Supporting Information

Visible-light-enabled aerobic synthesis of benzoin bis-ether from alkynes and alcohols

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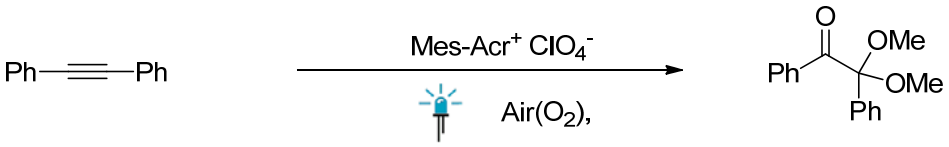
1. General Considerations

Unless otherwise stated, all reactions were set up in a clear pyrex glass tube and were stirred with a Teflon-coated magnetic stir bar. Analytical grade solvents and commercially available reagents were used to conduct the reactions. Reactions were monitored by thin layer chromatography (TLC), and the products were obtained by column chromatography on silica gel (200-300 mesh) or aluminum oxide neutral (200-300 mesh). NMR spectra were recorded on Bruker AM-400 MHz spectrometer for proton and carbon magnetic resonance spectra (^{1}H **NMR** and ^{13}C **NMR**) in the solvent of $CDCl_3$ as the internal standard (^{1}H NMR: TMS at 0.00 ppm, $CDCl_3$ at 7.27 ppm,). In reporting spectral data the format (δ) chemical shift (multiplicity, J values in Hz, integration) was used with the following abbreviations: s = singlet, d = doublet, t = triplet, q = quartet, quint = quintuplet, m = multiplet. Mass spectra were reported in units of m/z, and were obtained with esquire6000, TRACE DSQ and ORBITRAP ELITE. The procedures for the synthesis of alkynes are according to the reported literature.[1, 2, 3]

2. Condition Screening for the Catalytic Protocol.



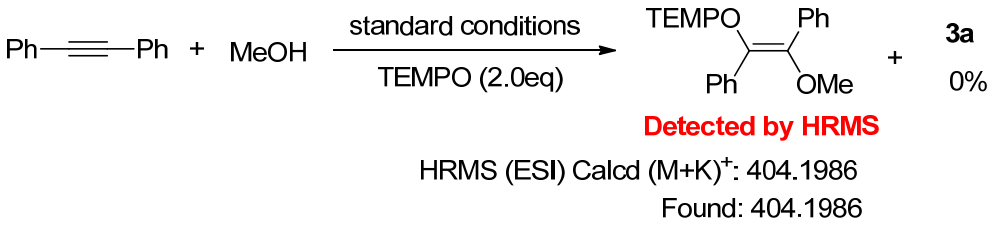
Entry	Catalysis	solvent	**3a**(%)[e]
1	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH	82
2 [d]	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH	N. R
3	-	MeOH	0
4	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH:CH_3CN=5:1	81
5	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH:CH_3CN=3:1	78
6 [e]	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH:CH_3CN=1:1	75
7	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH :CH_3CN =1:3	72
8	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH(20 equiv) and CH_3CN(0.5mL)	68
9	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH(10 equiv) and CH_3CN(0.5mL)	56
10	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH(8 equiv) and CH_3CN(0.5mL)	42

11	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH(4 equiv) and CH_3CN(0.5mL)	36
12	Mes-Acr$^+$ ClO_4^-(1.0 mol %)	MeOH	76
13	Mes-Acr$^+$ ClO_4^-(0.5 mol %)	MeOH	62
14[f]	Mes-Acr$^+$ ClO_4^-(1.5 mol %)	MeOH	0

[a] Conditions: **1a** (0.1 mmol, 1.0 equiv), *Mes-Acr$^+$ClO$_4^-$*(x mol %) in 1.2 mL solvent in air for 3.0 h under irradiation of 5 W blue LEDs at room temperature. [b] Isolated yields. [c] N. R = no reaction. [d] Reaction was carried out in the dark. [e] For 5.0 h. [f] Under an argon atmosphere.

3. Control Experiments.

3.1. TEMPO Radical Trapping.



In a 10 mL of Schlenk tube equipped with a rubber septum and magnetic stirring bar, diphenylacetylene (0.10 mmol), *Mes-Acr$^+$ClO$_4^-$*(1.5 mol %) and TEMPO (0.20 mmol) were added into the 10 mL vial in 1.2 mL MeOH. Under visible-light generated from 5W blue LEDs, the reaction mixture was stirred at 25 °C in the air. The reaction was monitored by TLC. The reaction mixture was stirred for 5.0 h at rt. The mixture was analyzed by HRMS.

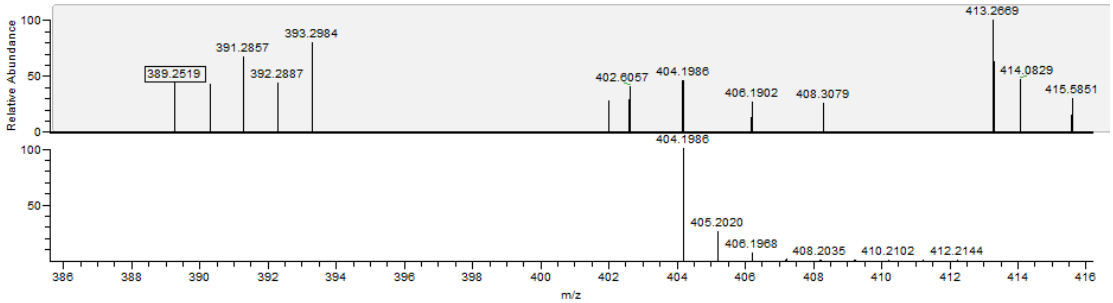
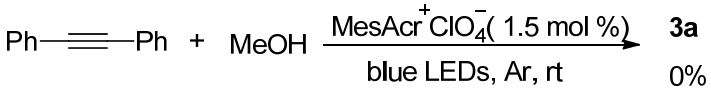


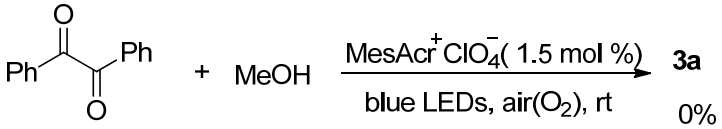
Figure S1. The resulte analyzed by HRMS

3.2. Under an Argon Atmosphere.



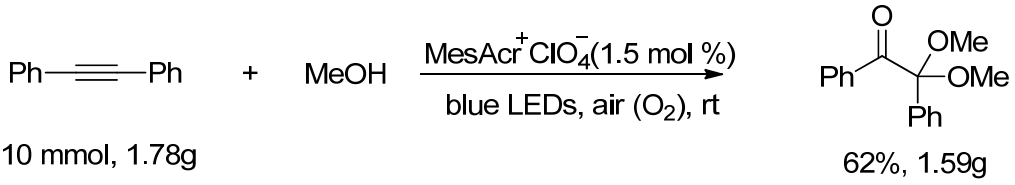
In a 10 mL of Schlenk tube equipped with a rubber septum and magnetic stirring bar, diphenylacetylene (0.10 mmol), *Mes-Acr*$^{+}$*ClO*$_4^{-}$(1.5 mol %) were added into the 10 mL vial in 1.2 mL MeOH. The mixture was bubbled with a stream of argon for 20 min via a syringe needle under visible-light generated from 5W blue LEDs, the reaction mixture was stirred for 3.0 h at 25 °C. We did not detected the product of 2, 2-dimethoxy-2-phenylacetophenone.

3.3. Verify Intermediate of Benzil.



In a 10 mL of Schlenk tube equipped with a rubber septum and magnetic stirring bar, benzil (0.10 mmol), *Mes-Acr*$^{+}$*ClO*$_4^{-}$(1.5 mol %) were added into the 10 mL vial in 1.2 mL MeOH. Under visible-light generated from 5W blue LEDs, the reaction mixture was stirred at 25 °C in the air. The reaction was monitored by TLC. We did not detected the product of 2, 2-Dimethoxy-2-phenylacetophenone.

4. Gram-scale synthesis of DMPA

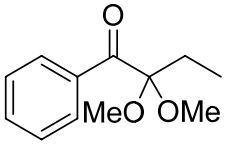


In a 100 mL clear pyrex glass flask with a rubber septum and magnetic stirring bar. alkynes (10 mmol,), *Mes-Acr*$^{+}$*ClO*$_4^{-}$(1.5 mol %) were added into the 10 mL vial in 50 mL MeOH as solvent Under visible-light generated from 5W blue LEDs, the reaction mixture was stirred at 25 °C in the air. The reaction was monitored by TLC, after completion of the reaction, the solvent was removed in vacuo or extraction and the residue was purified by chromatography column on silica

gel by petroleum ether/EtOAc to give the desired product**.**

5. General procedures to synthesize benzoin bis-ethers

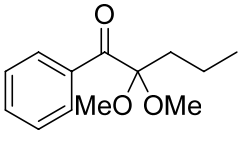
In a 10 mL of Schlenk tube equipped with a rubber septum and magnetic stirring bar. alkynes (0.10 mmol,), *Mes-Acr*$^{+}$*ClO*$_4^{-}$(1.5 mol %) were added into the 10 mL vial in relevant alcohols as solvent (If the solubility is not good, some CH_3CN need to add). Under visible-light generated from 5W blue LEDs, the reaction mixture was stirred at 25 °C in the air. The reaction was monitored by TLC, after completion of the reaction, the solvent was removed in vacuo or extraction and the residue was purified by chromatography column on silica gel by petroleum ether/EtOAc to give the desired product**.**



2,2-dimethoxy-1-phenylbutan-1-one (2a)

R$_f$ (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 80:1.

oil (15.8 mg, 76%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.21 (d, J=8.0Hz, 2H), 7.56 (t, J=7.8Hz, 1H), 7.42 (d. J= 8.0 Hz, 2H), 3.32 (s, 6H), 2.05 (q, J=7.8Hz, 2H), 0.74 (t, J=7.8Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.1, 135.1, 133.0, 129.8, 128.4, 105.4, 49.6, 27.0, 7.3. **HRMS (ESI, m/z):** Calculated for $[C_{12}H_{16}O_3]$ $(M+Na)^+$ 231.0992, found 231.0990.

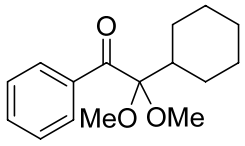


2,2-dimethoxy-1-phenylpentan-1-one (2b)

R$_f$ (petroleum ether/EtOAc 10:1): 0.5. **Eluent**: petroleum ether/EtOAc: 80:1

oil(16.2mg, 73%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.20 (d, J=8.0Hz, 2H), 7.54 (t, J=7.6Hz, 1H),

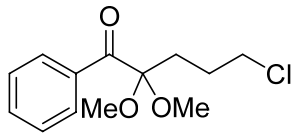
7.44 (d, J= 8.0Hz, 2H), 3.32 (s, 6H), 2.00-1.96 (m, 2H), 1.22-1.14 (m, 2H), 0.81 (t, J=7.6Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.1, 135.1, 133.0, 130.0, 128.3, 105.0, 50.0, 36.3, 16.4, 14.1. **HRMS (ESI, m/z):** Calculated for $[C_{13}H_{18}O_3]$ $(M+Na)^+$, 245.1148 found 245.1150.



2-cyclohexyl-2,2-dimethoxy-1-phenylethan-1-one (2c)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 80:1

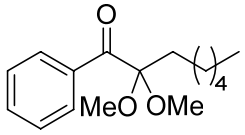
oil (18.1mg, 69%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.18 (d, J=8.0Hz,s, 2H), 7.20 (t, J=7.2Hz, 1H), 7.46 (d, J=7.2, 2H), 3.33 (s, 6H), 2.03-1.99 (m, 1H), 1.98-1.95 (m, 2H), 1.93-1.89 (m, 2H), 1.76-1.58 (m, 1H), 1.22-1.15(m, 2H), 1.13-0.97 (m, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.7, 137.4, 132.6, 130.6, 128.0, 107.9, 49.8, 42.9, 27.8, 26.59, 26.1. **HRMS (ESI, m/z):** Calculated for $[C_{16}H_{22}O_3]$ $(M+Na)^+$, 285.1461 found 285.1463.



5-chloro-2,2-dimethoxy-1-phenylpentan-1-one (2d)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 80:1

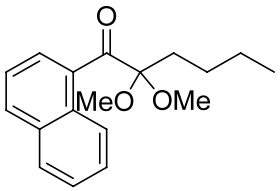
Oil (19.2mg, 75%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.21 (d, J=8.0Hz, 2H), 7.20 (t, J=8.4Hz, 1H), 7.46 (d, J= 8.0Hz, 2H), 3.44 (t, J=6.4 Hz, 2H), 3.34 (s, 6H), 2.21-2.17 (m, 2H), 1.68-1.61 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.7, 134.8, 133.2, 129.9, 128.5, 104.6, 49.7, 44.6, 31.4, 26.3. **HRMS (ESI, m/z):** Calculated for $[C_{13}H_{17}ClO_3]$ $(M+Na)^+$, 279.0758 found 279.0760.



2,2-dimethoxy-1-phenyloctan-1-one (2e)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 80:1

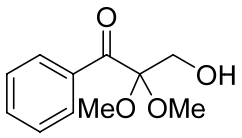
Oil (19.2 mg, 72%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.20 (d, J=8.0Hz, 2H), 7.55 (t, J=8.4Hz, 1H), 7.46 (d, J= 8.0Hz, 2H), 3.31 (s, 6H), 2.02-1.98 (m, 2H), 1.21-1.15 (m, 8H), 0.79 (t, J=6.8Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.1, 135.1, 133.0, 130.0, 128.3, 105.0, 50.0, 34.1, 31.3, 29.1, 22.8, 22.4, 13.9. **HRMS (ESI, m/z):** Calculated for $[C_{16}H_{24}O_3]$ $(M+Na)^+$, 287.1618 found 287.1620.



2,2-dimethoxy-1-(naphthalen-1-yl)hexan-1-one (2f)

R_f (petroleum ether/EtOAc 10:1): 0.46. **Eluent**: petroleum ether/EtOAc: 80:1

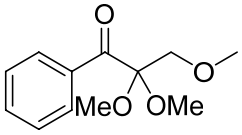
oil (21.7mg, 76%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.32 (d, J=8.8Hz,1H), 8.22 (d, J= 7.6 Hz, 1H) 7.98 (d, J=8.4Hz, 1H), 7.88 (d, J=7.2Hz, 1H), 7.59-7.47(m, 3H), 3.37(s, 6H), 2.04-2.00 (m, 2H), 1.24-1.16 (m, 4H), 0.71(t, J=7.2Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 200.9, 134.0, 132.3, 130.8, 128.6, 127.9, 127.7, 126.2, 125.4, 124.0, 104.9, 49.7, 33.8, 25.0, 22.6, 13.6. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{22}O_3]$ $(M+Na)^+$, 309.1461 found 309.1462.



3-hydroxy-2,2-dimethoxy-1-phenylpropan-1-one (2g)

R_f (petroleum ether/EtOAc 5:1): 0.40. **Eluent**: petroleum ether/EtOAc: 30:1

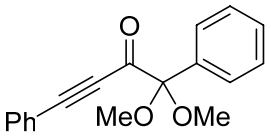
oil(11.7mg, 56%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.32 (d, J=7.6Hz, 2H), 7.98 (t, J=7.6Hz, 1H), 8.22 (dd, J= 7.6Hz, 0.8 Hz, 1H), 4.00 (s, 2H), 3.41 (s, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.8, 135.0, 133.3, 129.9, 128.4, 103.7, 62.7, 50.3. **HRMS (ESI, m/z):** Calculated for $[C_{11}H_{14}O_4]$ $(M+Na)^+$, 233.0874. found 233.0875.



2,2,3-trimethoxy-1-phenylpropan-1-one (2h)

R_f (petroleum ether/EtOAc 7:1): 0.4. **Eluent**: petroleum ether/EtOAc: 50:1

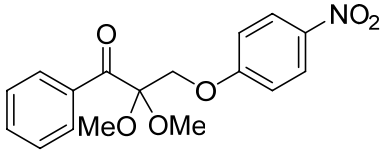
oil(15.4mg, 69%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.13 (d, J=7.6Hz, 2H), 7.98 (t, J=7.2Hz, 1H), 8.22 (d, J= 7.6 Hz, 1H), 3.77 (s, 2H), 3.37 (s, 6H), 3.27 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.8, 136.2, 132.7, 129.9, 128.0, 103.3, 72.1, 59.5, 49.8. **HRMS (ESI, m/z):** Calculated for $[C_{12}H_{16}O_4]$ $(M+Na)^+$, 247.0941 found 247.0942.



