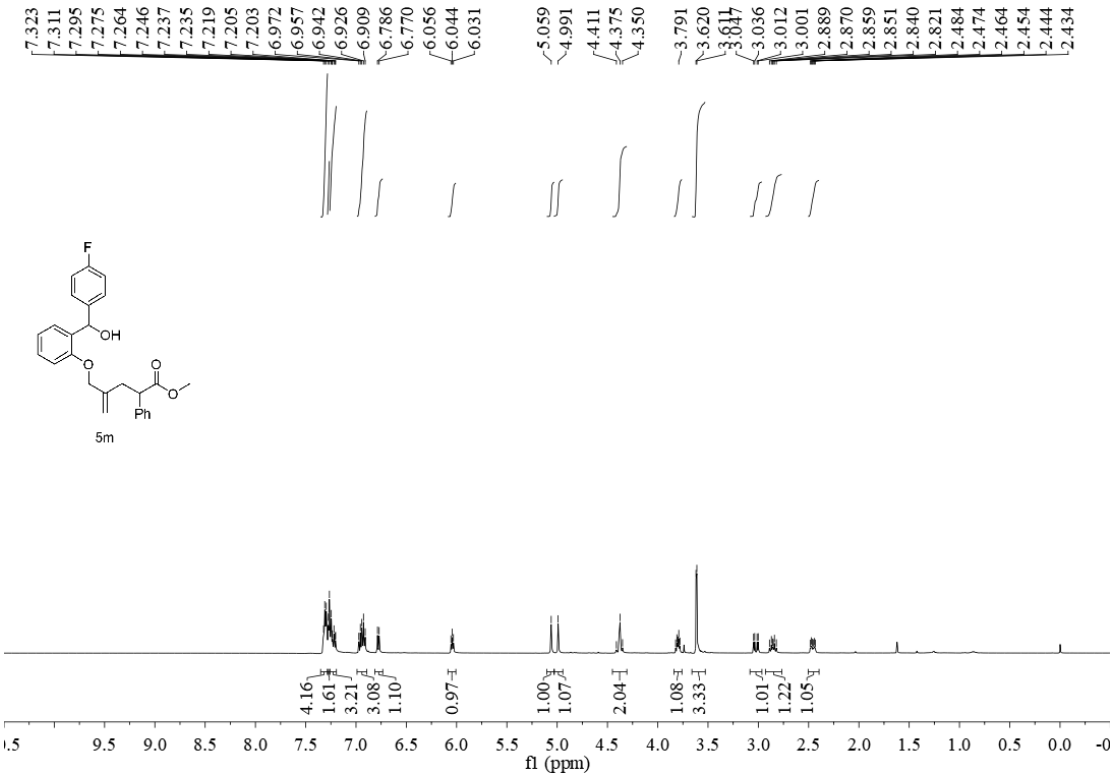
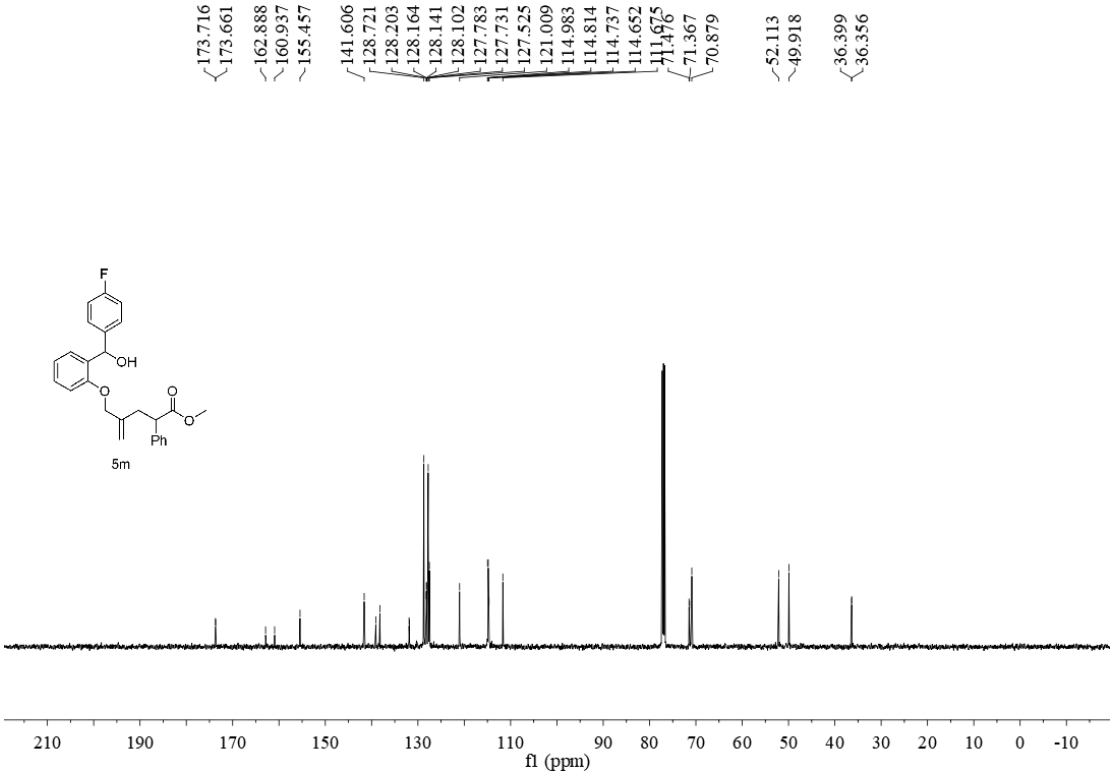
50.252
36.850
16.268
OH
O
O
O
Ph
5l
f1 (ppm)

5m:


7.323
7.311
7.295
7.275
7.264
7.246
7.237
7.235
7.219
7.205
7.203
6.972
6.957
6.942
6.926
6.909
6.786
6.770
6.056
6.044
6.031
5.059
4.991
4.411
4.375
4.350
3.791
3.620
3.611
3.047
3.036
3.012
3.001
2.889
2.870
2.859
2.851
2.840
2.821
2.484
2.474
2.464
2.454
2.444
2.434
F
OH
O
O
O
Ph
5m
4.16
1.61
3.21
3.08
1.10
0.97
1.00
1.07
2.04
1.08
3.33
1.01
1.22
1.05
f1 (ppm)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128.721
128.203
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128.141
128.102
127.783
127.731
127.525
121.009
114.983
114.814
114.737
114.652
111.675
111.476
71.367
70.879
52.113
49.918
36.399
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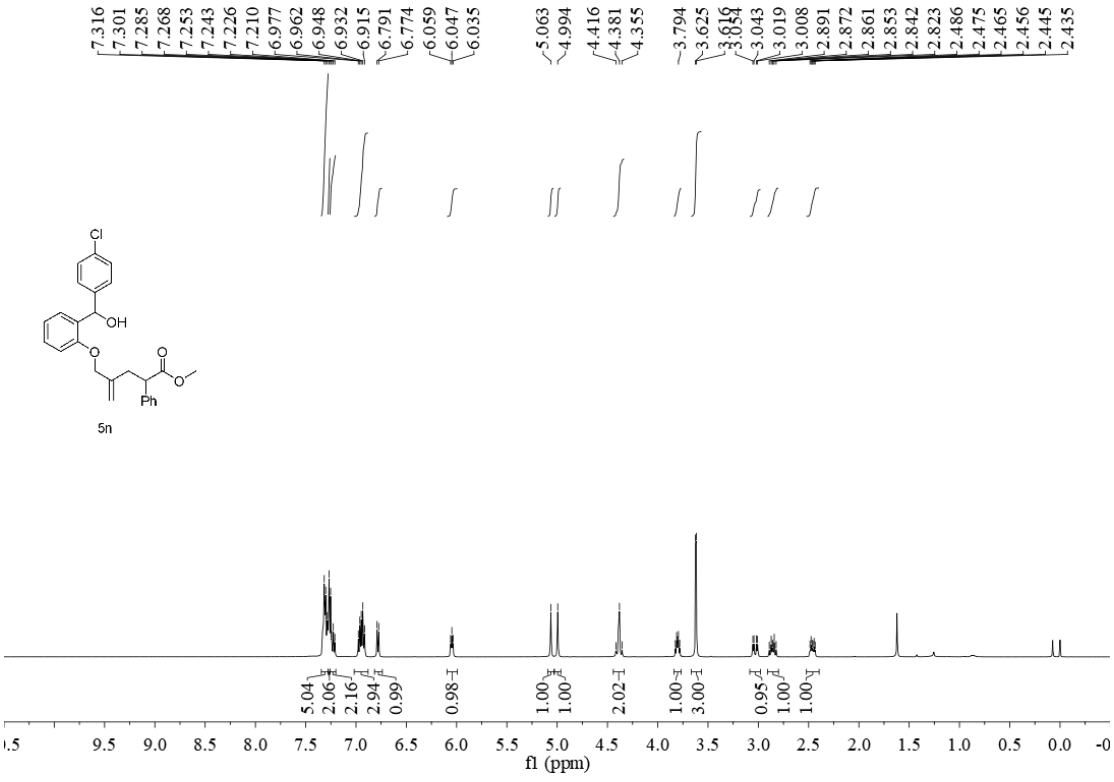
F
OH
O
O
O
Ph
5m
f1 (ppm)