1,1-dimethoxy-1,4-diphenylbut-3-yn-2-one (2i)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 70:1

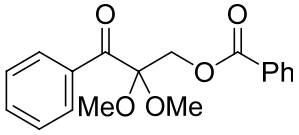
oil(18.4mg, 66%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.69-7.67 (m, 2H), 7.52-7.50 (m, 2H), 7.47-7.34 (m, 6H), 3.37 (s, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.3, 135.3, 133.2, 130.9, 129.3, 128.6, 128.5, 127.6, 119.9, 104.1, 94.8, 86.4, 50.6. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{16}O_3]$ $(M+Na)^+$, 303.0992 found 303.0995.



2,2-dimethoxy-3-(4-nitrophenoxy)-1-phenylpropan-1-one (2j)

R_f (petroleum ether/EtOAc 5:1): 0.4. **Eluent**: petroleum ether/EtOAc: 30:1

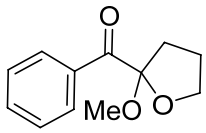
oil(15.2mg, 46%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.20-8.14 (m, 4H), 7.57 (t, J=7.6Hz, 1H), 7.46 (d, J= 7.6Hz, 2H), 7.89 (d, J=9.6Hz, 2H), 4.41 (s, 2H), 3.43 (s, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.1, 162.1, 142.1, 136.1, 133.1, 130.1, 128.2, 126.0, 125.8, 114.6, 102.8, 67.5, 50.1. **HRMS (ESI, m/z):** Calculated for $[C_{17}H_{17}NO_6]$ $(M+Na)^+$, 354.0948 found 354.0950.



2,2-dimethoxy-3-oxo-3-phenylpropyl benzoate (2k)

R_f (petroleum ether/EtOAc 7:1): 0.40. **Eluent**: petroleum ether/EtOAc: 60:1

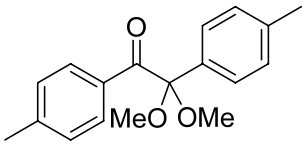
oil(16.3mg, 52%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.21 (d, J=8.0Hz, 2H), 7.98 (d, J=8.0Hz, 2H), 7.58-7.56(m, 1H), 7.55-7.51(m, 1H), 7.36 (d, J= 7.6Hz, 1H), 7.36 (d, J= 8.0Hz, 1H), 4.72 (s, 2H), 3.43 (s, 6H), 3.27 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.3, 165.5, 135.7, 133.2, 133.1, 130.0, 129.8, 129.2, 128.3, 102.7, 63.1, 50.2. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{18}O_5]$ $(M+Na)^+$, 337.1046 found 337.1045.



(2-methoxytetrahydrofuran-2-yl)(phenyl)methanone (2l)

R_f (petroleum ether/EtOAc 9:1): 0.45. **Eluent**: petroleum ether/EtOAc: 70:1

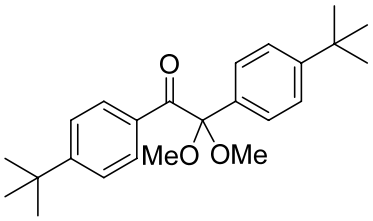
oil (9.0 mg, 44%) **^{1}H NMR** (400 MHz, CDCl3) δ 8.13 (d, J=8.0Hz, 2H), 7.98 (t, J=7.2Hz, 1H), 8.22 (d, J= 8.0 Hz, 2H), 4.18-4.07 (m, 2H), 3.25 (s, 3H), 2.34-2.23 (m, 2H), 2.22-2.13 (m, 1H), 2.04-2.00 (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 160.0, 134.3, 133.2, 129.4, 128.3, 109.8, 68.6, 50.9, 35.4, 24.4. **HRMS (ESI, m/z):** Calculated for $[C_{12}H_{14}O_3]$ $(M+Na)^+$, 229.0835 found 229.0836.



2,2-dimethoxy-1,2-di-p-tolylethan-1-one (2m)[4]

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 50:1

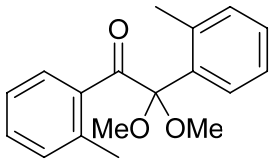
oil(22.1 mg, 78%) ^{1}H NMR (400 MHz, CDCl3) δ 7.80 (d, J=8.0Hz 2H), 7.49 (d, J=8.4Hz, 2H), 7.15 (d, J=8.0Hz, 2H), 7.10 (d, J=8.4Hz, 2H), 3.21 (s,6H), 2.32 (s, 3H), 2.31 (s, 3H) . ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.0, 139.3, 136.7, 135.1, 135.0, 131.7, 131.6, 130.9, 129.4, 128.7, 128.4, 125.6, 124.7, 102.7, 49.7, 21.0, 19.9. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{20}O_3]$ $(M+Na)^+$, 307.1305 found 307.1306.



1,2-bis(4-(tert-butyl)phenyl)-2,2-dimethoxyethan-1-one (2n)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 80:1

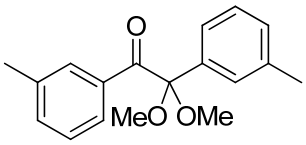
oil(29.4mg, 80%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.04 (d, J=8.8Hz, 2H), 7.54 (d, J=8.4Hz, 2H), 7.36 (d, J=8.8Hz, 2H), 7.33 (d, J=8.4Hz, 2H), 3.20 (s,6H), 1.29 (s, 9H), 1.28 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 194.9, 156.4, 151.7, 133.8, 131.7, 130.1, 126.6, 125.4, 125.0, 103.8, 50.0, 35.0, 34.6, 31.2, 31.0. **HRMS (ESI, m/z):** Calculated for $[C_{24}H_{32}O_3]$ $(M+Na)^+$, 391.2244 found 391.2245.



2,2-dimethoxy-1,2-di-o-tolylethan-1-one (2o)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 80:1

oil(20.4 mg, 72%) **^{1}H NMR** (400 MHz, CDCl3) δ 7.89 (d, J=6.0Hz, 2H), 7.74 (d, J=5.2Hz, 1H), 7.19 (d, J=5.2Hz, 1H), 7.15 (d, J= 5.2Hz, 1H), 7.12 (d, J=5.2Hz, 2H), 7.01 (d, J=5.2Hz, 1H), 6.97 (d, J= 5.2Hz, 1H), 3.25 (s,6H), 2.40 (s, 3H), 2.23 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.0, 139.3, 136.7, 135.1, 135.0, 131.7, 131.6, 131.0, 129.4, 128.7, 128.4, 125.6, 124.7, 102.7, 49.7, 21.0, 19.9. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{20}O_3]$ $(M+Na)^+$, 307.1305 found 307.1307.

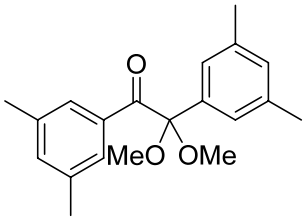


2,2-dimethoxy-5-methyl-3-methylene-1-(m-tolyl)hex-4-en-1-one (2p)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc:80:1

oil(21.3 mg, 75%) **^{1}H NMR** (400 MHz, CDCl3) δ 7.86 (s, 2H), 7.44 (d, J=4.8Hz, 1H), 7.39 (s,

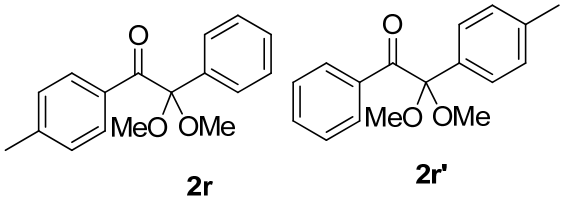
1H), 7.24 (d, J=5.2Hz, 2H), 7.16 (d, J= 8.0Hz, 1H), 7.10 (d, J=5.2Hz, 1H), 3.21 (s, 6H), 2.32 (s, 3H), 2.31 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.0, 139.3, 136.7, 135.1, 135.0, 131.7, 131.6, 130.9, 129.4, 128.7, 128.4, 125.6, 124.7, 102.7, 49.7, 21.0, 19.9. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{20}O_3]$ $(M+Na)^+$, 307.1305 found 307.1306.



1,2-bis(3,5-dimethylphenyl)-2,2-dimethoxyethan-1-one (2q)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 80:1

oil(22.7 mg, 73%) **^{1}H NMR** (400 MHz, CDCl3) δ 7.69 (s, 2H), 7.23 (s, 2H), 7.07 (s, 1H), 6.93 (s, 1H), 3.20 (s, 6H), 2.29 (s, 6H), 2.28 (s, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.6, 138.0, 137.5, 136.8, 134.5, 134.4, 130.4, 127.8, 124.6, 103.7, 50.0, 21.3, 21.2. **HRMS (ESI, m/z):** Calculated for $[C_{20}H_{24}O_3]$ $(M+Na)^+$, 335.1618 found 335.1620.



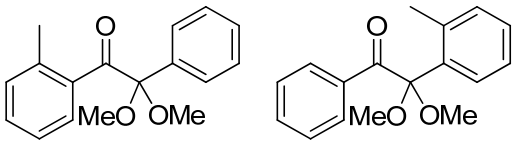
2r **2r'**

2r:2r'>10:1

2,2-dimethoxy-2-phenyl-1-(p-tolyl)ethanone (2r)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 80:1

oil(20.5 mg, 76%) **^{1}H NMR** (400 MHz, CDCl3) δ 7.99 (d, J=8.0Hz, 2H), 7.44 (d, J=8.0Hz, 2H), 7.37-7.30 (m, 3H), 7.10 (d, J=8.0Hz, 2H), 3.22 (s, 6H), 2.32 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 194.6, 143.7, 137.1, 130.2, 128.9, 128.8, 128.5, 126.9, 103.5, 50.0, 21.6. **HRMS (ESI, m/z):** Calculated for $[C_{17}H_{18}O_3]$ $(M+Na)^+$, 293.1148 found 293.1150.



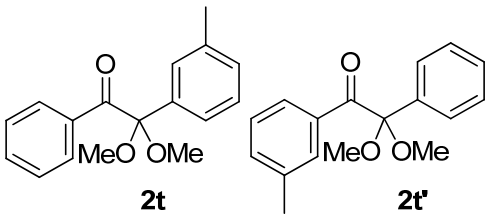
2s **2s'**

2s : 2s >10:1

2,2-dimethoxy-2-phenyl-1-(o-tolyl)ethanone (2s)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 80:1

oil(19.7mg, 73%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.60 (d, J=8.0Hz, 1H), 7.44 (d, J= 7.6Hz, 2H), 7.35-7.30 (m, 3H), 7.25 (t, J=6.4Hz, 1H), 7.10 (d, J=7.6Hz, 1H), 7.07 (t, J=7.6Hz, 2H), 3.23 (s, 6H), 2.17 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 199.4, 138.2, 136.5, 136.3, 131.2, 130.5, 128.9, 128.5, 128.4, 127.2, 124.6, 104.5, 50.2, 20.4. **HRMS (ESI, m/z):** Calculated for $[C_{17}H_{18}O_3]$ $(M+Na)^+$, 293.1148 found 293.1148.



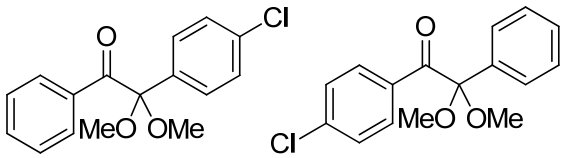
2t **2t'**

2t : 2t'=1.6:1

2,2-dimethoxy-2-phenyl-1-(m-tolyl)ethanone (2t)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 80:1

oil(20 mg, 74%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.05 (d, J=8.0Hz, 1.5H), 7.87 (d, J=7.6Hz, 0.7H), 7.62-7.60 (m, 1.8H), 7.44 (d, J=8.0Hz, 2.5H), 7.37-7.32 (m, 2.6H), 7.30-7.22 (m, 5.4H), 7.18 (d, J=6.4Hz, 1.9H), 7.15 (d, J=8.0Hz, 1.3H), 7.11 (d, J=7.6Hz, 0.75H), 3.22 (s, 7.46H), 3.21 (s, 4.66H), 2.30(s, 2.35H)，2.30(s, 3.65H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.3, 138.2, 137.8, 137.0, 136.7, 134.2, 133.6, 132.8, 130.4, 130.0, 129.7, 128.8, 128.5, 128.4, 128.1, 127.9, 127.4, 127.2, 126.9, 124.0, 103.6, 50.0, 21.3. **HRMS (ESI, m/z):** Calculated for $[C_{17}H_{18}O_3]$ $(M+Na)^+$, 293.1148 found 293.1150.

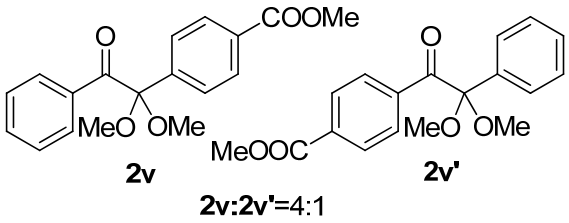


2u : 2u'=1.2:1

2-(4-chlorophenyl)-2,2-dimethoxy-1-phenylethanone (2u)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 80:1

oil(22.3mg, 77%) **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.05-8.01 (m, 4H), 7.60-7.54 (m, 4H), 7.47-7.43 (m, 1.2H), 7.38-7.31 (m, 7.1H), 7.29-7.26 (m, 1.8H), 3.22 (s, 6H), 3.21 (s, 5.46H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 194.8, 194.0, 139.4, 136.6, 135.5, 135.0, 134.1, 133.1, 132.5, 131.5, 129.9, 129.1, 128.8, 128.6, 128.5, 128.4, 128.2, 126.8, 103.5, 103.3, 50.1, 50.1. **HRMS (ESI, m/z):** Calculated for $[C_{16}H_{15}ClO_3]$ $(M+Na)^+$, 313.0602 found 313.0605.

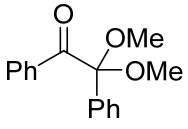


2v:2v'=4:1

methyl 4-(1,1-dimethoxy-2-oxo-2-phenylethyl)benzoate (2v)

R_f (petroleum ether/EtOAc 5:1): 0.50. **Eluent**: petroleum ether/EtOAc: 30:1

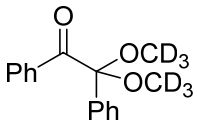
oil(24.8 mg, 79%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.11-8.09 (m, 0.5H), 8.08-8.02 (m, 4H), 7.95 (d, J=8.0Hz, 0.5H), 7.20-7.00 (m, 2.0H), 7.61-7.59 (m, 0.5H), 7.50-7.42 (m, 1.24H), 7.38-7.30(m, 0.5H), 7.29-7.27 (m, 2.3H), 3.90 (0.8H), 3.89 (3H), 3.24 (6H), 3.24 (1.5H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 194.9, 194.5, 166.5, 166.2, 141.8, 134.0, 133.1, 130.7, 130.1, 129.9, 129.8, 129.3, 129.1, 128.6, 128.4, 128.2, 127.0, 126.9, 103.6, 103.3, 52.3, 52.2, 50.2, 50.1. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{18}O_5]$ $(M+Na)^+$ 337.1046, found 337.1045.



2,2-dimethoxy-1,2-diphenylethan-1-one (3a)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 70:1

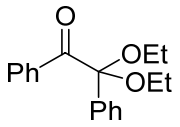
oil(20.9 mg, 82%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.06 (d, J=7.2Hz, 2H), 7.62 (d, J=7.2Hz, 2H), 7.42 (t. J=7.2Hz, 1H), 7.36-7.28 (m, 5H), 3.23 (s, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.1, 136.9, 134.3, 132.8, 130.0, 128.9, 128.5, 128.1, 126.9, 103.6, 50.0. **HRMS (ESI, m/z):** Calculated for $[C_{16}H_{16}O_3]$ $(M+Na)^+$ 279.0992, found 279.0990.



2,2-bis(methoxy-d3)-1,2-diphenylethan-1-one (3b)

R_f (petroleum ether/EtOAc 10:1): 0.50. **Eluent**: petroleum ether/EtOAc: 70:1

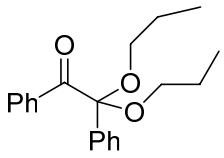
oil(21.2 mg, 81%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.06 (d, J=8.0Hz, 2H), 7.20 (d. J=7.6Hz, 2H), 7.36 (m, 1H), 7.37-.27 (m, 5H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.2, 136.9, 134.2, 132.8, 130.0, 128.9, 128.5, 128.1, 126.9, 103.5, 49.2(t. J=21Hz). **HRMS (ESI, m/z):** Calculated for $[C_{16}H_{10}D_6O_3]$ $(M+Na)^+$ 285.1368, found 285.1368.