5n: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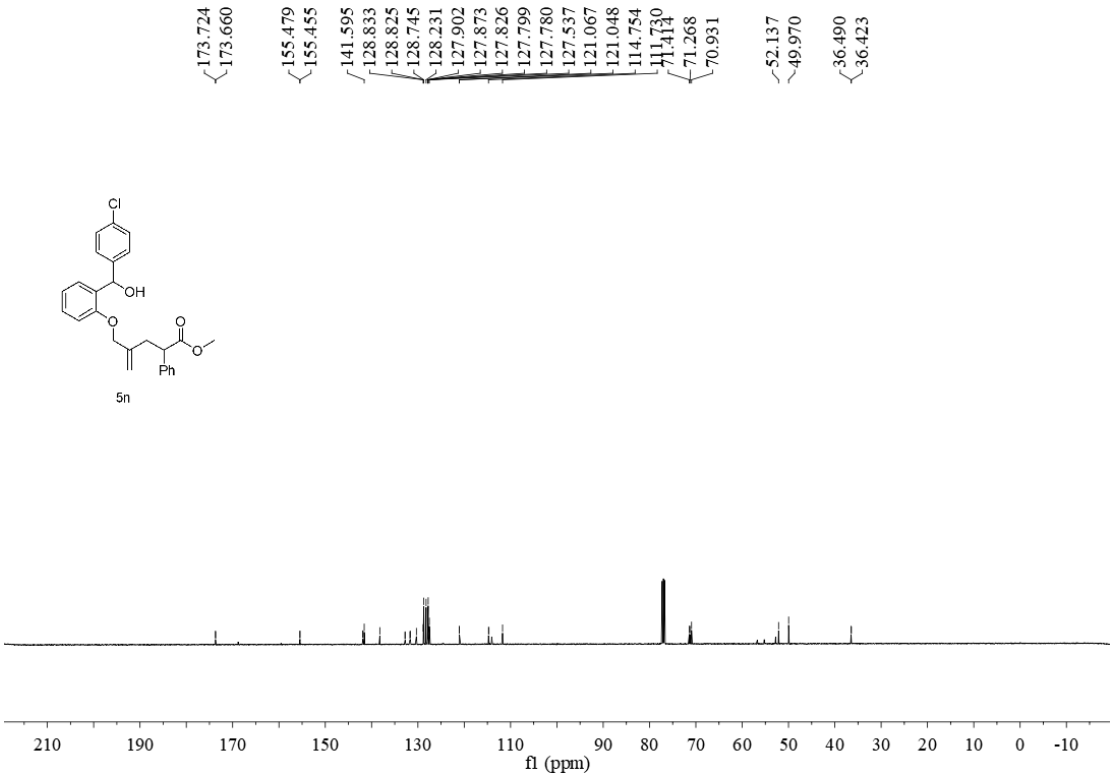
7.301
7.285
7.268
7.253
7.243
7.226
7.210
6.977
6.962
6.948
6.932
6.915
6.791
6.774
6.059
6.047
6.035
5.063
4.994
4.416
4.381
4.355
3.794
3.625
3.616
3.054
3.043
3.019
3.008
2.891
2.872
2.861
2.853
2.842
2.823
2.486
2.475
2.465
2.456
2.445
2.435
Cl
OH
O
O
O
Ph
5n
5.04
2.06
2.16
2.94
0.99
0.98
1.00
1.00
2.02
1.00
3.00
0.95
1.00
1.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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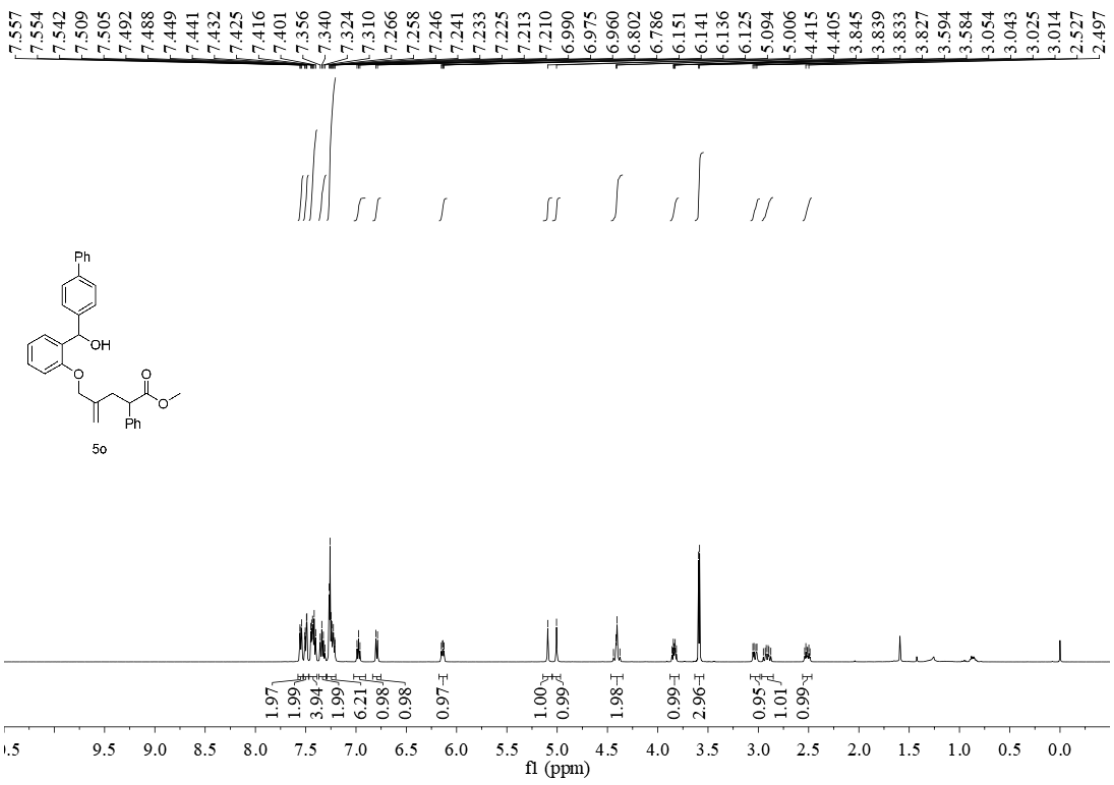
128.745
128.231
127.902
127.873
127.826
127.799
127.780
127.537
121.067
121.048
114.754
111.730
111.414
71.268
70.931
52.137
49.970
36.490
36.423
Cl
OH
O
O
O
Ph
5n
210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

5o: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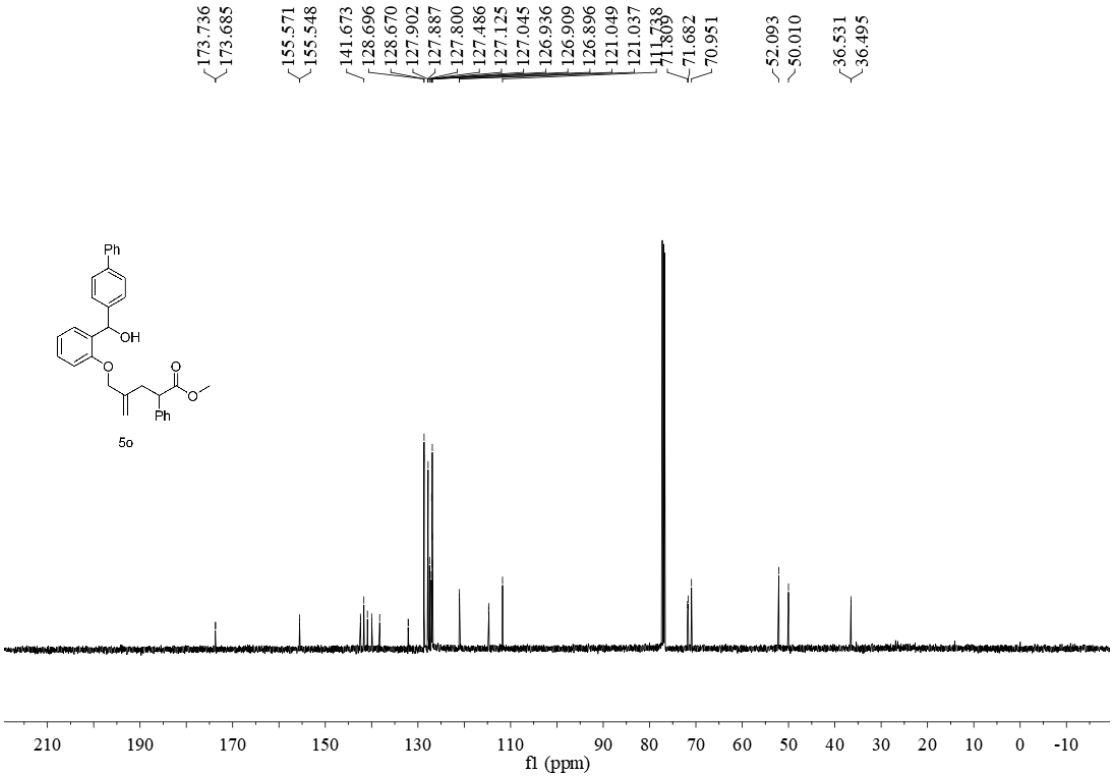
7.449
7.441
7.432
7.425
7.416
7.401
7.356
7.340
7.324
7.310
7.266
7.258
7.246
7.241
7.233
7.225
7.213
7.210
6.990
6.975
6.960
6.802
6.786
6.151
6.141
6.136
6.125
5.094
5.006
4.415
4.405
3.845
3.839
3.833
3.827
3.594
3.584
3.054
3.043
3.025
3.014
2.527
2.497
Ph
OH
O
O
O
Ph
5o
1.97
1.99
3.94
1.99
6.21
0.98
0.98
0.97
1.00
0.99
1.98
0.99
2.96
0.95
1.01
0.99
f1 (ppm)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127.800
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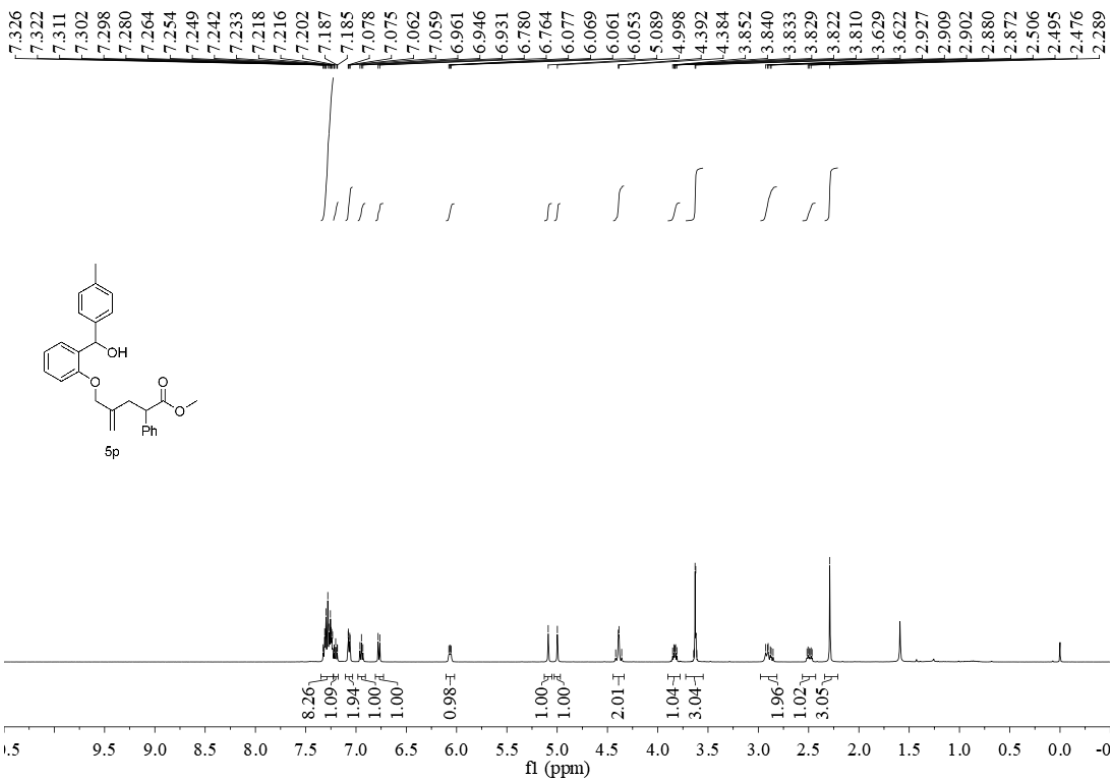
127.125
127.045
126.936
126.909
126.896
121.049
121.037
111.738
111.809
71.682
70.951
52.093
50.010
36.531
36.495
Ph
OH
O
O
O
Ph
5o
f1 (ppm)