2,2-diethoxy-1,2-diphenylethan-1-one (3c)

R_f (petroleum ether/EtOAc 10:1): 0.46. **Eluent**: petroleum ether/EtOAc: 70:1

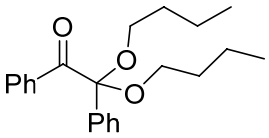
oil (22.5 mg, 79%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.06 (d, J=7.2Hz, 2H), 7.65 (d, J=6.8Hz, 2H), 7.42 (t. J=7.2Hz, 1H), 7.36-7.27 (m, 5H), 3.46-3.38 (m, 4H), 1.19 (t. J=7.2Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.5, 137.8, 134.5, 132.6, 130.0, 128.7, 128.4, 128.0, 126.9, 103.1, 58.2, 15.0. **HRMS (ESI, m/z):** Calculated for $[C_{18}H_{20}O_3]$ $(M+Na)^+$ 307.1305, found 307.1306.



1,2-diphenyl-2,2-dipropoxyethan-1-one (3d)

R_f (petroleum ether/EtOAc 10:1): 0.6. **Eluent**: petroleum ether/EtOAc:100:1

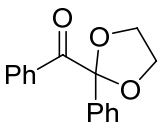
oil(23.7 mg, 76%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.04 (d, J=8.0Hz, 2H), 7.65 (d, J=7.6Hz, 2H), 7.42 (t, J=7.6Hz, 1H), 7.36-7.32 (m, 2H), 7.29-7.26 (m, 3H), 3.36-3.26 (m, 4H), 1.65-1.56 (m, 4H), 0.90 (t, J=7.2Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.5, 138.0, 134.6, 132.6, 130.0, 128.6, 128.4, 127.9, 126.9, 102.7, 63.9, 22.8, 10.7. **HRMS (ESI, m/z):** Calculated for $[C_{20}H_{24}O_3]$ $(M+Na)^+$ 335.1618, found 335.1619.



2,2-dibutoxy-1,2-diphenylethan-1-one (3e)

R_f (petroleum ether/EtOAc 10:1): 0.60. **Eluent**: petroleum ether/EtOAc: 100:1

oil(25.5 mg, 75%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.02 (d, J=7.6Hz, 2H), 7.62 (d, J=7.2Hz, 2H), 7.42 (t, J=7.2Hz, 1H), 7.34 (d, J=7.2Hz, 2H), 7.32-7.26 (m, 3H), 3.39-3.29 (m, 4H), 1.60-1.53 (m, 4H), 1.41-1.32 (m, 4H), 0.86 (t, J=7.2Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.6, 138.0, 134.7, 132.6, 130.0, 128.6, 128.4, 127.9, 126.9, 102.9, 62.1, 31.7, 19.4, 13.8. **HRMS (ESI, m/z):** Calculated for $[C_{22}H_{28}O_3]$ $(M+Na)^+$ 363.1931, found 363.1930.

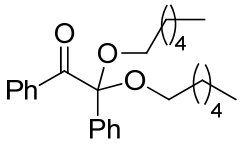


phenyl(2-phenyl-1,3-dioxolan-2-yl)methanone (3f)

R_f (petroleum ether/EtOAc 6:1): 0.45. **Eluent**: petroleum ether/EtOAc: 40:1

oil(14.9 mg, 59%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.04 (d, J=8.0Hz, 2H), 7.61 (d, J=7.6Hz, 2H), 7.46 (t, J=7.6Hz, 1H), 7.40-7.32 (m, 5H), 4.22-4.17 (m, 2H), 4.16-4.12 (m, 2H). **^{13}C NMR** (100

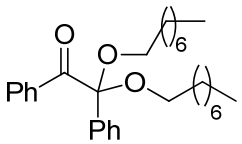
MHz, $CDCl_3$) δ 194.8, 137.5, 133.7, 133.0, 130.5, 129.2, 128.7, 128.1, 125.6, 109.3, 65.8. **HRMS (ESI, m/z):** Calculated for $[C_{16}H_{14}O_3]$ $(M+Na)^+$ 277.0835, found 277.0836.



2,2-bis(hexyloxy)-1,2-diphenylethan-1-one (3g)

R_f (petroleum ether/EtOAc 10:1): 0.60. **Eluent**: petroleum ether/EtOAc: 100:1

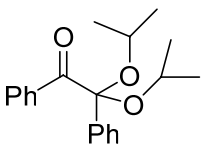
oil(28.9 mg, 73%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.03 (d, J=7.6Hz, 2H), 7.63 (d, J=7.2Hz, 2H), 7.40 (t, J=7.2Hz, 1H), 7.32 (d, J=7.6Hz, 2H), 7.30-7.26 (m, 3H), 3.38-3.28 (m, 4H), 1.63-1.54 (m, 4H), 1.33-1.21 (m, 12H), 0.86 (t, J=7.2Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.6, 138.0, 134.7, 132.6, 130.0, 128.6, 128.4, 127.9, 126.9, 102.8, 62.4, 31.6, 29.5, 25.9, 22.6, 14.0. **HRMS (ESI, m/z):** Calculated for $[C_{26}H_{36}O_3]$ $(M+Na)^+$ 419.2557, found 419.2556.



2,2-bis(octyloxy)-1,2-diphenylethan-1-one (3h)

R_f (petroleum ether/EtOAc 10:1): 0.55. **Eluent**: petroleum ether/EtOAc: 100:1

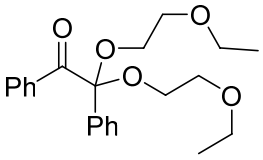
Oil (29.9mg, 69%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.03 (d, J=8.0Hz, 2H), 7.63 (d, J=7.6Hz, 2H), 7.40 (t, J=7.6Hz, 1H), 7.33 (d, J=7.2Hz, 2H), 7.32-7.26 (m, 3H), 3.38-3.28 (m, 4H), 1.61-1.54 (m, 4H), 1.29-1.23 (m, 20H), 0.87 (t, J=6.8Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.6, 138.0, 134.6, 132.6, 130.0, 128.6, 128.4, 127.9, 126.9, 102.8, 62.4, 31.8, 29.5, 29.3, 29.2, 26.2, 22.6, 14.1. **HRMS (ESI, m/z):** Calculated for $[C_{30}H_{44}O_3]$ $(M+Na)^+$ 475.3183, found 475.3181.



2,2-diisopropoxy-1,2-diphenylethan-1-one (3i)

R_f (petroleum ether/EtOAc 10:1): 0.45. **Eluent**: petroleum ether/EtOAc: 70:1

oil(18.7 mg, 60%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.93 (d, J=7.2Hz, 2H), 7.53 (d, J=7.2Hz, 2H), 7.36-7.34 (m, 1H), 7.32-7.27 (m, 2H), 7.26-.19 (m, 3H), 4.16-4.6 (m, 2H), 1.04 (d, J=6.4Hz, 3H), 0.99(d, J=6.4Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.9, 139.7, 135.0, 132.2, 130.6, 128.5, 128.2, 127.7, 127.0, 101.7, 65.8, 23.8, 23.6. **HRMS (ESI, m/z):** Calculated for $[C_{20}H_{24}O_3]$ $(M+Na)^+$ 335.1618, found 335.1620.



2,2-bis(2-ethoxyethoxy)-1,2-diphenylethan-1-one (3j)

R_f (petroleum ether/EtOAc 10:1): 0.40. **Eluent**: petroleum ether/EtOAc: 80:1

Oil (24.1 mg, 65%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.09 (d, J=8.0Hz, 2H), 7.63 (d, J=6.8Hz, 2H), 7.43-7.39 (m, 1H), 7.35-7.32 (m, 2H), 7.30-7.26 (m, 3H), 3.66-3.55 (m, 8H), 3.52-3.46 (m, 4H), 1.18 (t, J=6.8Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.0, 137.2, 134.4, 132.8, 130.2, 128.9, 128.5, 128.0, 127.0, 103.2, 69.3, 66.4, 61.9, 15.2. **HRMS (ESI, m/z):** Calculated for $[C_{22}H_{28}O_5]$ $(M+Na)^+$ 395.1829, found 395.1830.

6. Follow-up functionalization reactions of 3a.

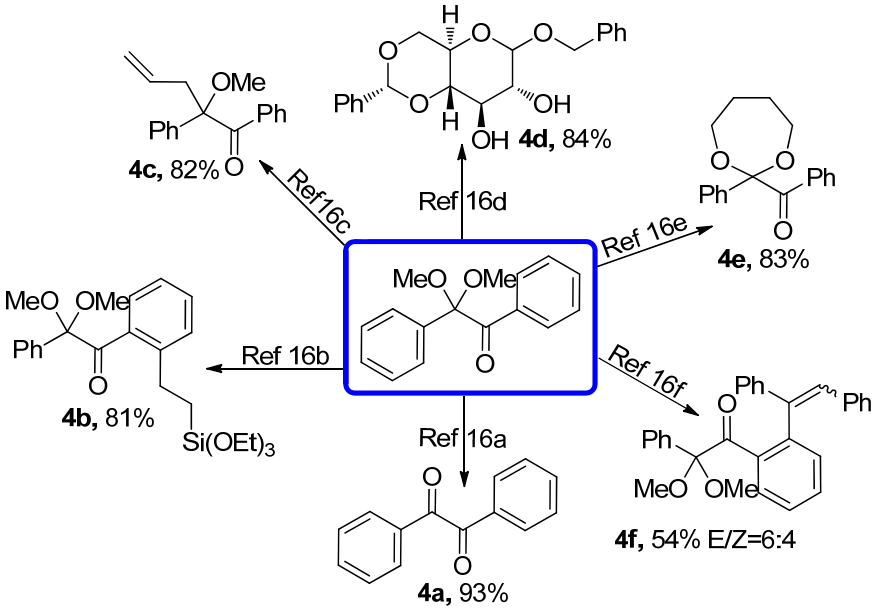
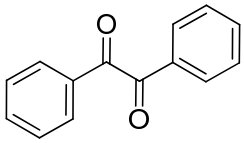


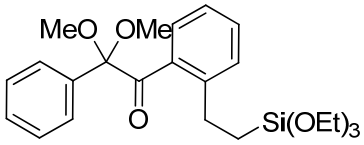
Figure S2. The further synthetic application of the product **3a**.

In Figure S2, the general procedure of **4a-4f** have been reported in corresponding references.[5]



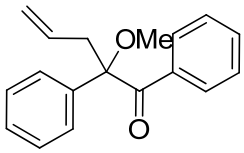
Benzil (4a)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, J=8.4Hz, 4H), 7.69-7.50 (m, 2H), 7.52 (d, J=8.4Hz, 4H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 194.6, 134.9, 132.9, 129.9, 129.0. **MS (ESI, m/z):** Calculated for $[C_{14}H_{10}O_2]$ $(M+H)^+$ 211.07, found 211.07.



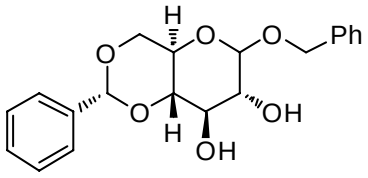
2, 2-dimethoxy-2-phenyl-1-(2-(2-(trimethoxysilyl)ethyl)phenyl)ethanone (4b)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (dd, J=8.0Hz, 1H), 7.51(d, J=4.0Hz, 2H), 7.33-7.27 (m, 4H), 7.21 (m, J=7.2Hz, 2H), 7.10-7.05 (m, 1H), 3. 78 (q, J=6.8Hz, 6H), 3.29 (s, 6H), 2.54-2.49 (m, 1H), 1.21 (t, J=6.8Hz, 9H), 0.93-0.89 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 199.4, 144.6, 136.4, 135.8, 130.6, 129.5, 128.7, 128.3, 127.3, 124.4, 104.6, 58.2, 50.1, 26.6, 18.2, 12.8. **MS (ESI, m/z):** Calculated for $[C_{24}H_{34}O_6Si]$ $(M+H)^+$ 447.21, found 447.21.



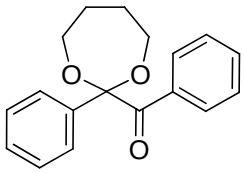
2-methoxy-1, 2-diphenylpent-4-en-1-one (4c)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, J=8.0Hz, 2H), 7.51 (d, J=7.6Hz, 2H), 7.51 (t, J=7.6Hz, 1H) 7.32-7.27 (m, 2H), 7.25-7.21 (m, 3H), 7.10-7.05 (m, 1H), 5.57-5.46 (m, 1H), 5.00(d, J=2.0Hz, 1H), 4.96(s, 1H), 3.26 (s, 3H), 3.21-3.17 (m, 1H), 2.92-2.86 (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 200.6,140.5, 134.9, 132.6, 132.2, 129.9, 128.3, 127.7, 127.3, 125.3, 118.0, 87.7, 51.9, 39.0. **MS (ESI, m/z):** Calculated for $[C_{18}H_{18}O_2]$ $(M+H)^+$ 267.13, found 267.13



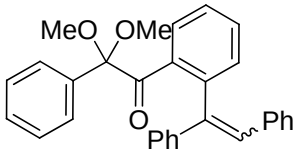
(2R,4aR,7R,8R,8aS)-6-(benzyloxy)-2-phenylhexahydropyrano[3,2-d][1,3]dioxine-7,8-diol(4d)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52-7.49 (m, 2H), 7.39-7.33 (m, 8H), 5.52 (s, 1H), 4.99 (d, J=3.6Hz, 1H), 4.77 (d, J=11.6Hz, 1H), 4.565 (d, J=11.6Hz, 1H), 4.236 (dd, J=10.0Hz, 1H), 3.950 (t, J=9.2Hz, 1H), 3.89-3.83 (m, 1H), 3.725 (t, J=10.0Hz, 1H), 3.639(d, J=2.0Hz, 1H), 3.616 (d, J=2.0Hz, 1H), 3.494 (t, J=9.2Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 136.9, 136.7, 129.2, 128.6, 128.3, 128.2, 128.1, 126.3, 101.8, 98.1, 80.7, 72.8, 71.8, 70.1, 68.8, 62.6. **MS (ESI, m/z):** Calculated for $[C_{20}H_{22}O_6]$ $(M+H)^+$ 359.14, found 359.14.



phenyl(2-phenyl-1,3-dioxepan-2-yl)methanone (4e)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, J=7.2Hz, 2H), 7.67 (t, J=7.2Hz, 1H), 7.34-7.24 (m, 5H), 3.85-3.77 (m, 4H), 1.76-1.66 (m, 4H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 195.8, 138.4, 134.4, 132.5, 130.3, 128.6, 128.3, 127.8, 126.8, 104.8, 64.4, 29.0. **MS (ESI, m/z):** Calculated for $[C_{18}H_{18}O_3]$ $(M+H)^+$ 283.13, found 283.13.



1-(2-(1, 2-diphenylvinyl)phenyl)-2,2-dimethoxy-2-phenylethanone (4f)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 (d, J=7.6Hz, 2H), 7.32-7.21 (m, 11H), 7.16-7.08 (m, 5H) 7.10 (d, J=7.6Hz, 2H), 6.25 (s, 1H), 3.16 (s, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 198.9, 144.8, 142.7, 140.1, 137.3, 136.7, 136.5, 130.9, 130.8, 130.1, 129.8, 129.6, 128.7, 128.2, 127.9, 127.7, 127.6, 127.2, 126.6, 126.3, 104.9, 50.2. **MS (ESI, m/z):** Calculated for $[C_{30}H_{26}O_3]$ $(M+H)^+$ 435.19, found 435.19

7. References and notes.

(1) K. Park, G. Bae, J. Moon, J. Choe, K. H. Song and S. Lee, *J. Org. Chem.*, 2010, **75**, 6244.

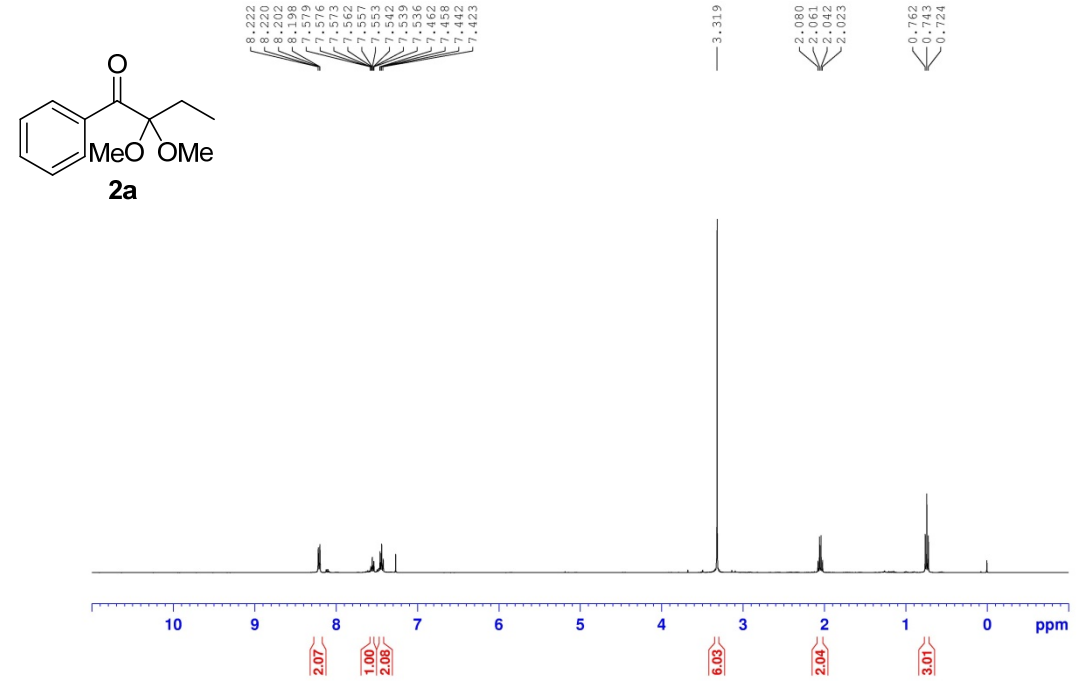
(2) (a) S. Fu, N.-Y. Chen, X. Liu, Z. Shao, S.-P, Lu and Q. Liu, *J. Am. Chem. Soc.*, 2016, **138**, 8588; (b) C. Belger, B. Plietker, *Chem. Commun.* 2012, **48**, 5419, (c) J. Guo, B. Cheng, X. Shen and Z. Lu, *J. Am. Chem. Soc.*, 2017, **139**, 15316.

(3) A. Sagadevan, P. C. Lyu and K. C. Hwang, *Green Chem.*, 2016, **18**, 4526.

(4) O. Mitsuhiro, T. Yukio. *B. Chem. Soc. Jpn.,* 2002, **75**, 2059.

(5) (a) A. D. Bailey, A. R Baru, K. K. Tasche and R. S. Mohan, *Tetrahedron Lett.*,2008, **49**, 691; (b) R. Martinez, M. O. Simon, R. Chevalier, C. Pautigny, J.-P. Genet and S. Darses, *J. Am. Chem. Soc.* **131**, 7887; (c) B. Qin and U. Schneider, *J. Am. Chem. Soc.* **138**, 13119; (d) O. M. T. Pearce and A. Varki, *Carbohydr. Res.*, 2010, **345**, 1225; (e) V. V. Yshin and F. A. Mikhailenko, Ukrainskii Khimicheskii Zhurnal (Russian Edition) (1990), **56,** 1116; (f) F. Hua and M. Szostak, *Chem. Commun.,* 2016, **52,** 9715.

8. Copy of NMR spectra of substrates and product.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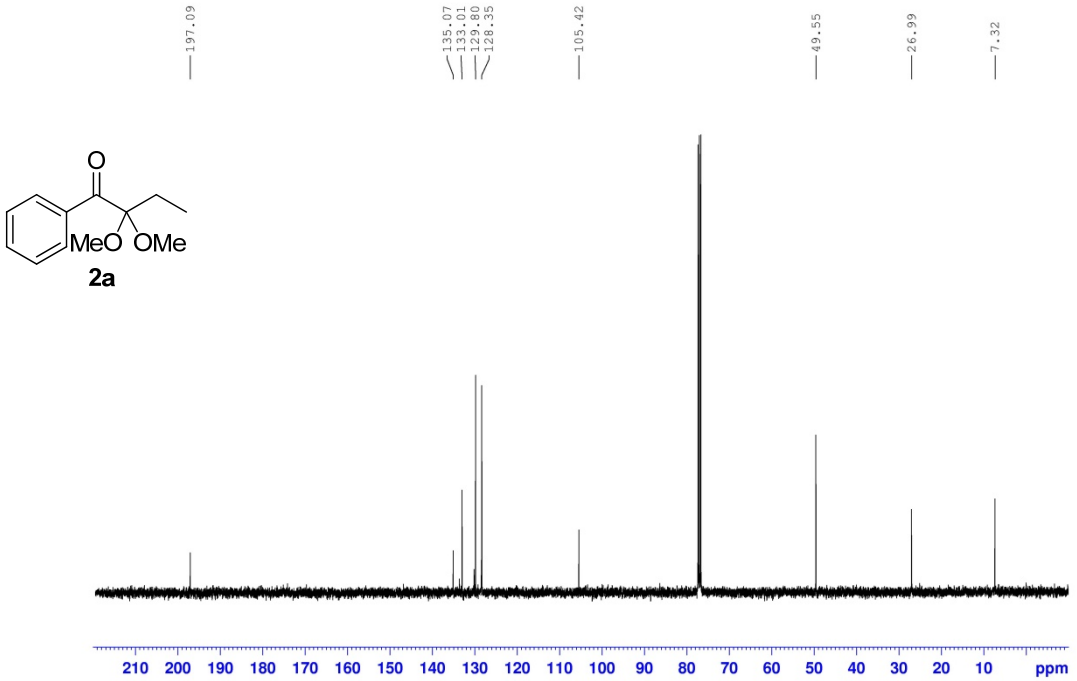
2a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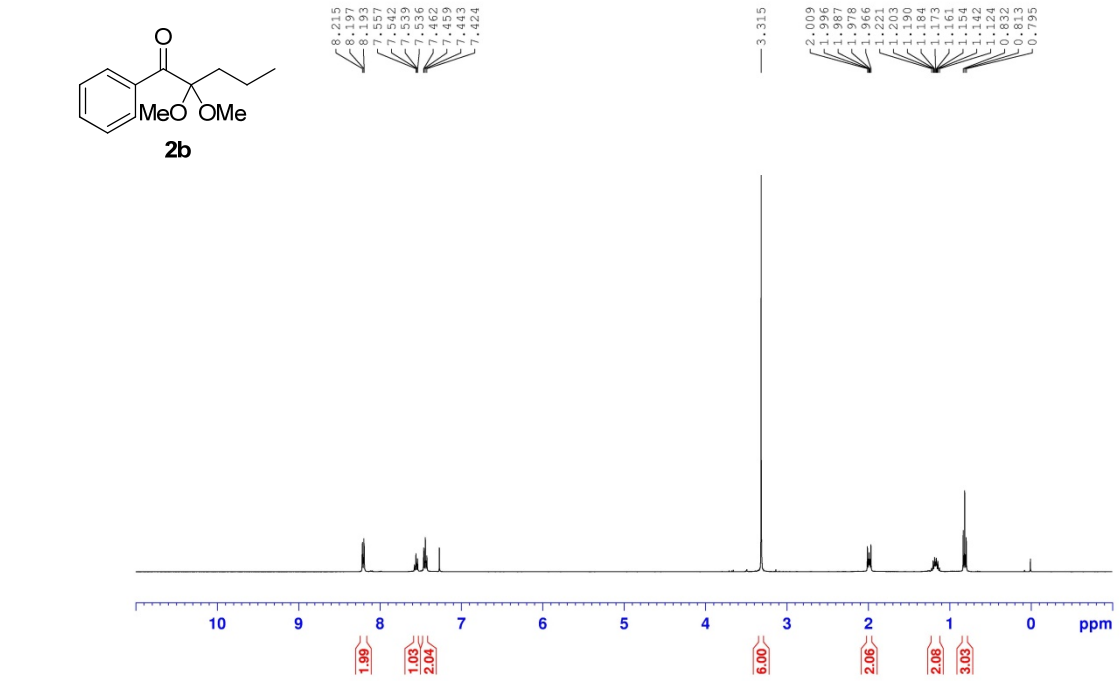
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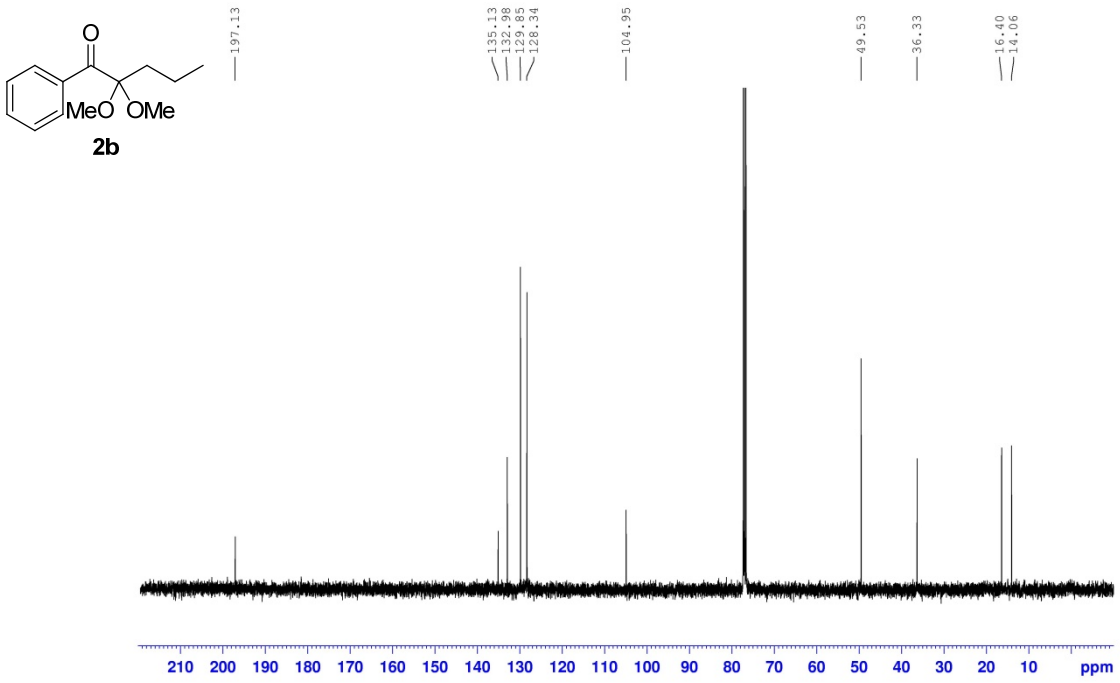
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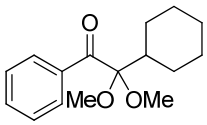
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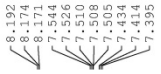
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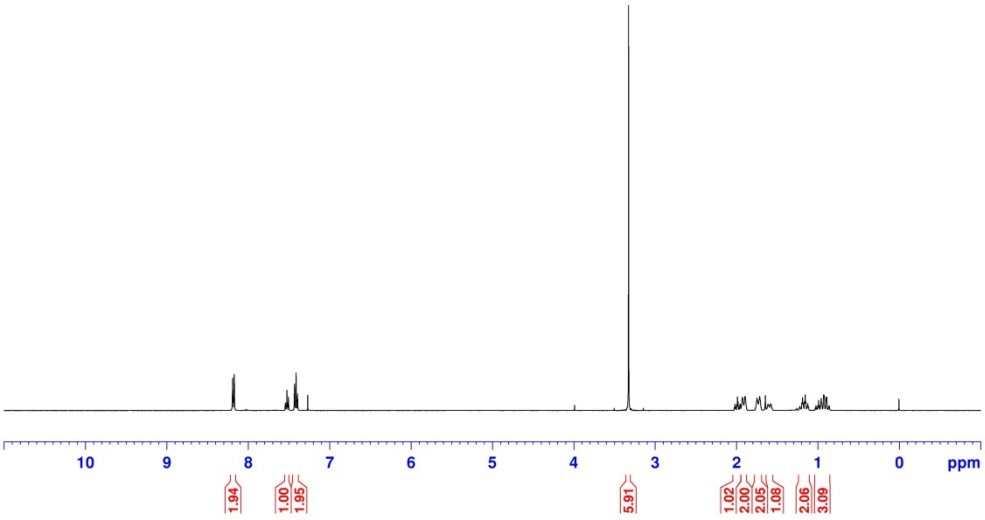
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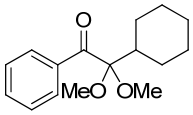
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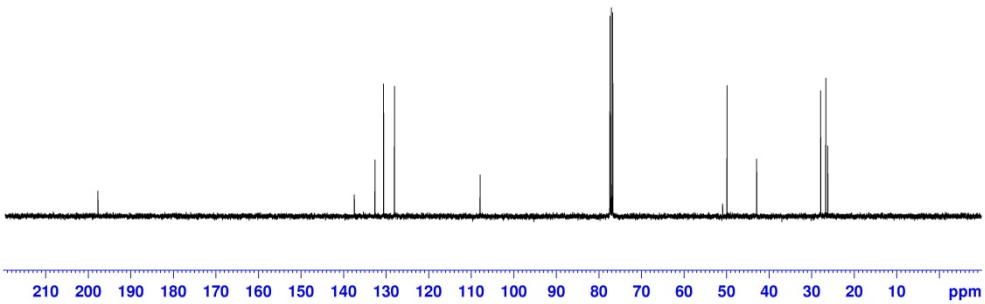
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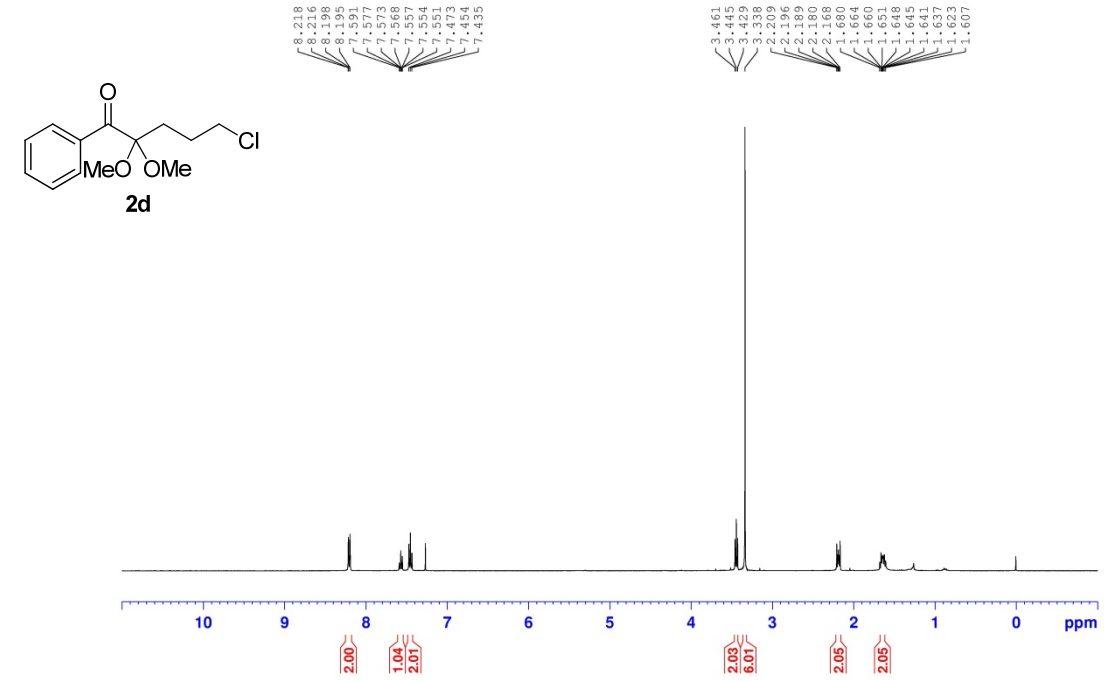
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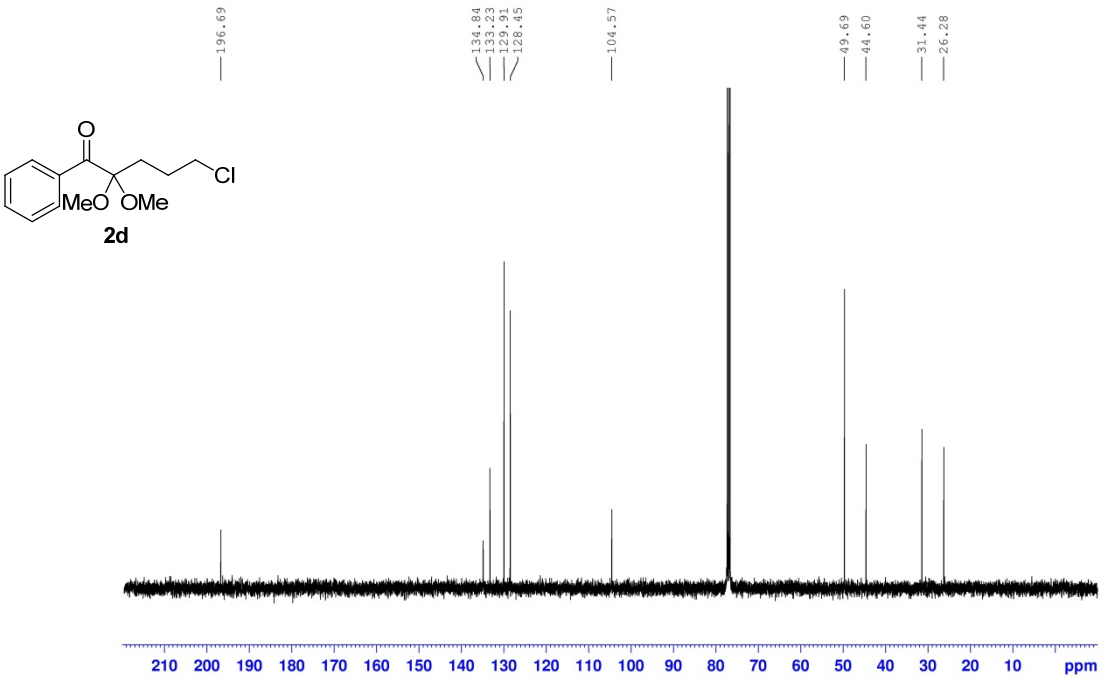
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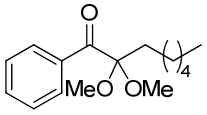
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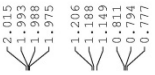
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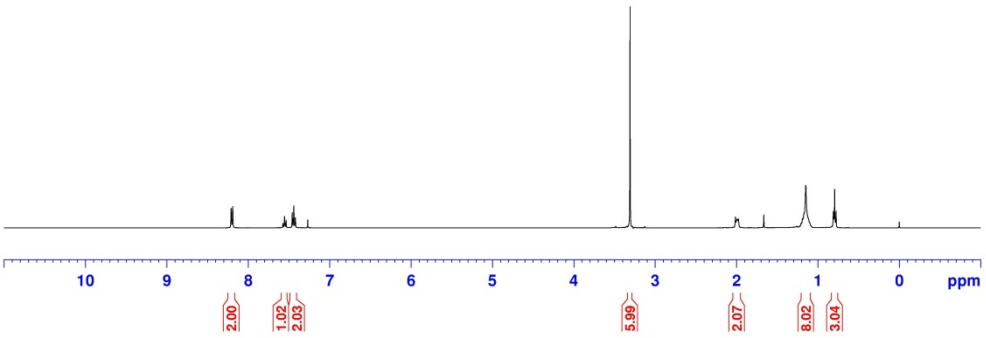
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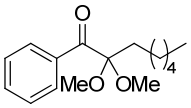
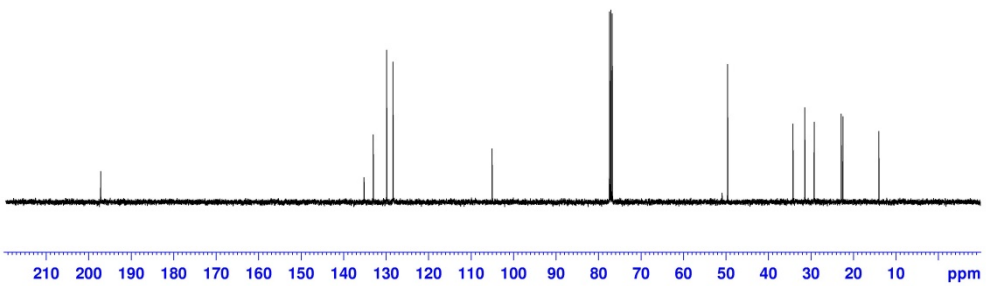
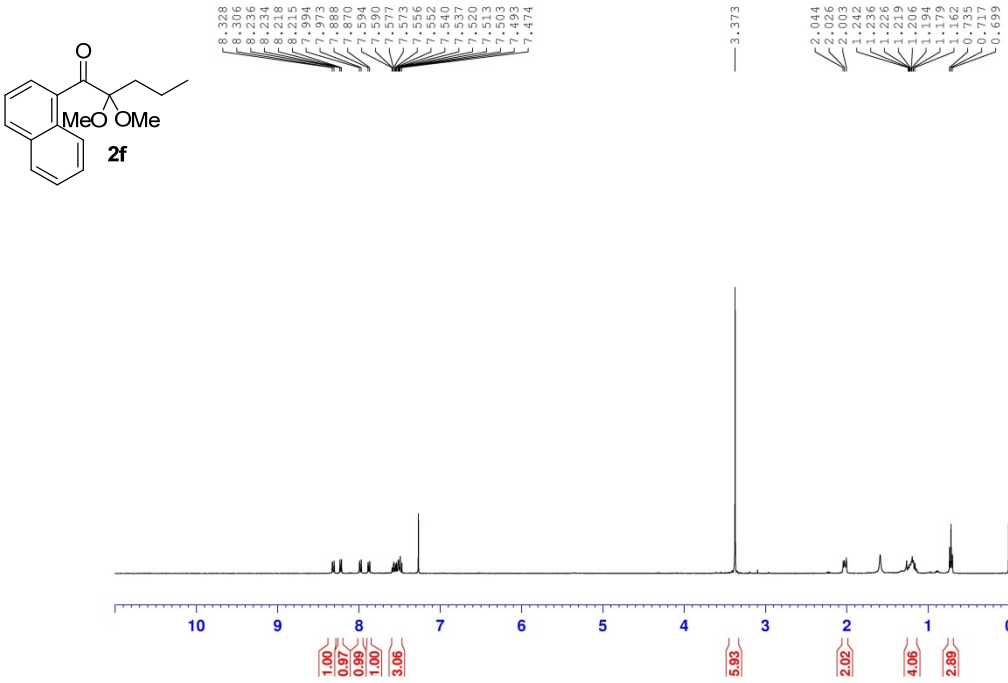
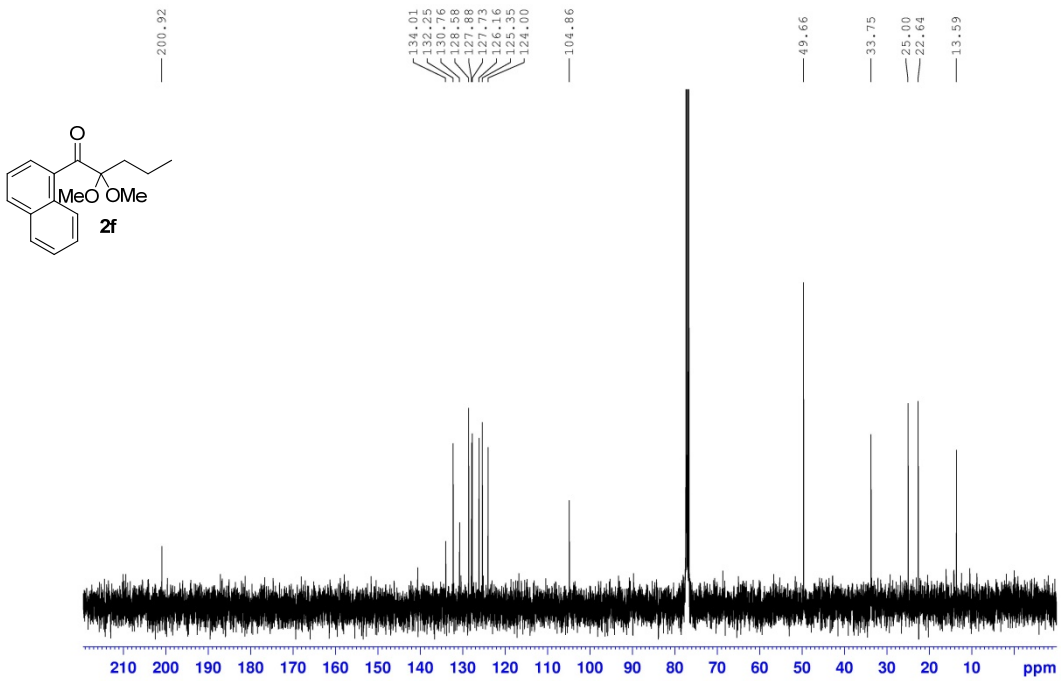
13.91