5p: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7.322
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7.302
7.298
7.280
7.264
7.254
7.249
7.242
7.233
7.218
7.216
7.202
7.187
7.185
7.078
7.075
7.062
7.059
6.961
6.946
6.931
6.780
6.764
6.077
6.069
6.061
6.053
5.089
4.998
4.392
4.384
3.852
3.840
3.833
3.829
3.822
3.810
3.629
3.622
2.927
2.909
2.902
2.880
2.872
2.506
2.495
2.476
2.289
OH
O
O
O
Ph
5p
8.26
1.09
1.94
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1.00
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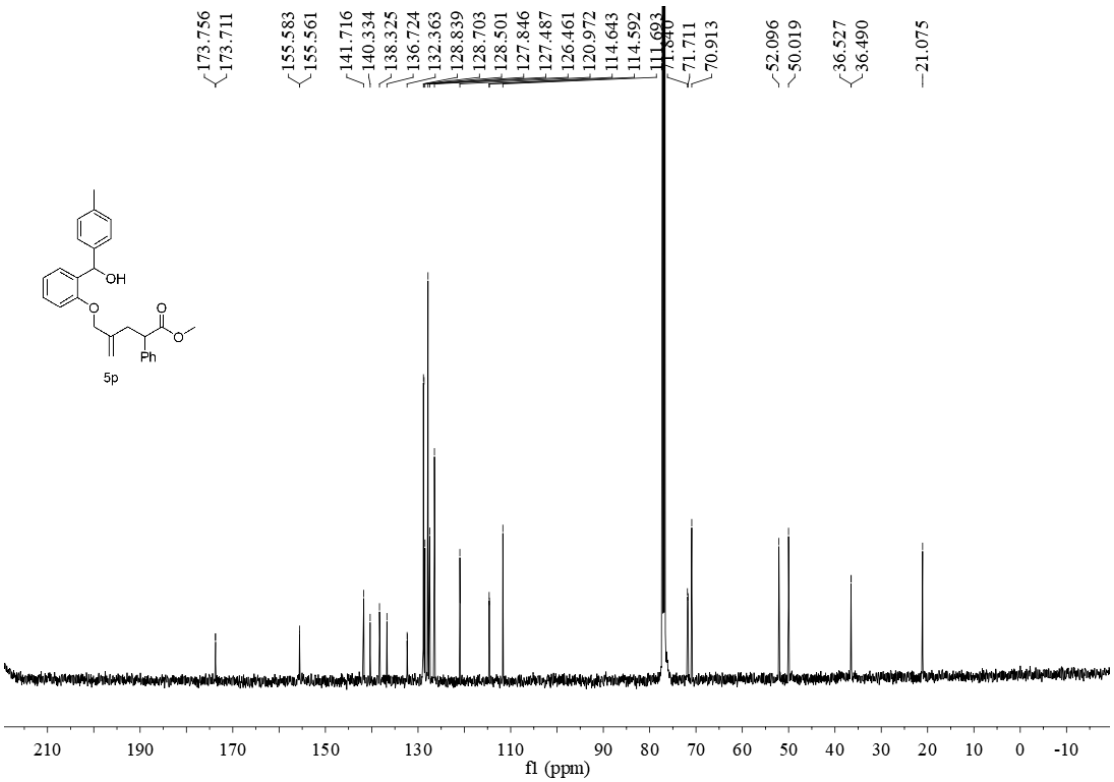
1.00
1.00
2.01
1.04
3.04
1.96
1.02
3.05
fl (ppm)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155.561
141.716
140.334
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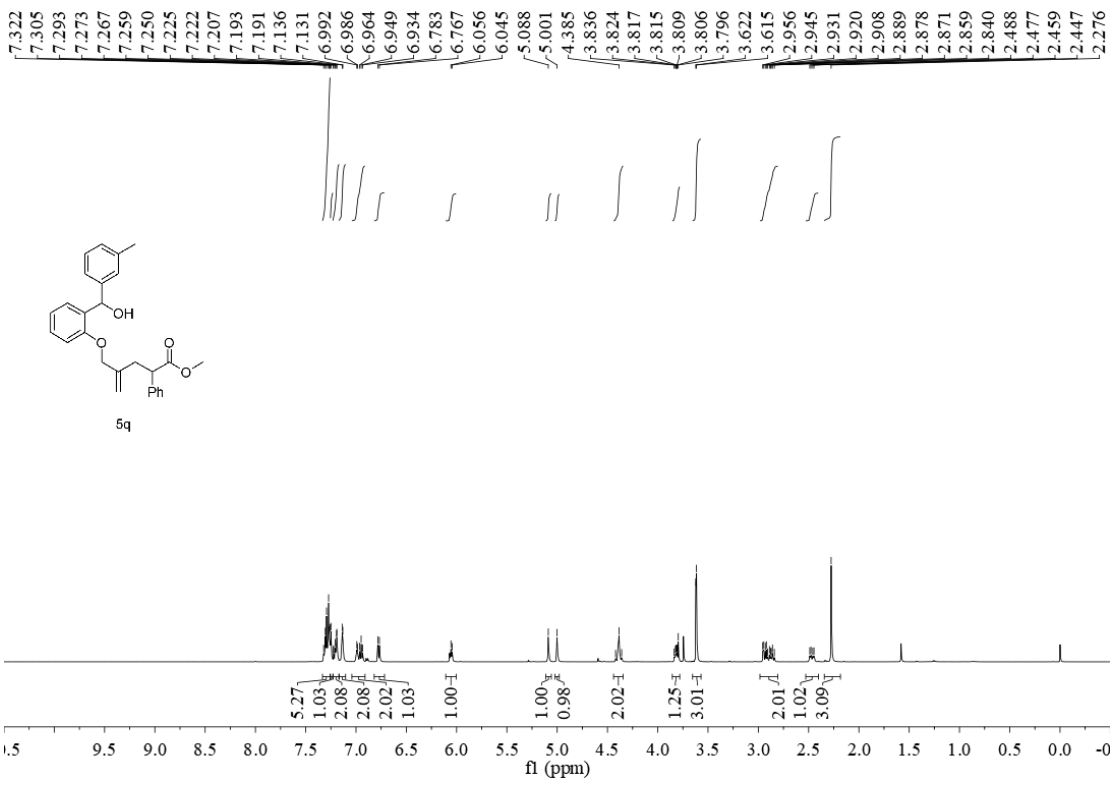
136.724
132.363
128.839
128.703
128.501
127.846
127.487
126.461
120.972
114.643
114.592
111.693
71.840
71.711
70.913
52.096
50.019
36.527
36.490
21.075
OH
O
O
O
Ph
5p
fl (ppm)

5q: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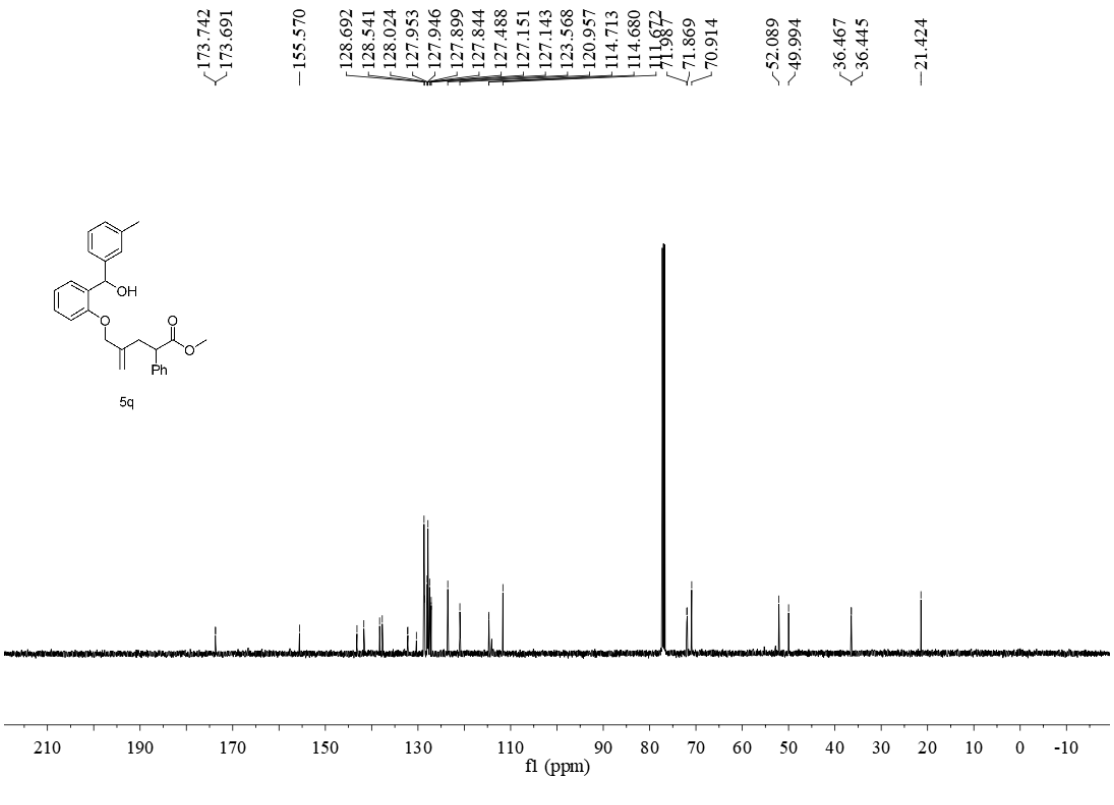
7.225
7.222
7.207
7.193
7.191
7.136
7.131
6.992
6.986
6.964
6.949
6.934
6.783
6.767
6.056
6.045
5.088
5.001
4.385
3.836
3.824
3.817
3.815
3.809
3.806
3.796
3.622
3.615
2.956
2.945
2.931
2.920
2.908
2.889
2.878
2.871
2.859
2.840
2.488
2.477
2.459
2.447
2.276
OH
O
O
O
Ph
5q
5.27
1.03
2.08
2.08
2.02
1.03
1.00
1.00
0.98
2.02
1.25
3.01
2.01
1.02
3.09
fl (ppm)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127.844
127.488
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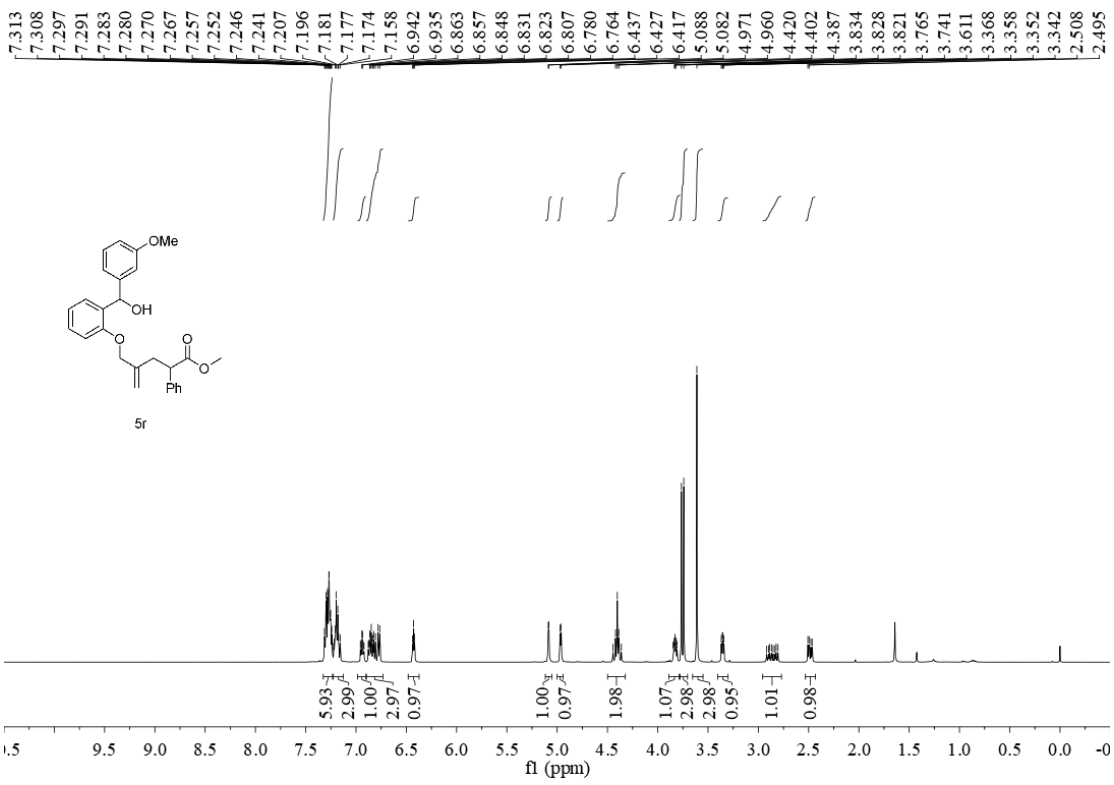
127.143
123.568
120.957
114.713
114.680
111.672
111.987
71.869
70.914
52.089
49.994
36.467
36.445
21.424
OH
O
O
O
Ph
5q
fl (ppm)

5r: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7.267
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7.252
7.246
7.241
7.207
7.196
7.181
7.177
7.174
7.158
6.942
6.935
6.863
6.857
6.848
6.831
6.823
6.807
6.780
6.764
6.437
6.427
6.417
5.088
5.082
4.971
4.960
4.420
4.402
4.387
3.834
3.828
3.821
3.765
3.741
3.611
3.368
3.358
3.352
3.342
2.508
2.495
OMe
OH
O
O
O
Ph
5r
5.93
2.99
1.00
2.97
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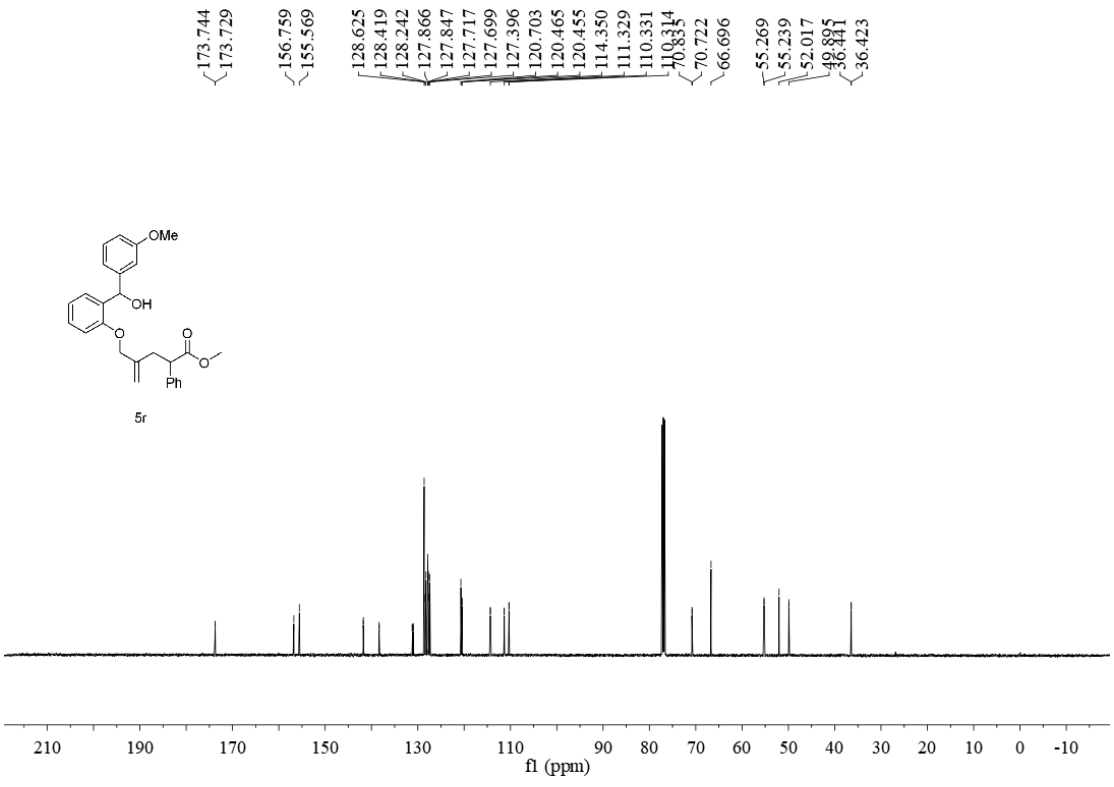
1.00
0.97
1.98
1.07
2.98
2.98
0.95
1.01
0.98
fl (ppm)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127.717
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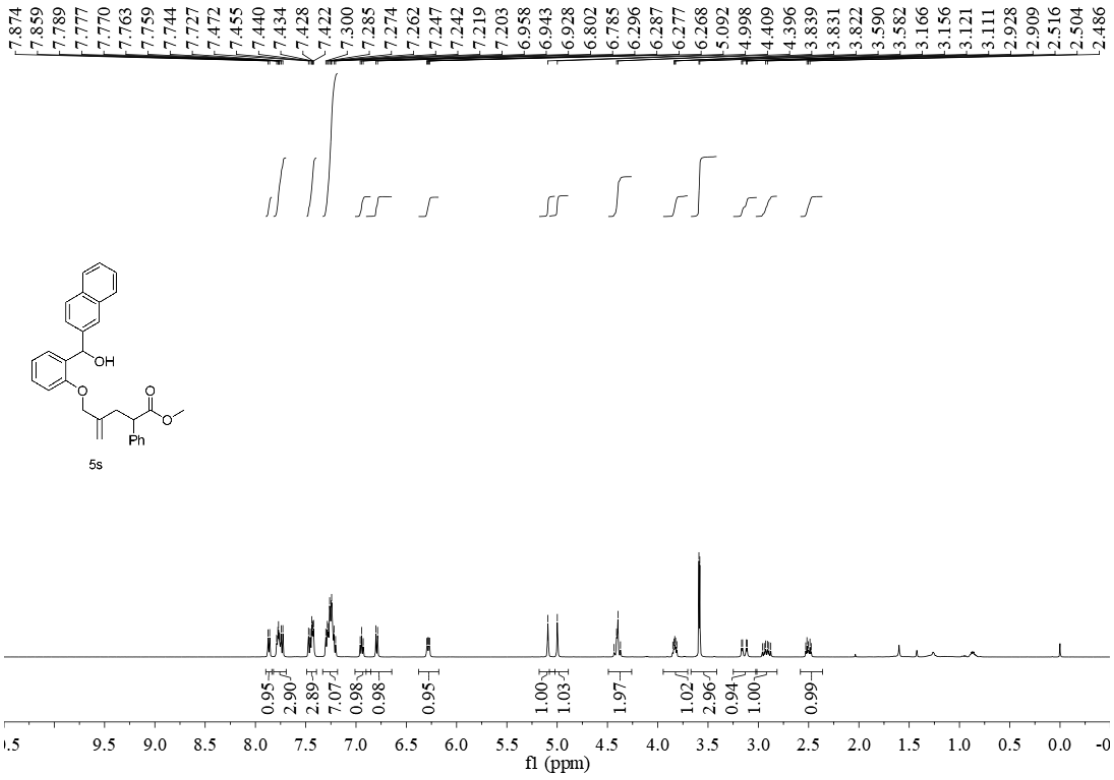
127.396
120.703
120.465
120.455
114.350
111.329
110.331
110.314
70.835
70.722
66.696
55.269
55.239
52.017
49.895
36.441
36.423
OMe
OH
O
O
O
Ph
5r
fl (ppm)