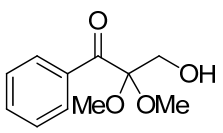

O
MeO
OMe
4

2e

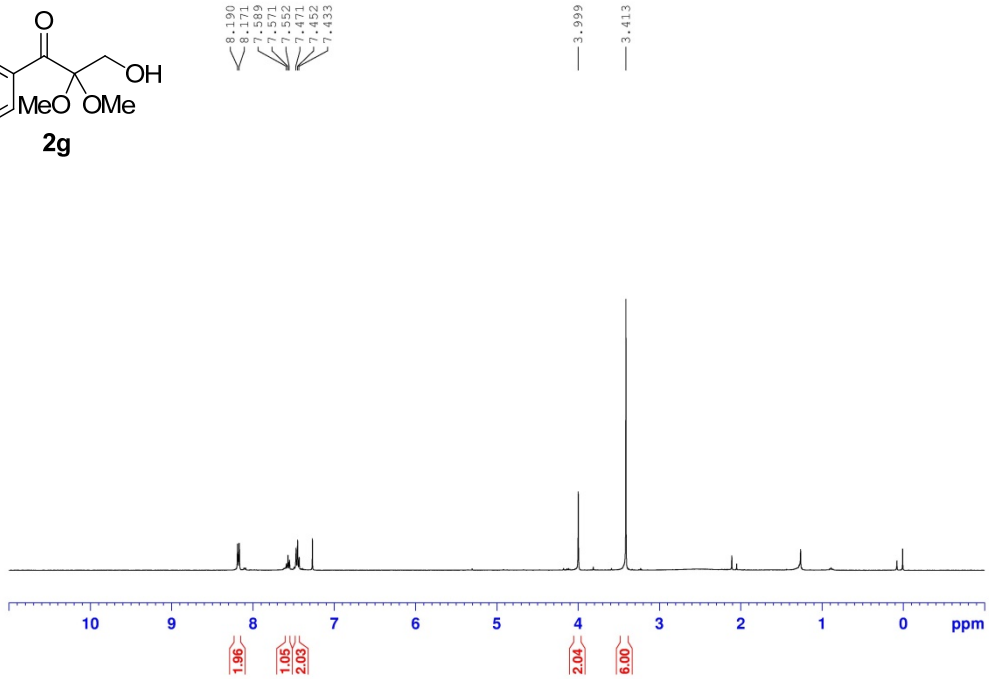

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

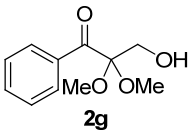

8.328
8.306
8.236
8.234
8.218
8.215
7.994
7.973
7.888
7.870
7.594
7.590
7.577
7.573
7.556
7.552
7.540
7.537
7.520
7.513
7.503
7.493
7.474
3.373
2.044
2.026
2.003
1.242
1.236
1.226
1.219
1.206
1.194
1.179
1.162
0.735
0.717
0.699
O
MeO OMe
2f
10 9 8 7 6 5 4 3 2 1 0 ppm
1.00 0.97 0.99 1.00 3.06 5.93 2.02 4.06 2.89


200.92
134.01
132.25
130.76
128.58
127.88
127.73
126.16
125.35
124.00
104.86
49.66
33.75
25.00
22.64
13.59
O
MeO OMe
2f
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

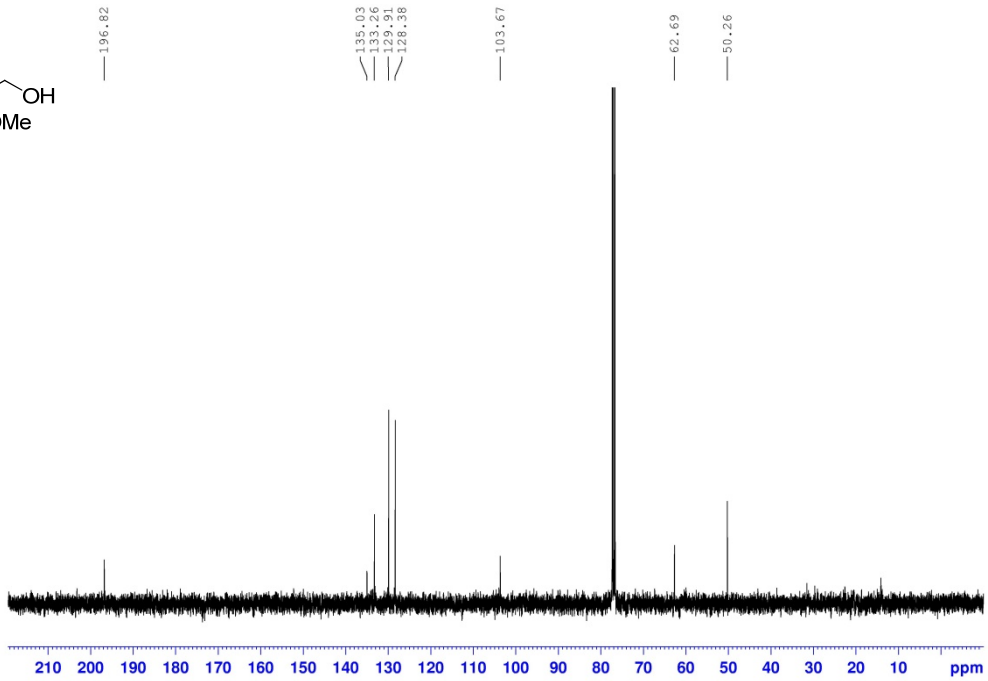

O
OH
MeO
OMe

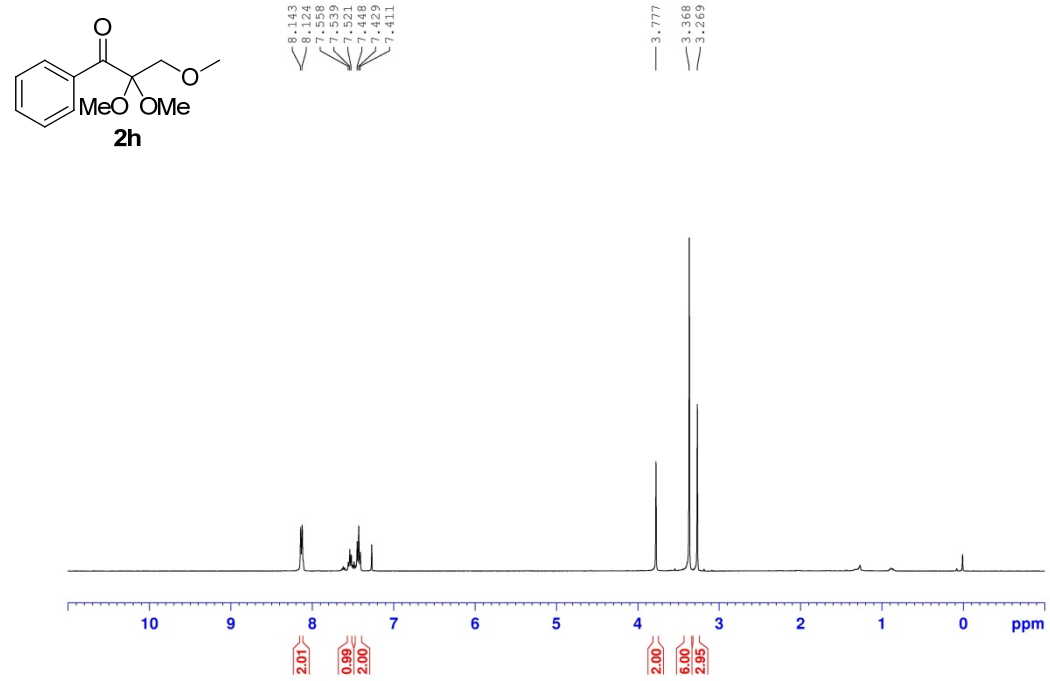
2g

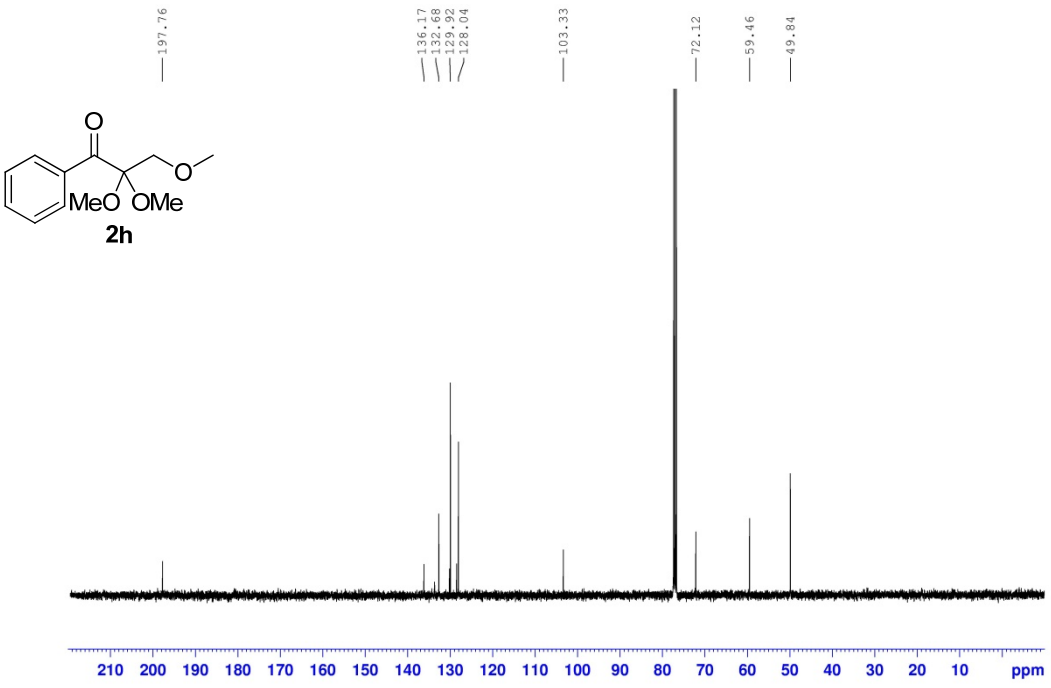

8.190
8.171
7.589
7.571
7.552
7.471
7.452
7.433
3.999
3.413
10
9
8
7
6
5
4
3
2
1
0
ppm
1.96
1.05
2.03
2.04
6.00