5s: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7.428
7.422
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7.274
7.262
7.247
7.242
7.219
7.203
6.958
6.943
6.928
6.802
6.785
6.296
6.287
6.277
6.268
5.092
4.998
4.409
4.396
3.839
3.831
3.822
3.590
3.582
3.166
3.156
3.121
3.111
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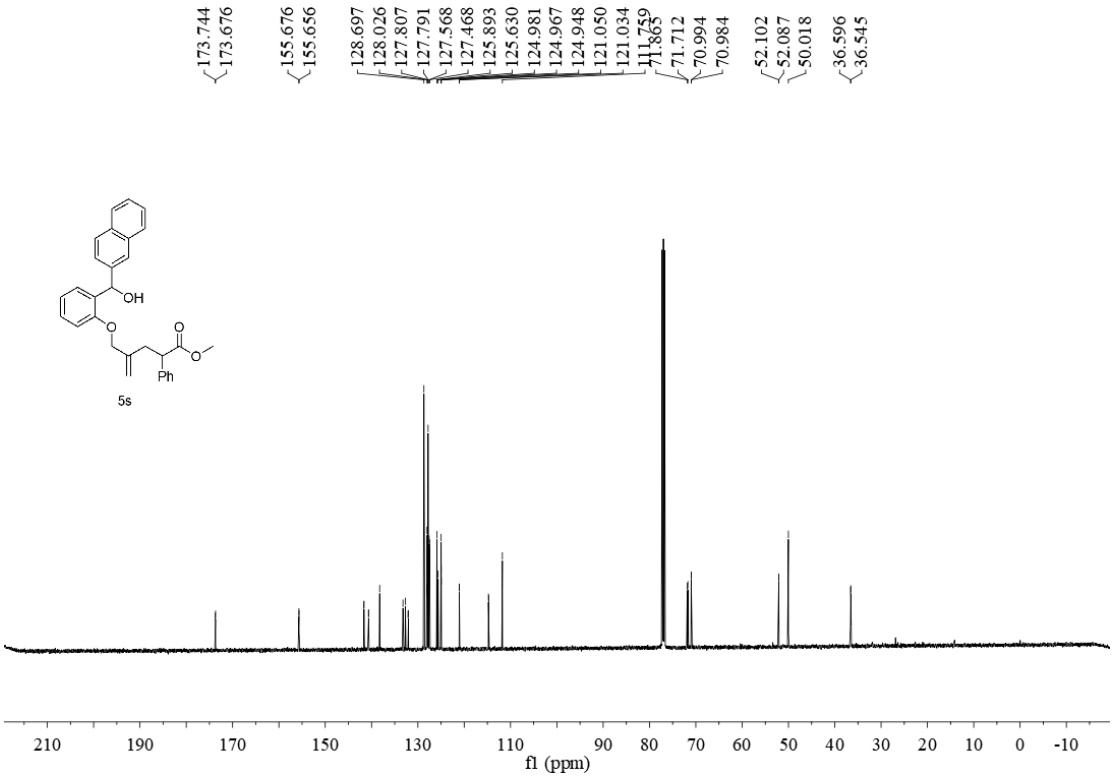
2.909
2.516
2.504
2.486
OH
O
O
O
Ph
5s
0.95
2.90
2.89
7.07
0.98
0.98
0.95
1.00
1.03
1.97
1.02
2.96
0.94
1.00
0.99
f1 (ppm)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173.676
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155.656
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128.026
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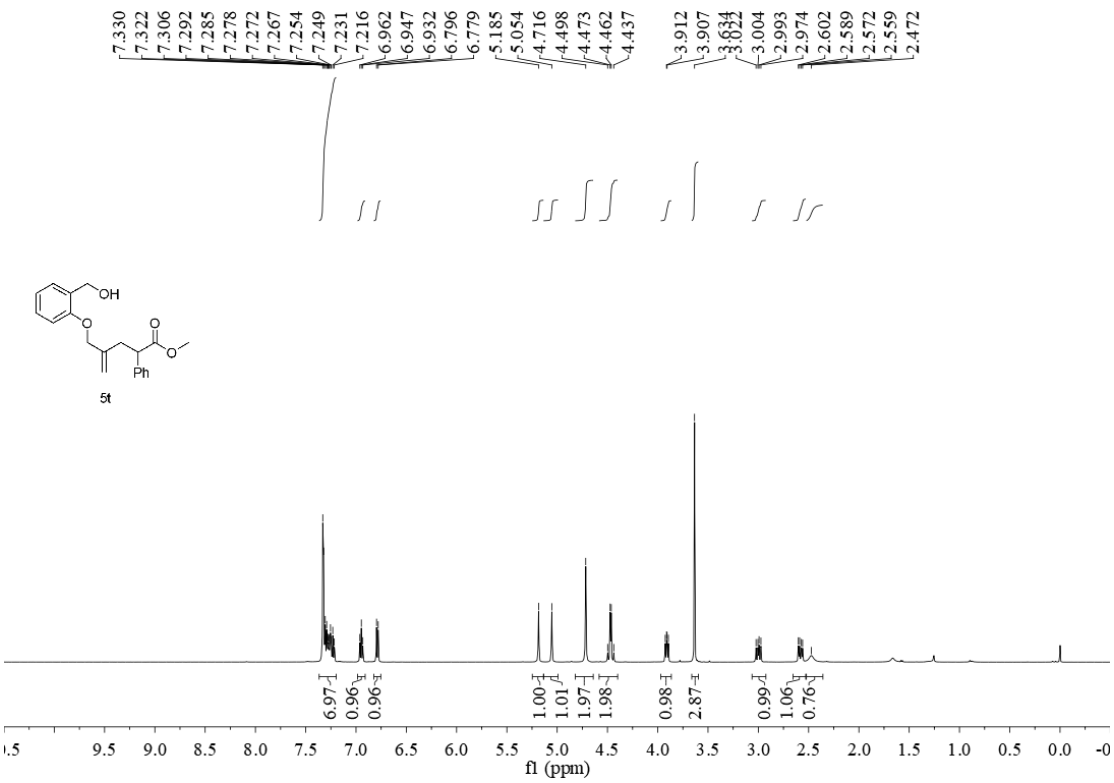
127.791
127.568
127.468
125.893
125.630
124.981
124.967
124.948
121.050
121.034
111.759
111.865
71.712
70.994
70.984
52.102
52.087
50.018
36.596
36.545
OH
O
O
O
Ph
5s
f1 (ppm)

5t: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7.322
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7.292
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7.278
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7.267
7.254
7.249
7.231
7.216
6.962
6.947
6.932
6.796
6.779
5.185
5.054
4.716
4.498
4.473
4.462
4.437
3.912
3.907
3.634
3.622
3.004
2.993
2.974
2.602
2.589
2.572
2.559
2.472
OH
O
O
O
Ph
5t
6.97
0.96
0.96
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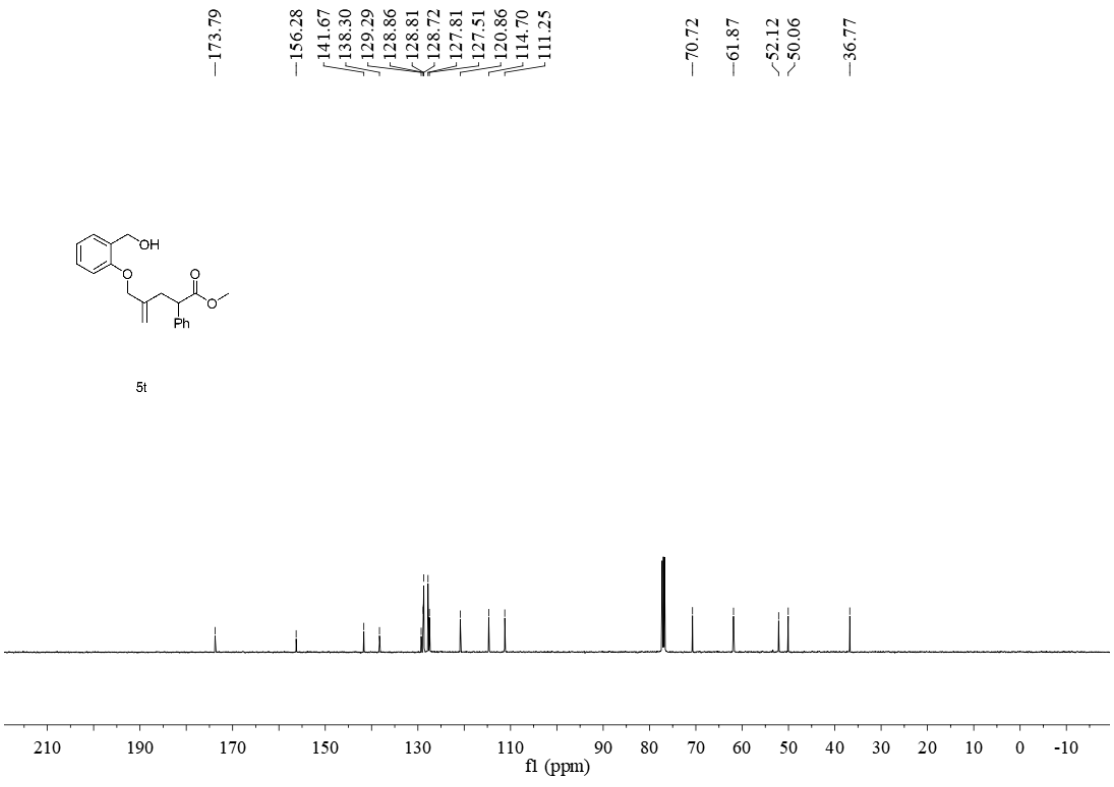
1.01
1.97
1.98
0.98
2.87
0.99
1.06
0.76
fl (ppm)


173.79
156.28
141.67
138.30
129.29
128.86
128.81
128.72
127.81
127.51
120.86
114.70
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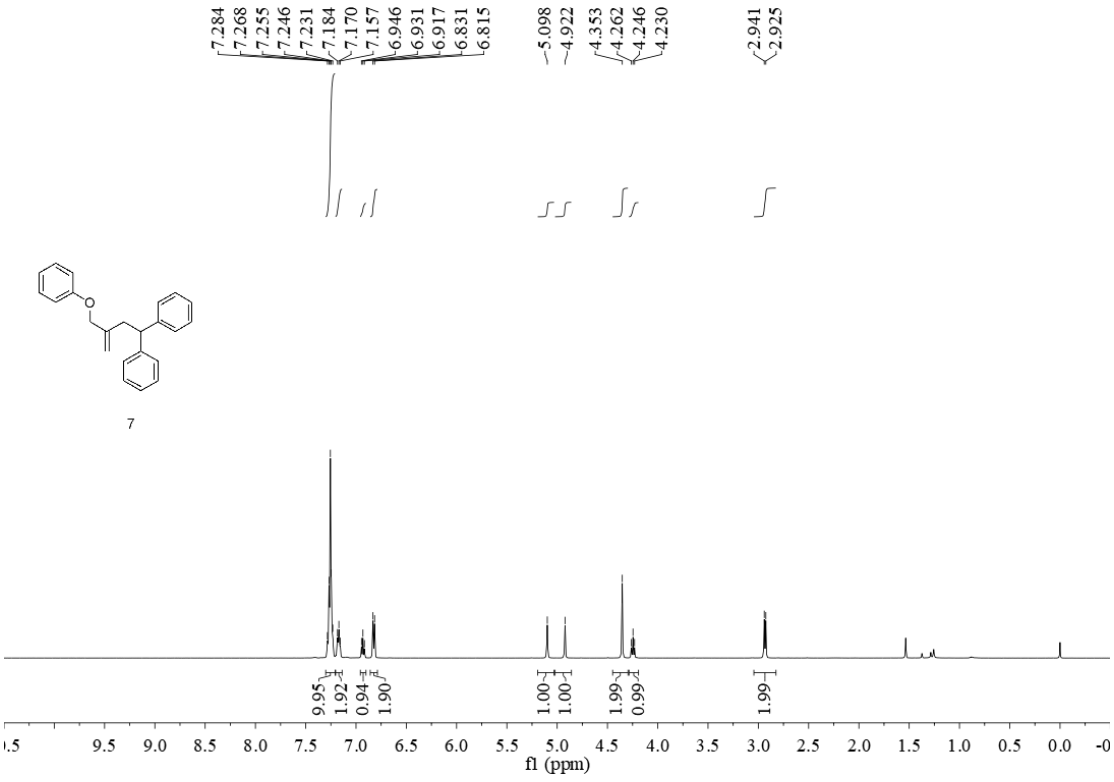
61.87
52.12
50.06
36.77
OH
O
O
O
Ph
5t
fl (ppm)

7:


7.284
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7.246
7.231
7.184
7.170
7.157
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6.931
6.917
6.831
6.815
5.098
4.922
4.353
4.262
4.246
4.230
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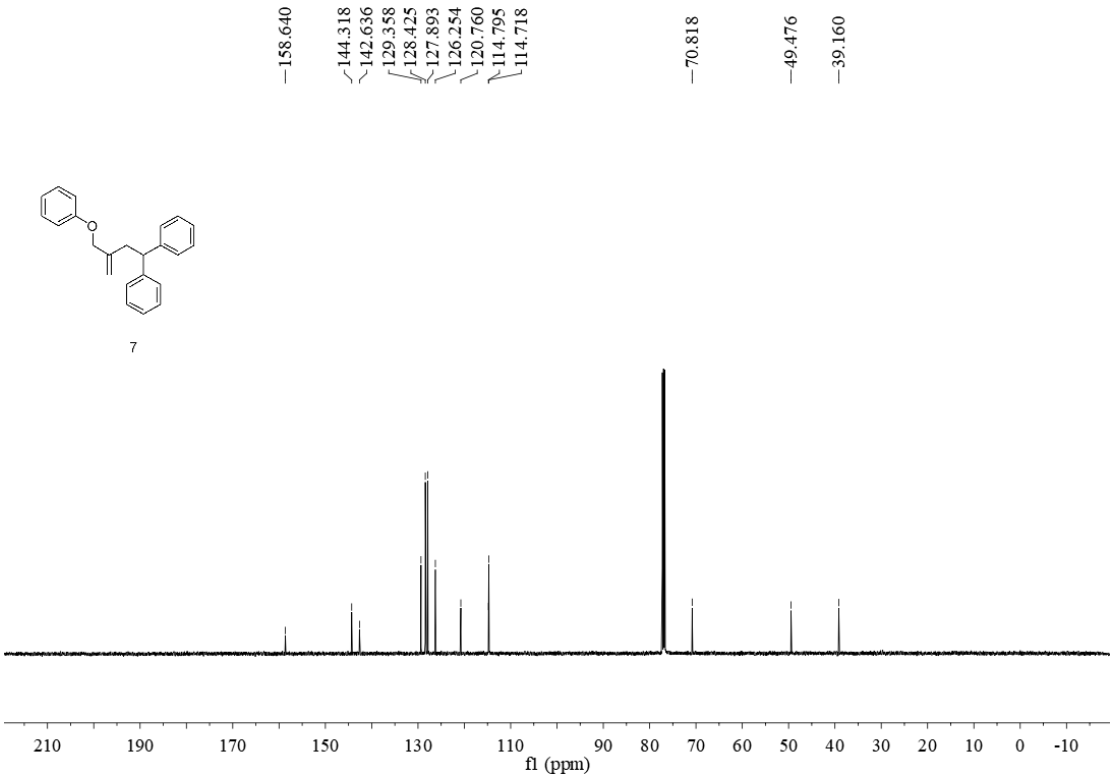
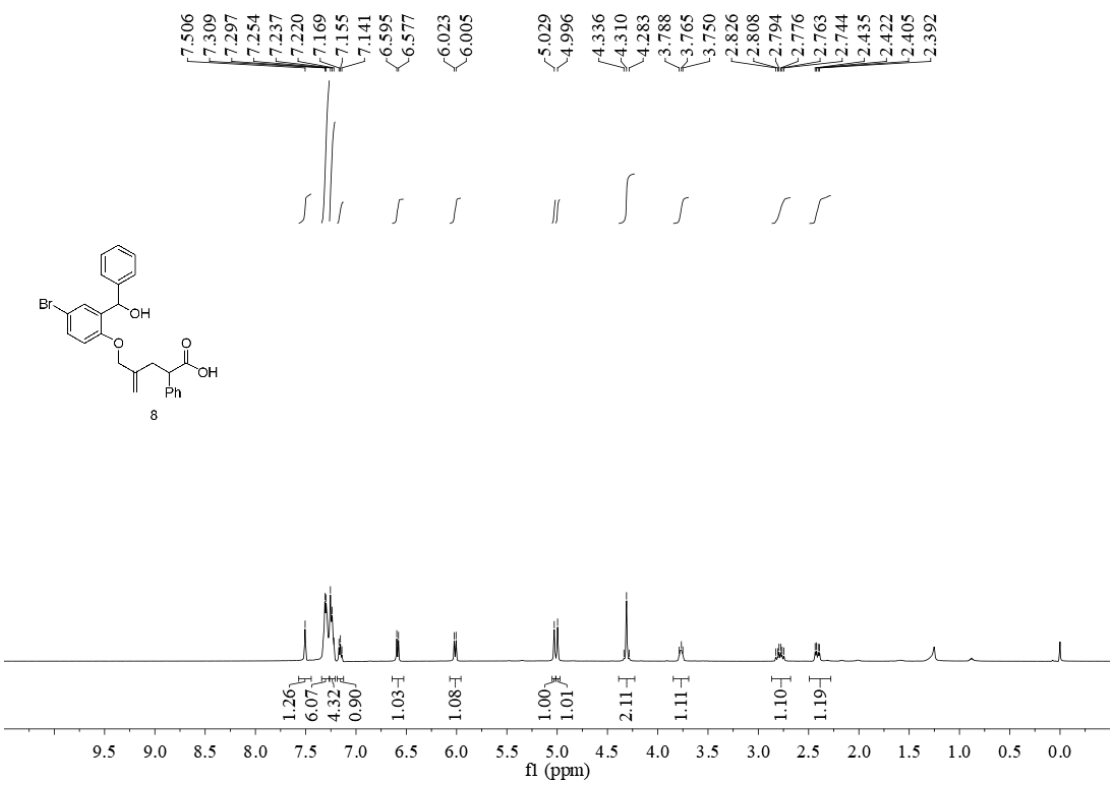
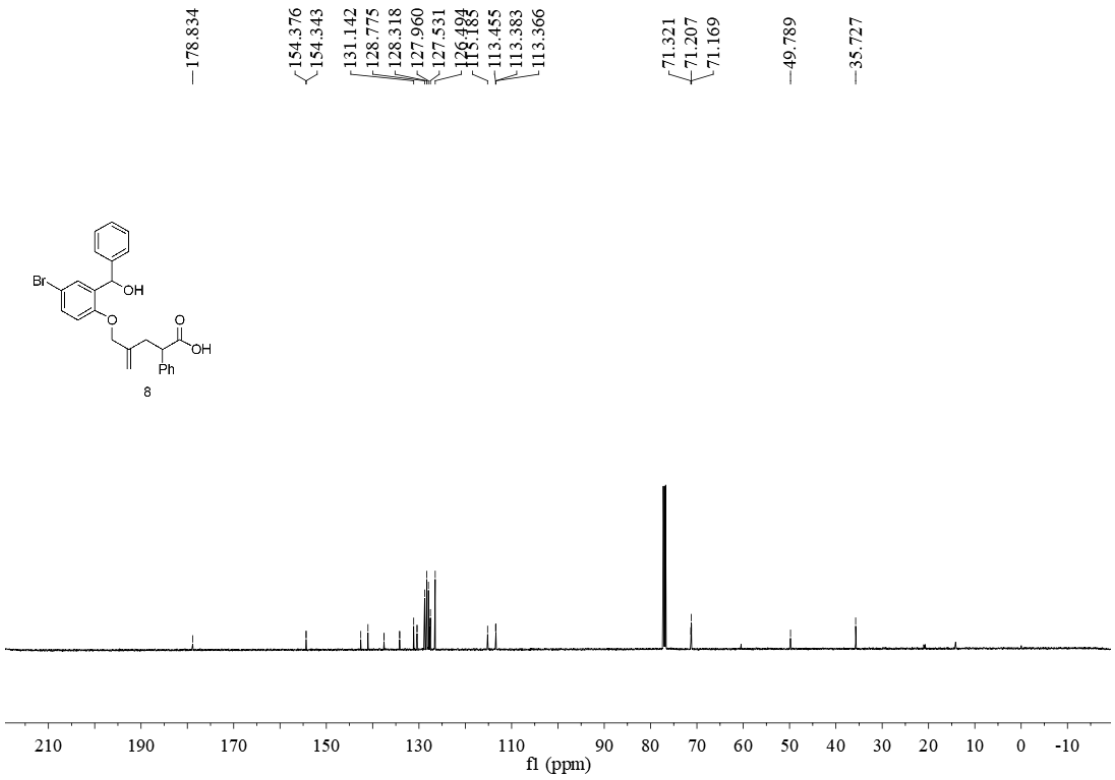
1.90
1.00
1.00
1.99
0.99
1.99
fl (ppm)