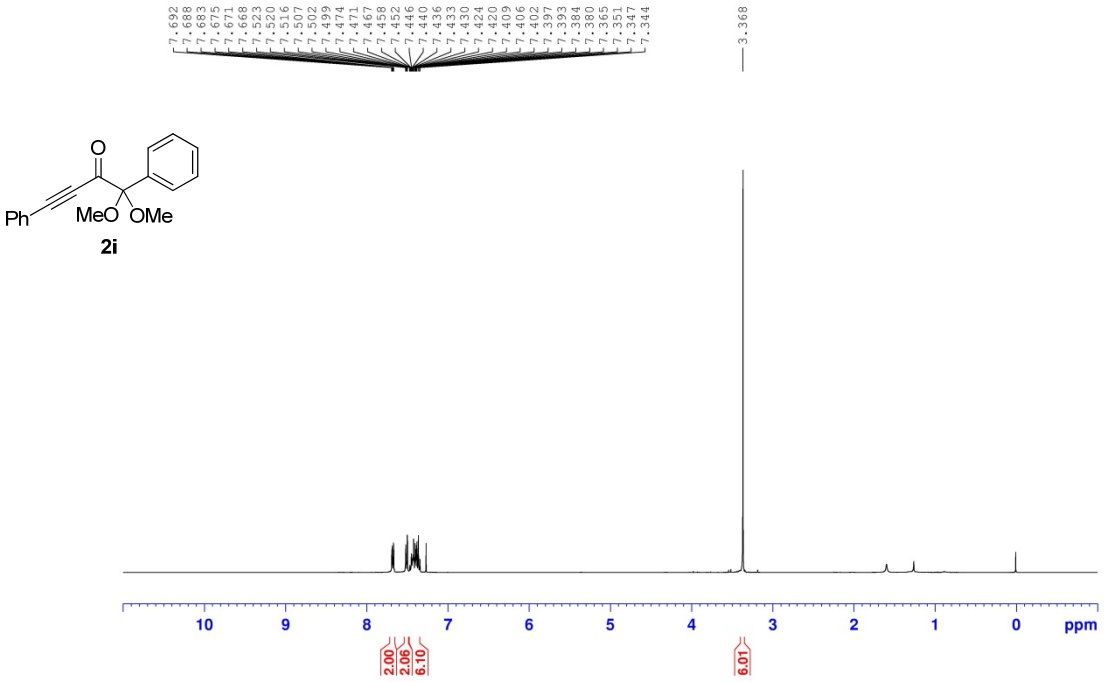

O
OH
MeO
OMe

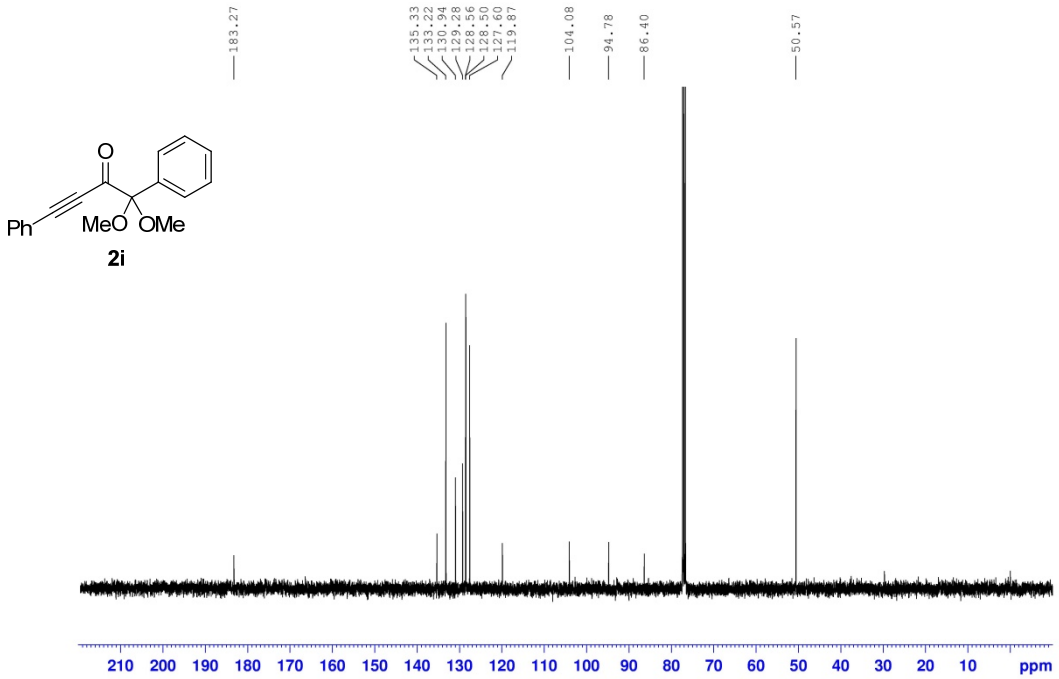
2g

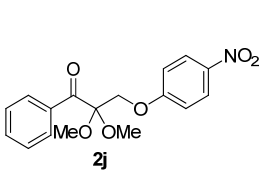

196.82
135.03
133.26
129.91
128.38
103.67
62.69
50.26
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


8.143
8.124
7.554
7.539
7.521
7.448
7.429
7.411
3.777
3.368
3.269
MeO OMe
2h
10 9 8 7 6 5 4 3 2 1 0 ppm
2.01
0.99
2.00
2.00
6.00
2.95

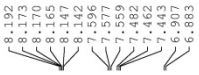

197.76
136.17
132.68
129.92
128.04
103.33
72.12
59.46
49.84
MeO OMe
2h
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

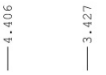

7.692
7.688
7.683
7.675
7.671
7.668
7.523
7.520
7.516
7.507
7.502
7.499
7.474
7.471
7.467
7.458
7.452
7.446
7.440
7.436
7.433
7.430
7.424
7.420
7.409
7.406
7.402
7.397
7.393
7.384
7.380
7.365
7.351
7.347
7.344
3.368
O
Ph
MeO OMe
2i
10 9 8 7 6 5 4 3 2 1 0 ppm
2.00
2.06
6.10
6.01

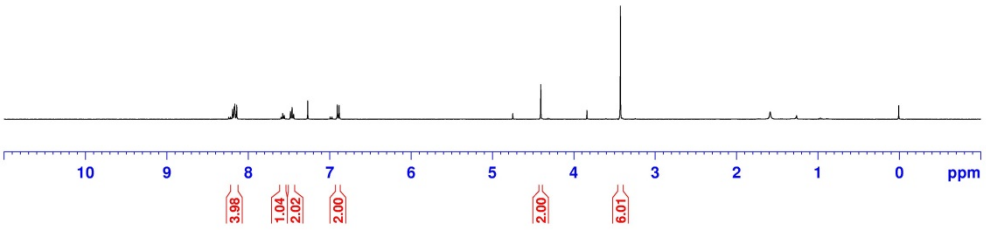

183.27
135.33
133.22
130.94
129.28
128.56
127.50
127.60
119.87
104.08
94.78
86.40
50.57
O
Ph
MeO OMe
2i
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

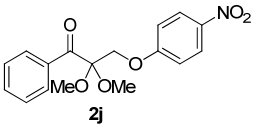

O
NO2
O
MeO OMe

2j

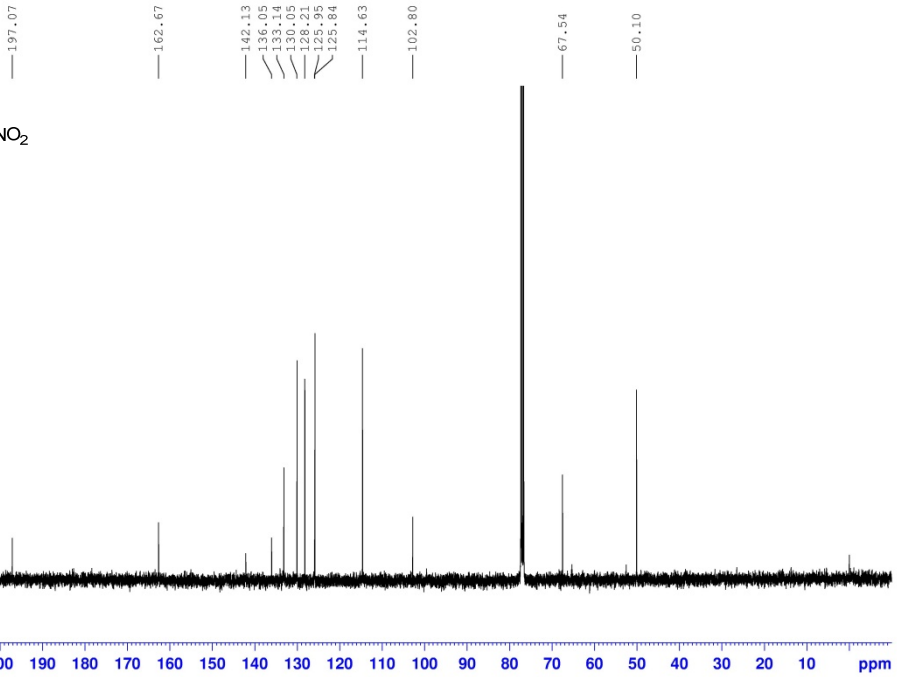

8.192
8.173
8.170
8.165
8.147
8.142
7.596
7.577
7.559
7.482
7.462
7.443
6.907
6.883

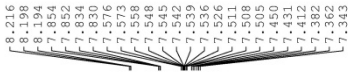

4.406
3.427

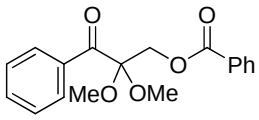

10
9
8
7
6
5
4
3
2
1
0
ppm
3.98
1.04
2.02
2.00
2.00
6.01


O
NO2
O
MeO OMe

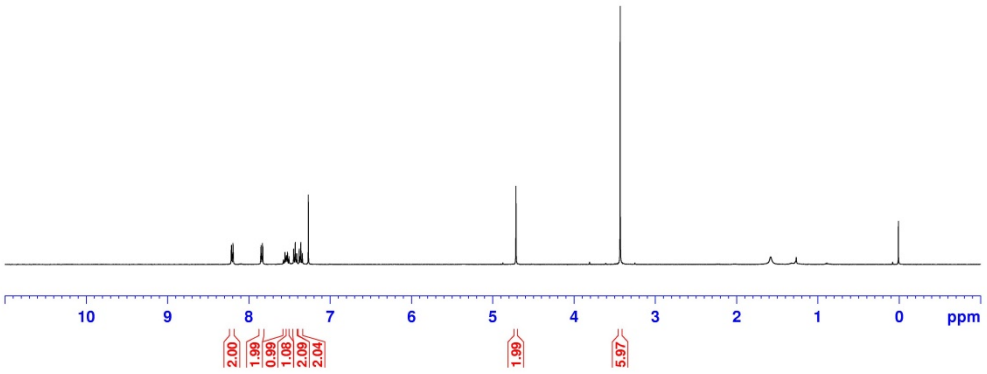
2j


197.07
162.67
142.13
136.05
133.14
130.05
128.21
125.95
125.84
114.63
102.80
67.54
50.10
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

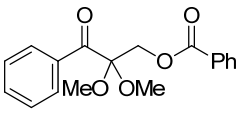

8.216
8.198
8.194
7.854
7.852
7.834
7.830
7.576
7.573
7.558
7.548
7.545
7.542
7.539
7.536
7.526
7.511
7.508
7.505
7.450
7.431
7.412
7.382
7.362
7.343
4.716
3.434


O
O
O
Ph
MeO
OMe

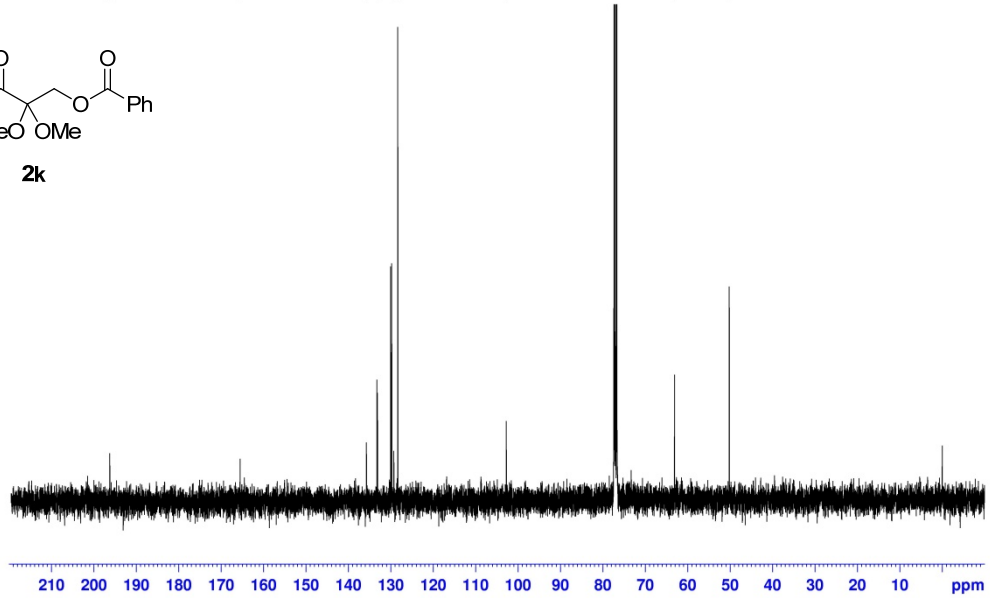
2k

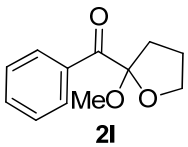

10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
1.99
0.99
1.08
2.09
2.04
1.99
5.97

196.27
165.52
135.71
133.23
133.11
130.02
129.76
129.24
128.32
102.73
63.06
50.15

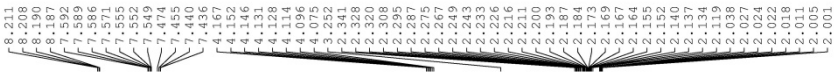

O
O
O
Ph
MeO
OMe

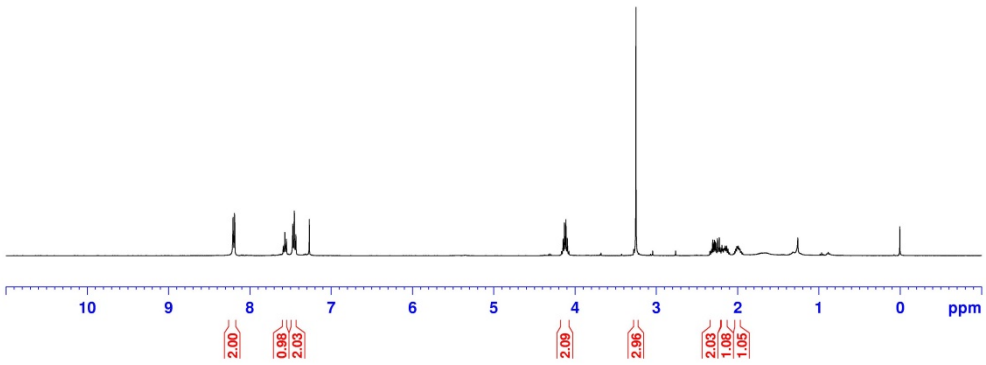
2k

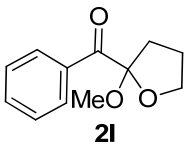

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


O
MeO
O

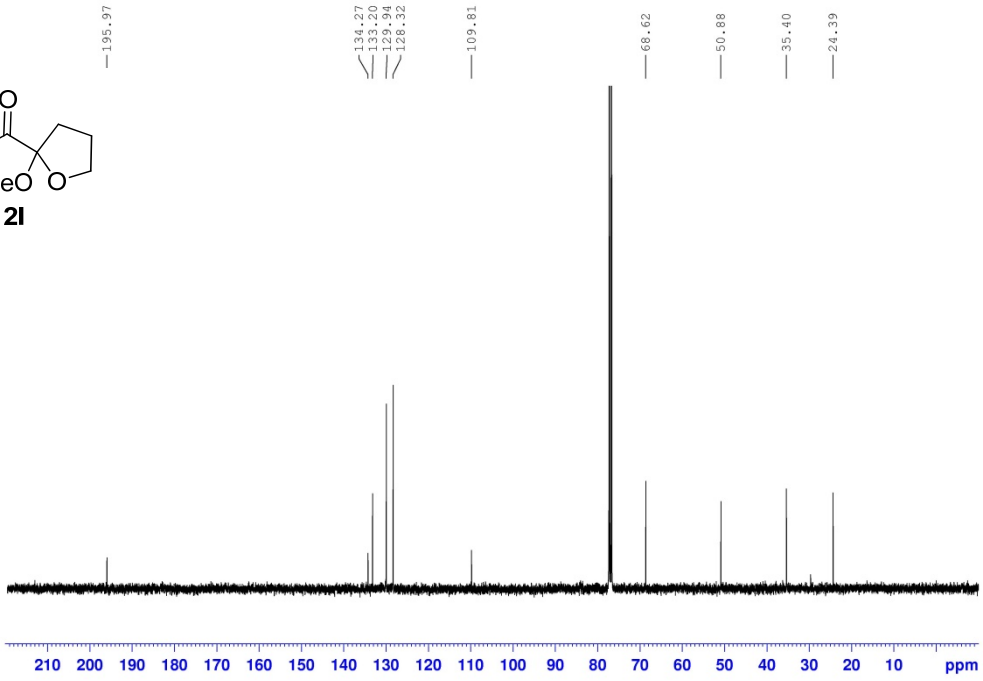
2l

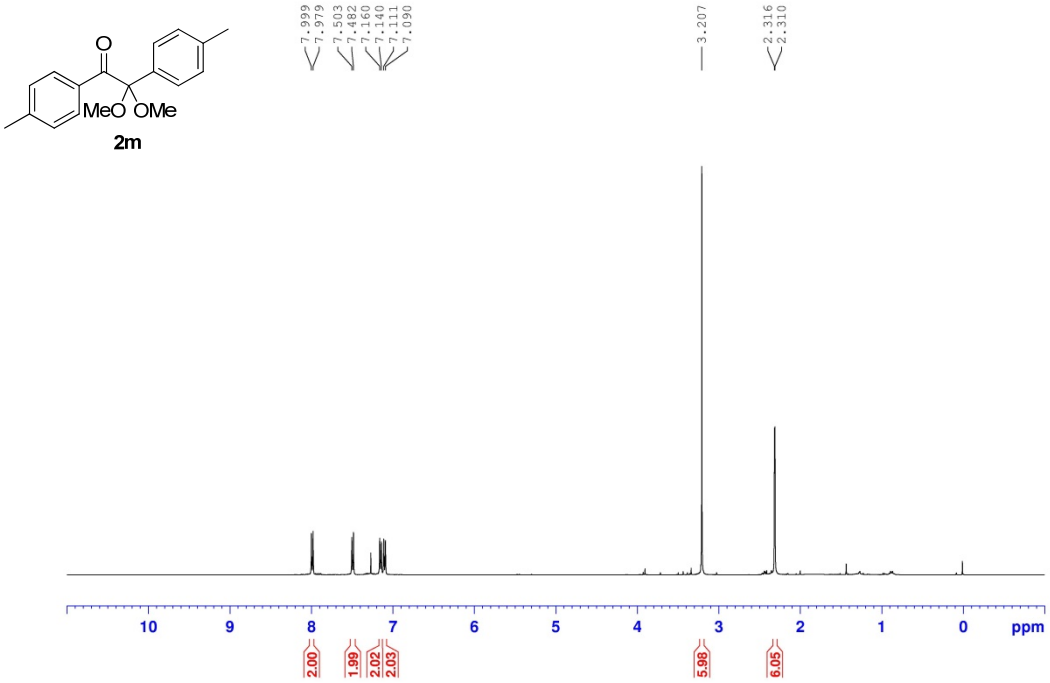

8.211
8.208
8.190
8.187
7.592
7.589
7.586
7.571
7.555
7.552
7.549
7.474
7.455
7.440
7.436
4.167
4.152
4.146
4.131
4.128
4.114
4.096
4.075
3.252
2.341
2.328
2.320
2.308
2.295
2.287
2.275
2.267
2.249
2.243
2.233
2.226
2.216
2.211
2.200
2.193
2.187
2.184
2.173
2.169
2.167
2.164
2.155
2.152
2.140
2.137
2.134
2.119
2.038
2.027
2.024
2.022
2.018
2.011
2.005
2.001

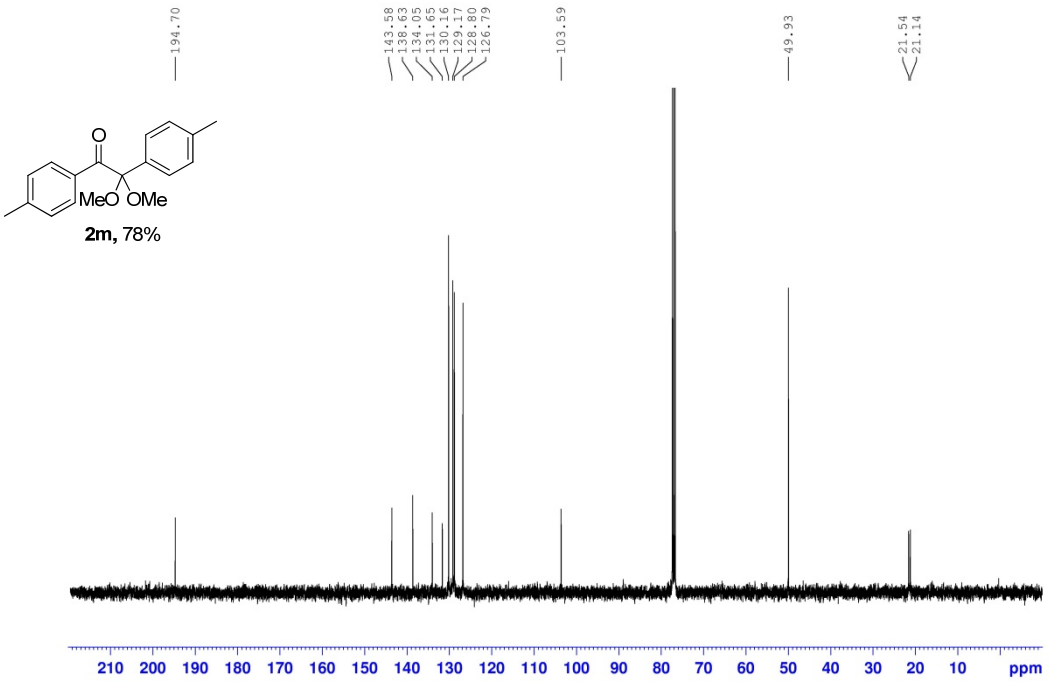

10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
0.98
2.03
2.09
2.96
2.03
1.08
1.05

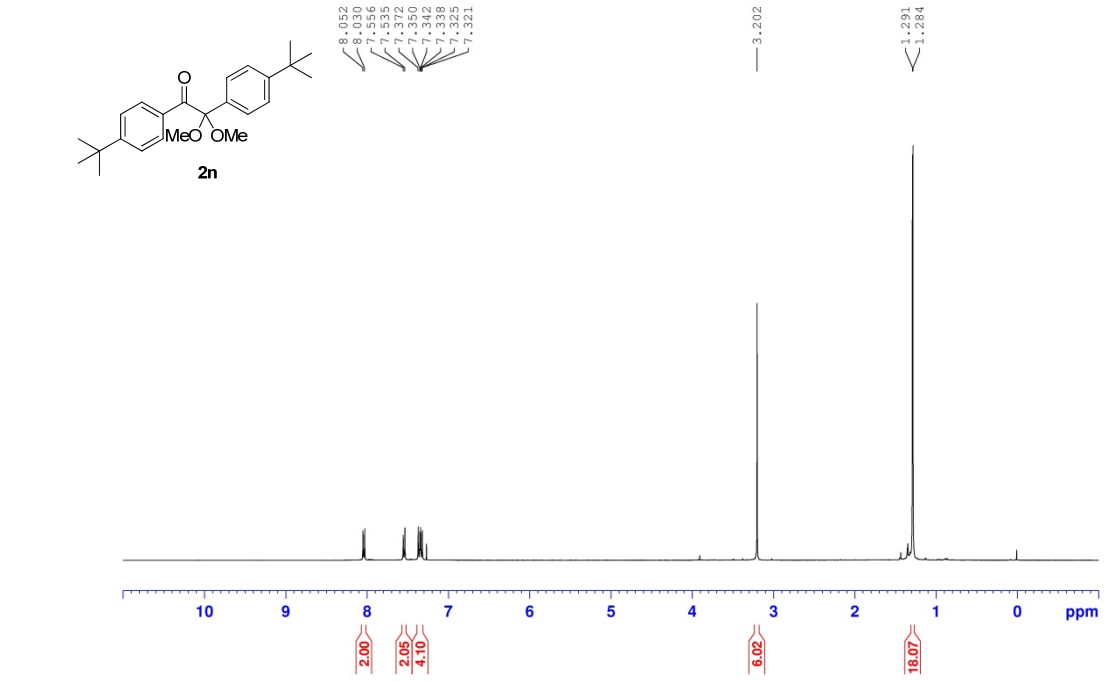

O
MeO
O

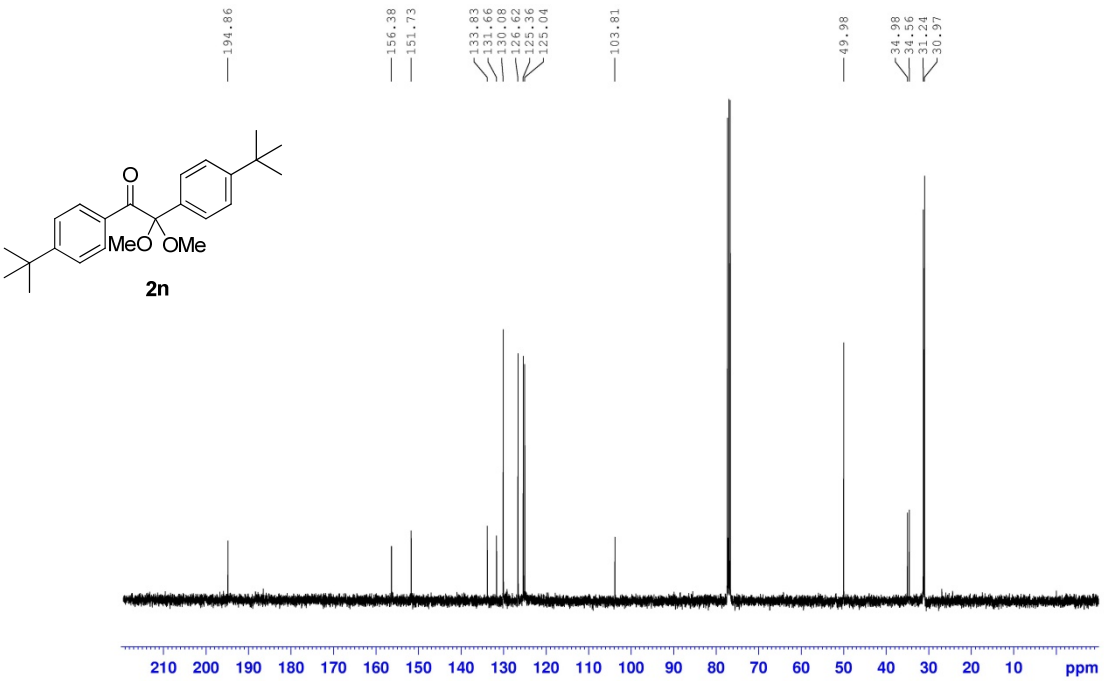
2l

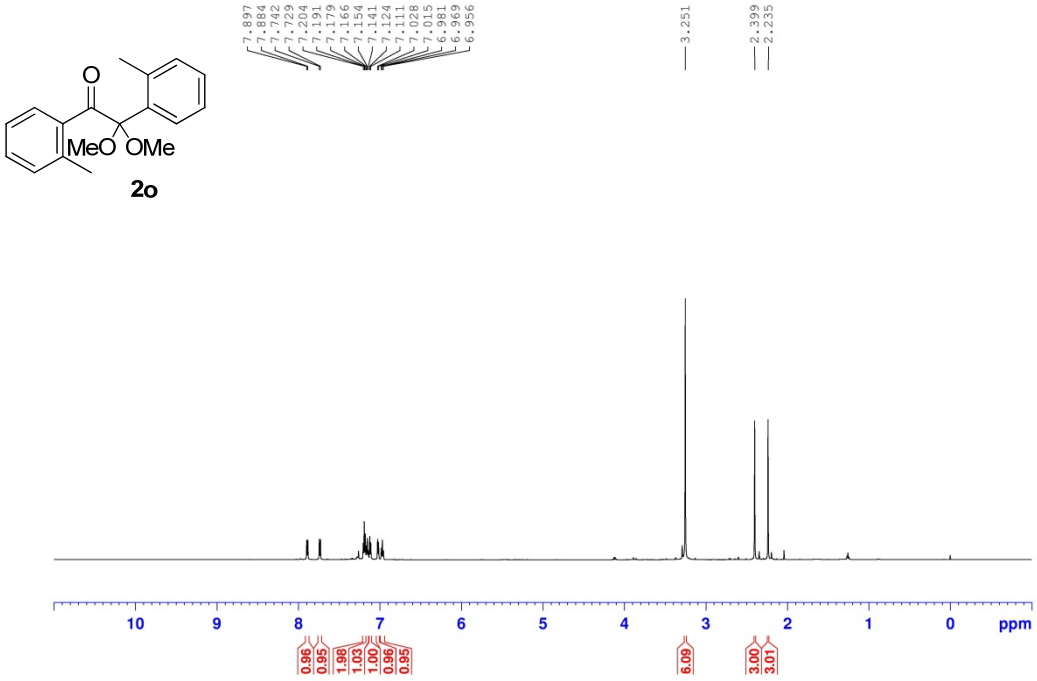

195.97
134.27
133.20
129.94
128.32
109.81
68.62
50.88
35.40
24.39
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

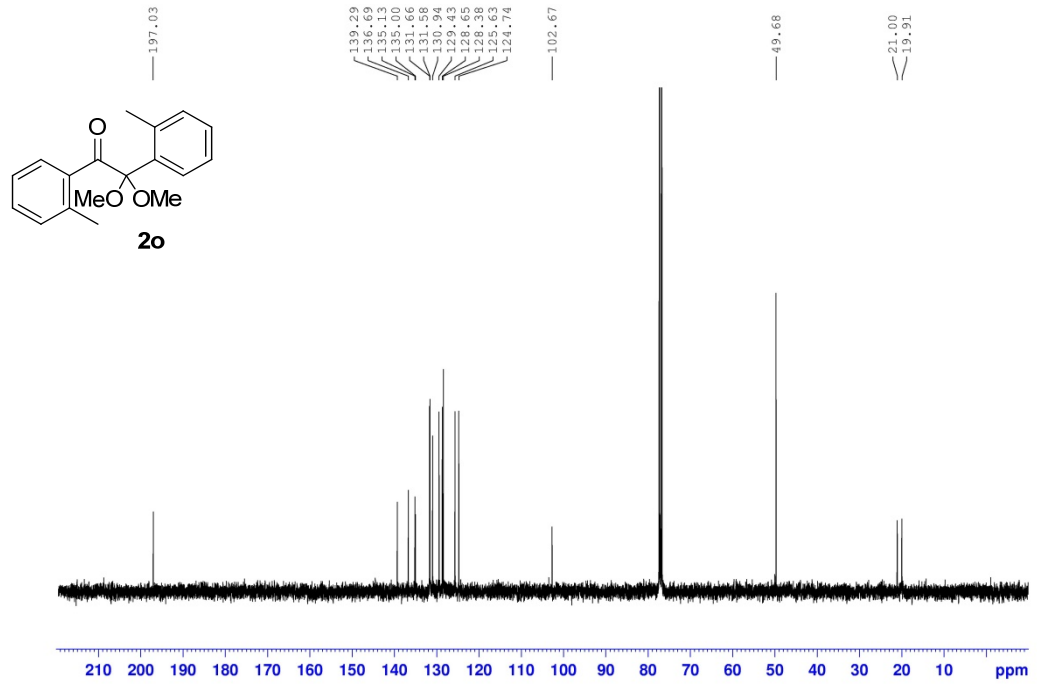

MeO OMe
2m
7.999
7.979
7.503
7.482
7.160
7.140
7.111
7.090
3.207
2.316
2.310
10 9 8 7 6 5 4 3 2 1 0 ppm
2.00
1.99
2.02
2.03
5.98
6.05