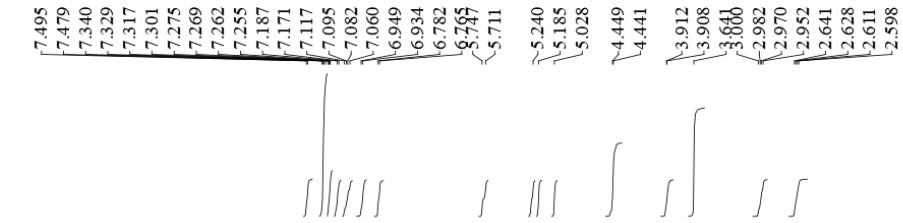

158.640
144.318
142.636
129.358
128.425
127.893
126.254
120.760
114.795
114.718
70.818
49.476
39.160
fl (ppm)

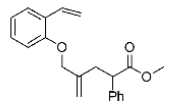
8:


7.506
7.309
7.297
7.254
7.237
7.220
7.169
7.155
7.141
6.595
6.577
6.023
6.005
5.029
4.996
4.336
4.310
4.283
3.788
3.765
3.750
2.826
2.808
2.794
2.776
2.763
2.744
2.435
2.422
2.405
2.392
Br
OH
O
O
OH
Ph
8
1.26
6.07
4.32
0.90
1.03
1.08
1.00
1.01
2.11
1.11
1.10
1.19
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

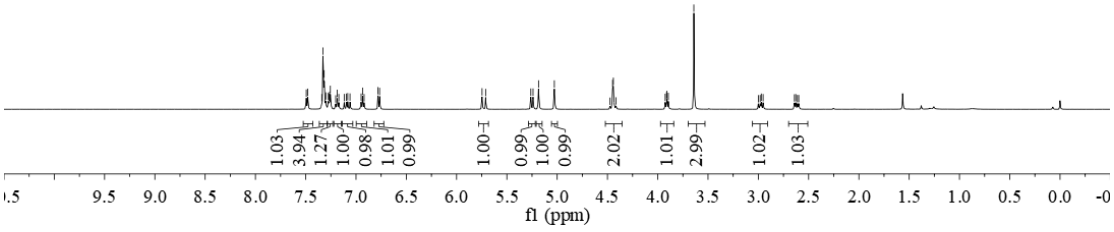

178.834
154.376
154.343
131.142
128.775
128.318
127.960
127.531
126.494
126.185
113.455
113.383
113.366
71.321
71.207
71.169
49.789
35.727
Br
OH
O
O
OH
Ph
8
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

9:

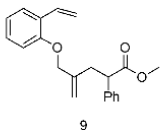

7.495
7.479
7.340
7.329
7.317
7.301
7.275
7.269
7.262
7.255
7.187
7.171
7.117
7.095
7.082
7.060
6.949
6.934
6.782
5.711
5.240
5.185
5.028
4.449
4.441
3.912
3.908
2.982
2.970
2.952
2.641
2.628
2.611
2.598


O
O
O
Ph

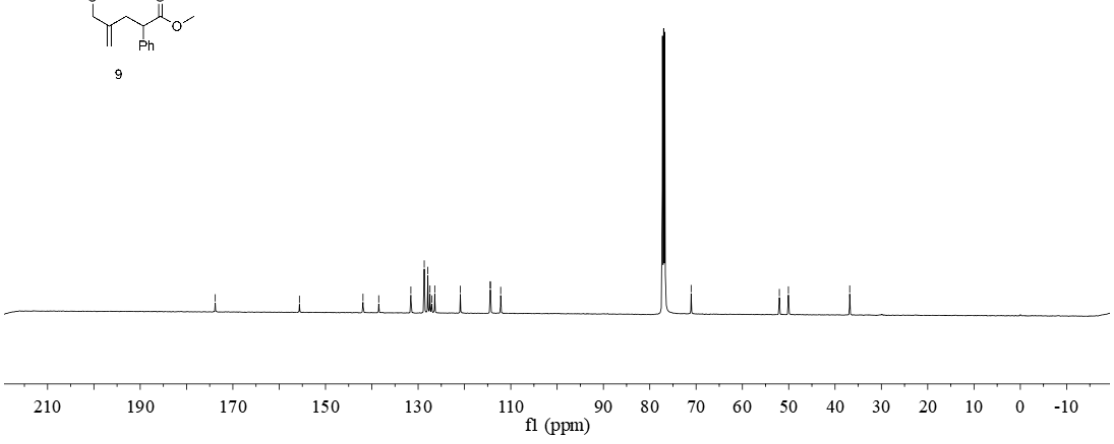
9


1.03
3.94
1.27
1.00
0.98
1.01
0.99
1.00
0.99
1.00
0.99
2.02
1.01
2.99
1.02
1.03
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

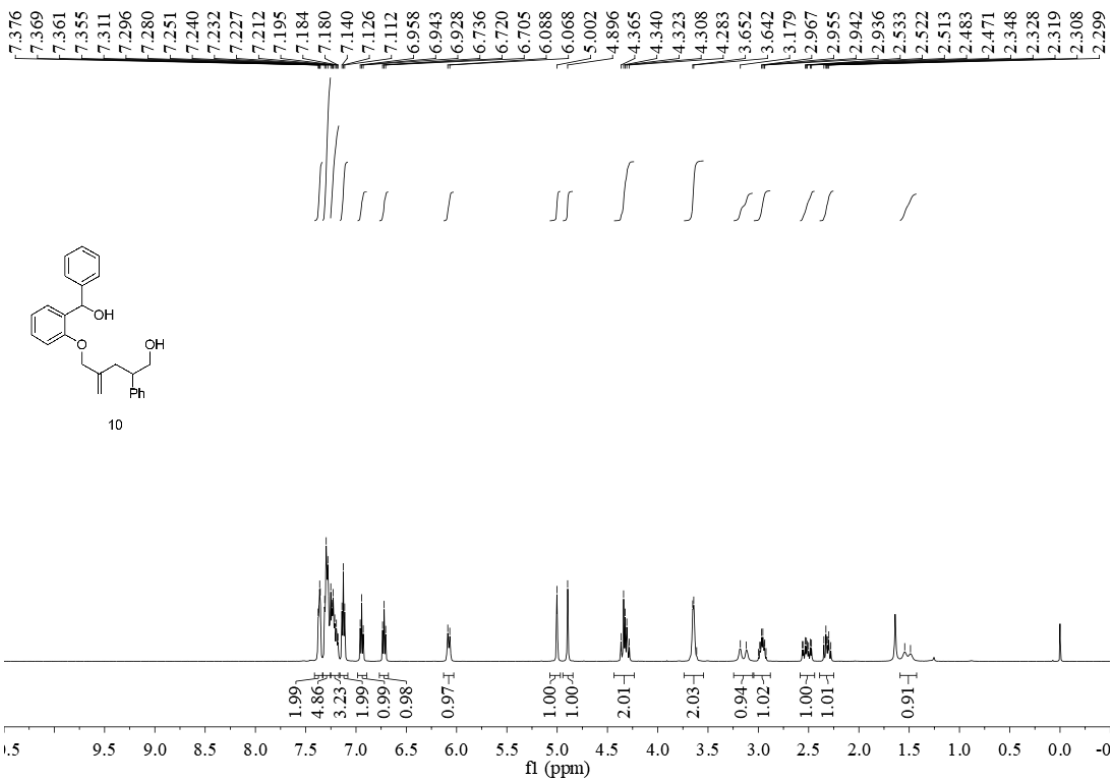

173.800
155.631
141.902
138.511
131.571
128.685
127.906
127.442
127.056
126.416
120.891
114.443
114.384
112.180
71.071
52.023
50.066
36.837

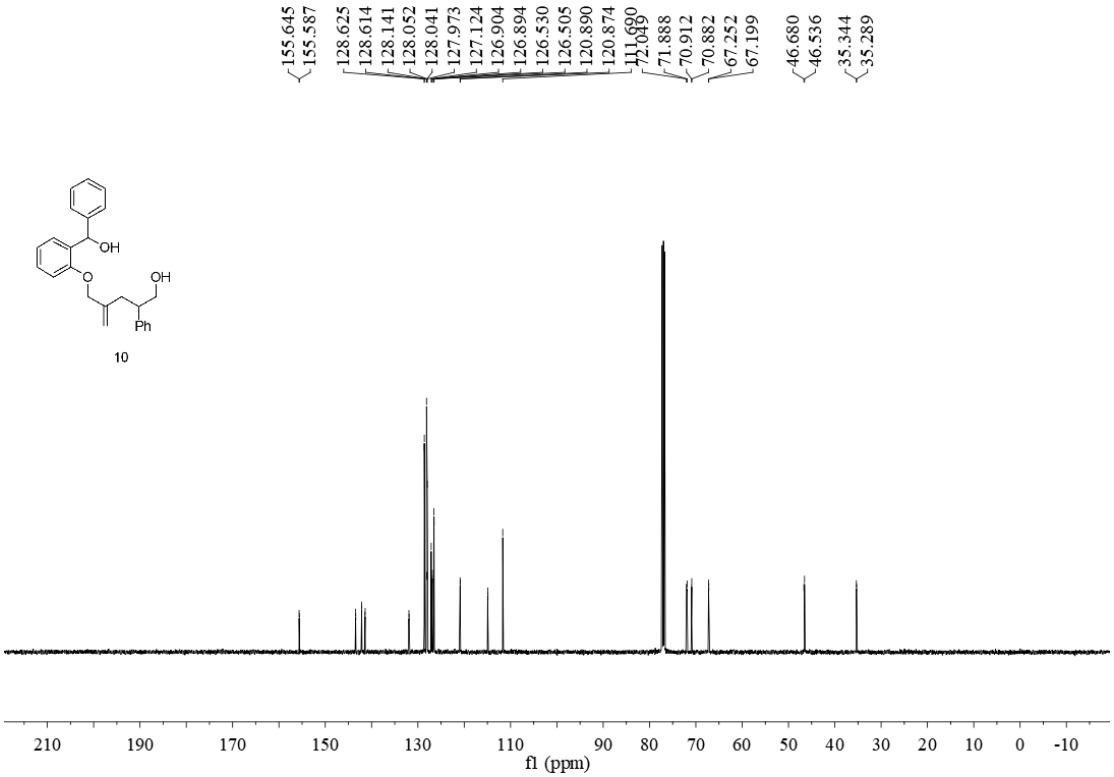

O
O
O
Ph

9

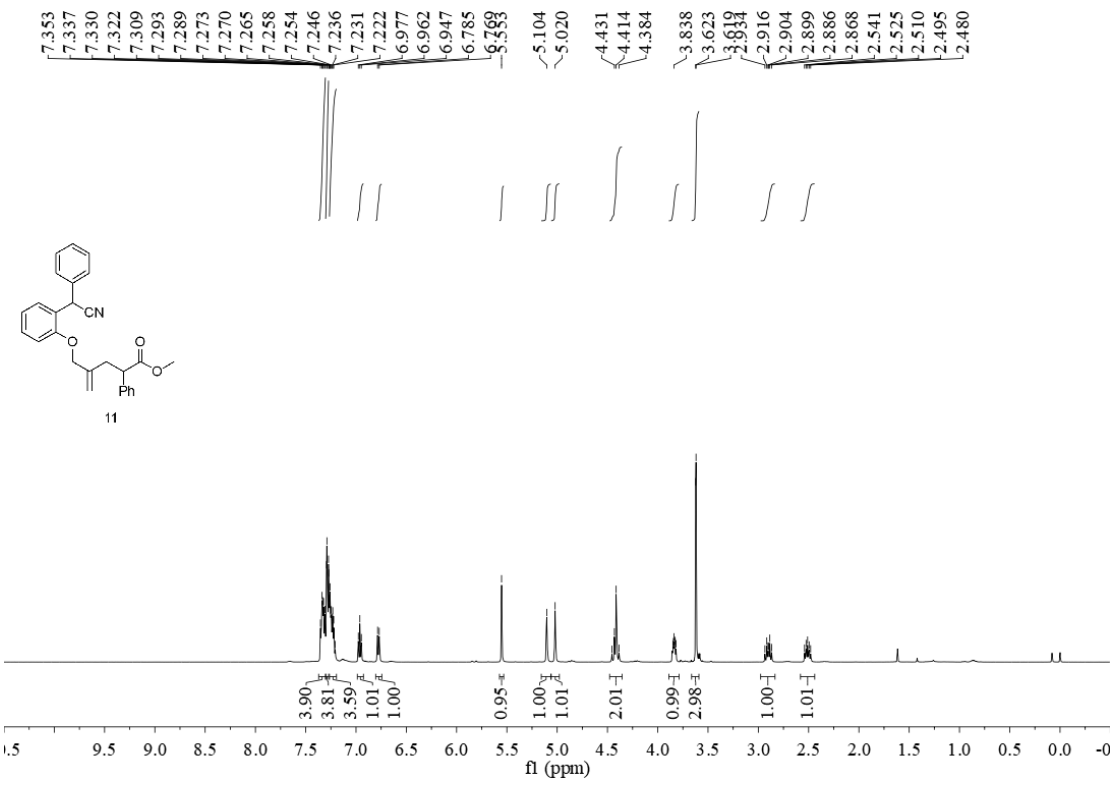

210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

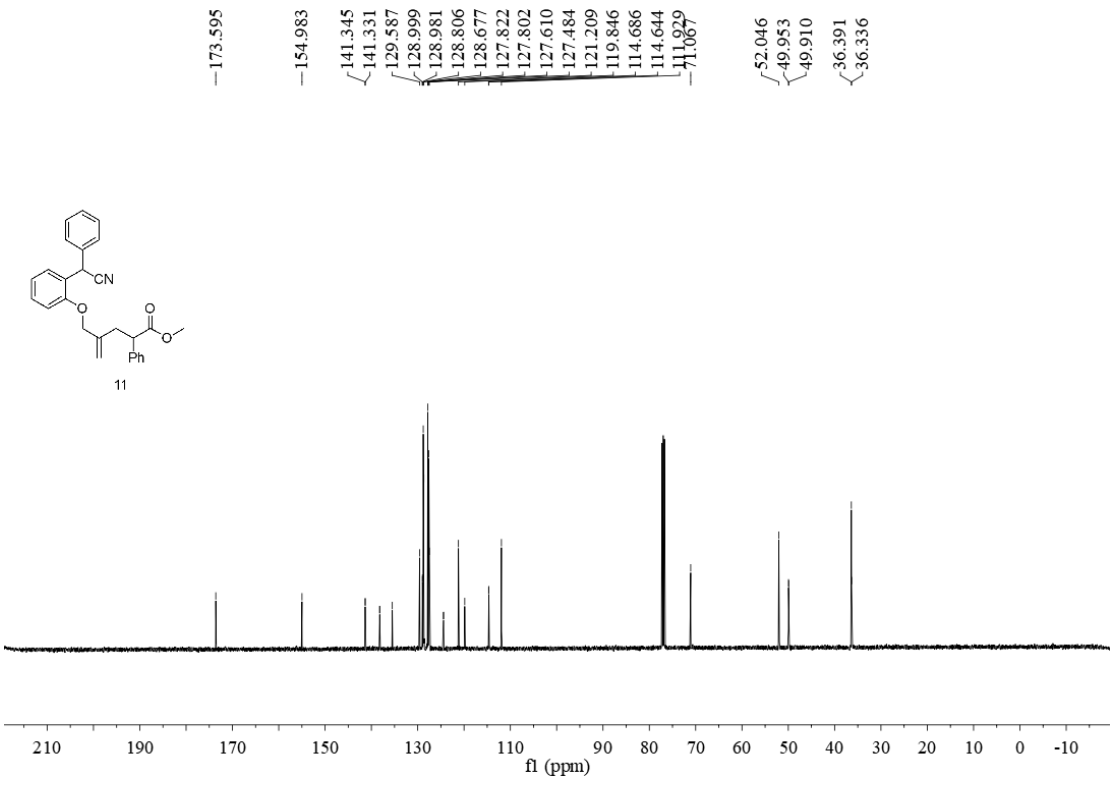
10:


7.376
7.369
7.361
7.355
7.311
7.296
7.280
7.251
7.240
7.232
7.227
7.212
7.195
7.184
7.180
7.140
7.126
7.112
6.958
6.943
6.928
6.736
6.720
6.705
6.088
6.068
5.002
4.896
4.365
4.340
4.323
4.308
4.283
3.652
3.642
3.179
2.967
2.955
2.942
2.936
2.533
2.522
2.513
2.483
2.471
2.348
2.328
2.319
2.308
2.299
OH
O
OH
Ph
10
1.99
4.86
3.23
1.99
0.99
0.98
0.97
1.00
1.00
2.01
2.03
0.94
1.02
1.00
1.01
0.91
fl (ppm)


155.645
155.587
128.625
128.614
128.141
128.052
128.041
127.973
127.124
126.904
126.894
126.530
126.505
120.890
120.874
111.690
72.049
71.888
70.912
70.882
67.252
67.199
46.680
46.536
35.344
35.289
OH
O
OH
Ph
10
fl (ppm)

11:


7.353
7.337
7.330
7.322
7.309
7.293
7.289
7.273
7.270
7.265
7.258
7.254
7.246
7.236
7.231
7.222
6.977
6.962
6.947
6.785
6.769
5.553
5.104
5.020
4.431
4.414
4.384
3.838
3.623
3.619
3.614
2.934
2.916
2.904
2.899
2.886
2.868
2.541
2.525
2.510
2.495
2.480
CN
O
O
O
Ph
11
3.90
3.81
3.59
1.01
1.00
0.95
1.00
1.01
2.01
0.99
2.98
1.00
1.01
fl (ppm)


173.595
154.983
141.345
141.331
129.587
128.999
128.981
128.806
128.677
127.822
127.802
127.610
127.484
121.209
119.846
114.686
114.644
111.929
111.067
52.046
49.953
49.910
36.391
36.336
CN
O
O
O
Ph
11
fl (ppm)

VII. Reference

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