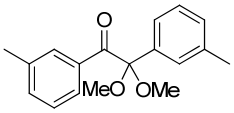

MeO OMe
2m, 78%
194.70
143.58
138.63
134.05
131.65
130.16
129.17
128.80
126.79
103.59
49.93
21.54
21.14
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


8.052
8.030
7.556
7.535
7.372
7.350
7.342
7.338
7.325
7.321
3.202
1.291
1.284
O
MeO OMe
2n
10 9 8 7 6 5 4 3 2 1 0 ppm
2.00
2.05
4.10
6.02
18.07


194.86
156.38
151.73
133.83
131.66
130.08
126.62
125.36
125.04
103.81
49.98
34.98
34.56
31.24
30.97
O
MeO OMe
2n
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


7.897
7.884
7.742
7.729
7.204
7.191
7.179
7.166
7.154
7.141
7.124
7.111
7.028
7.015
6.981
6.969
6.956
3.251
2.399
2.235
O
MeO OMe
2o
10 9 8 7 6 5 4 3 2 1 0 ppm
0.96 0.95 1.98 1.03 1.00 0.96 0.95
6.09
3.00 3.01

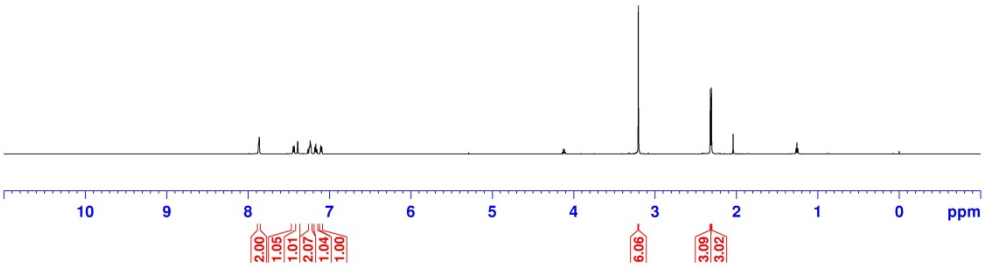

197.03
139.29
136.69
135.13
135.00
131.66
131.58
130.94
129.43
128.65
128.38
125.63
124.74
102.67
49.68
21.00
19.91
O
MeO OMe
2o
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


O
MeO
OMe

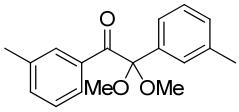
2p


7.862
7.445
7.433
7.389
7.249
7.243
7.236
7.231
7.224
7.180
7.173
7.167
7.153
7.107
7.094

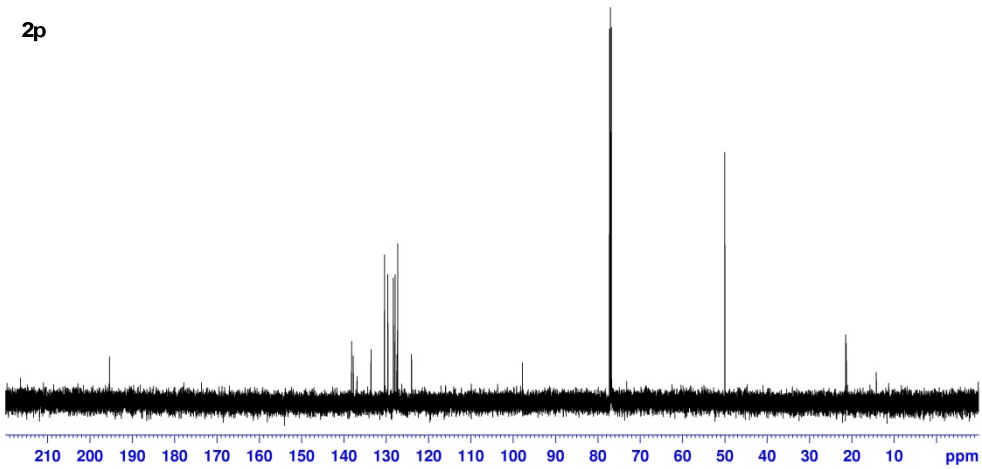

3.205
2.320
2.307

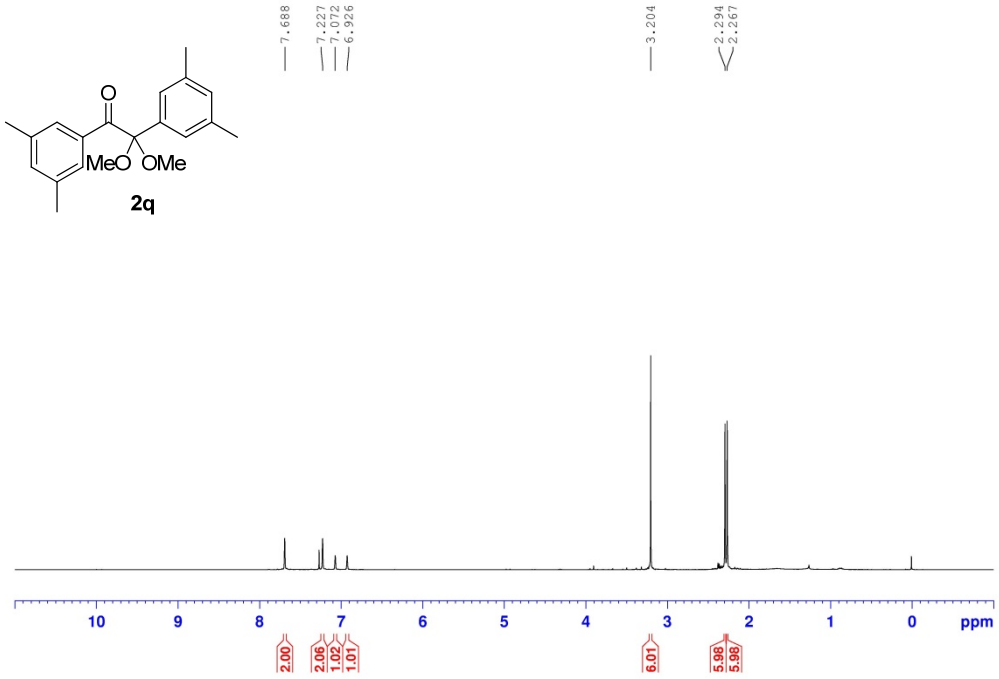

10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
1.05
1.01
2.07
1.04
1.00
6.06
3.09
3.02

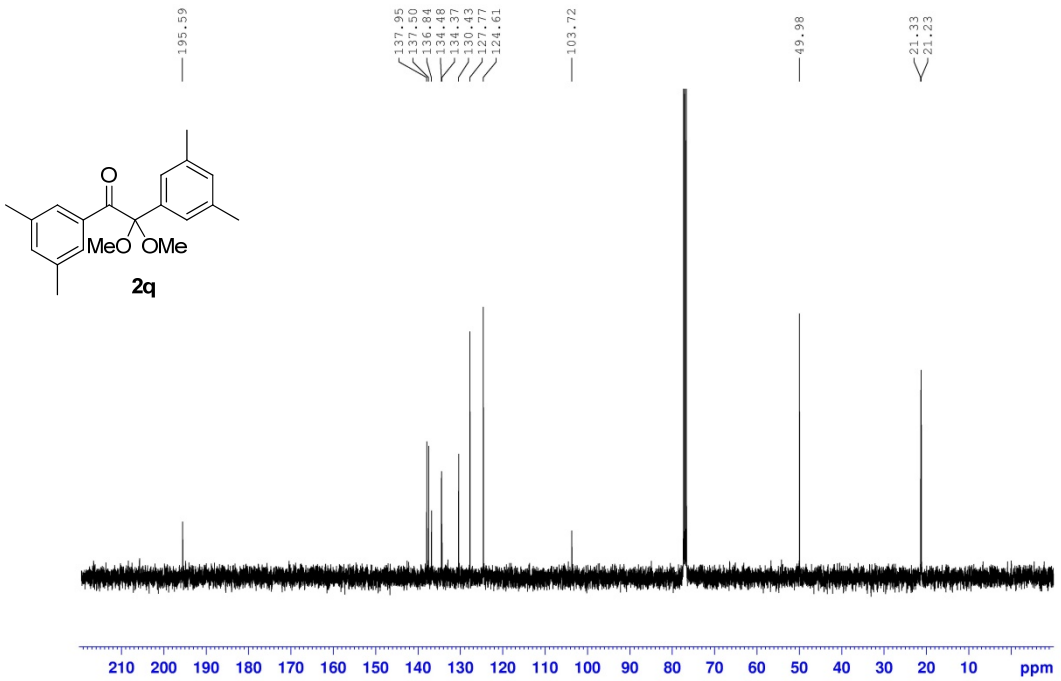

195.377
138.176
137.780
133.575
130.398
129.603
128.292
127.903
127.461
127.268
124.007
97.794
49.986
21.420
21.282

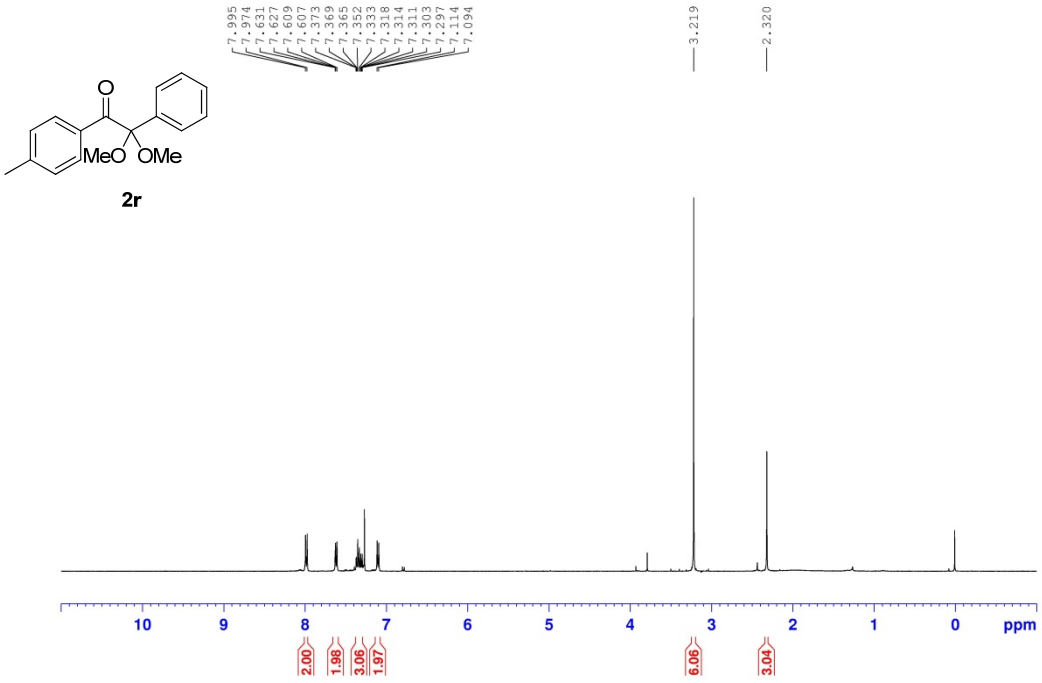

O
MeO
OMe

2p

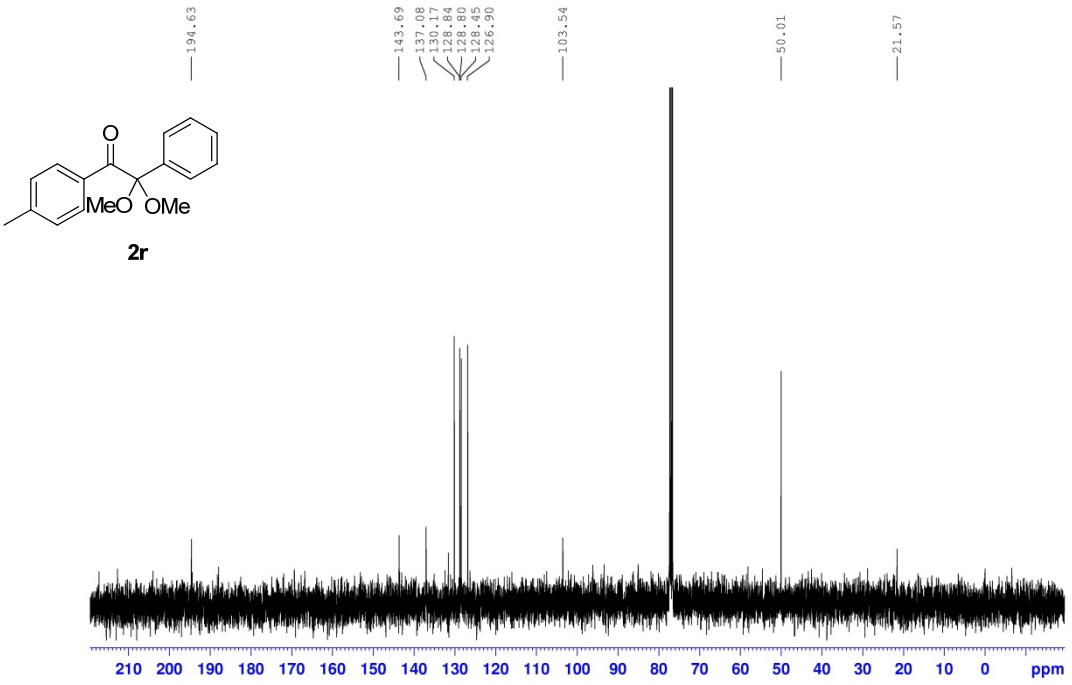

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


7.688
7.227
7.072
6.926
3.204
2.294
2.267
MeO OMe
2q
10 9 8 7 6 5 4 3 2 1 0 ppm
2.00
2.06
1.02
1.01
6.01
5.98
5.98

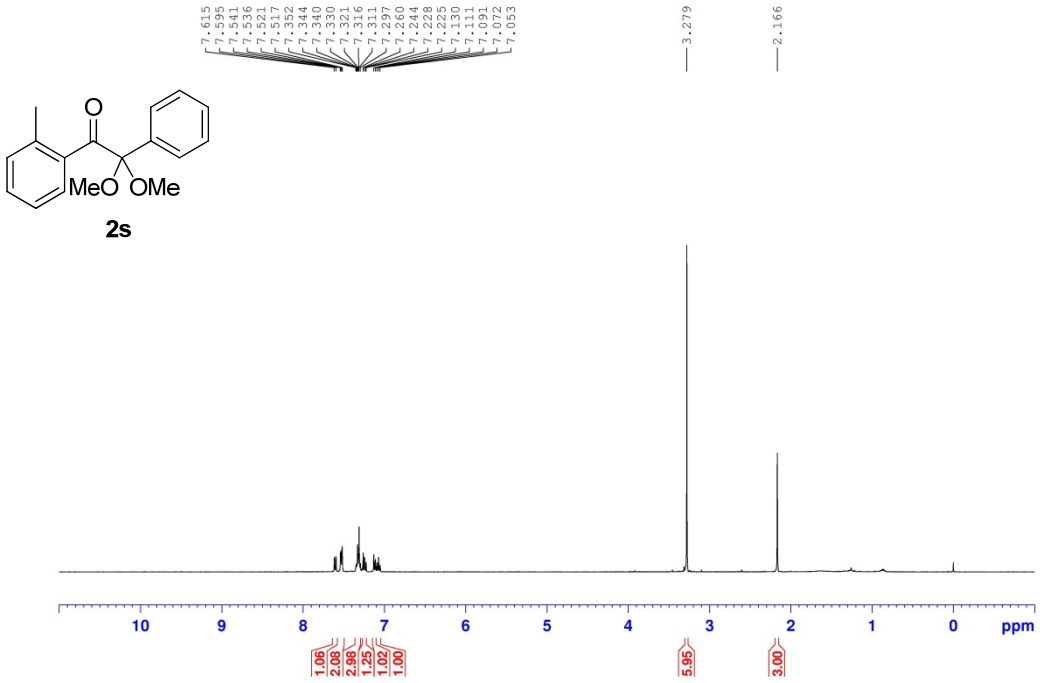

195.59
137.95
137.50
136.84
134.48
134.37
130.43
127.77
124.61
103.72
49.98
21.33
21.23
MeO OMe
2q
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

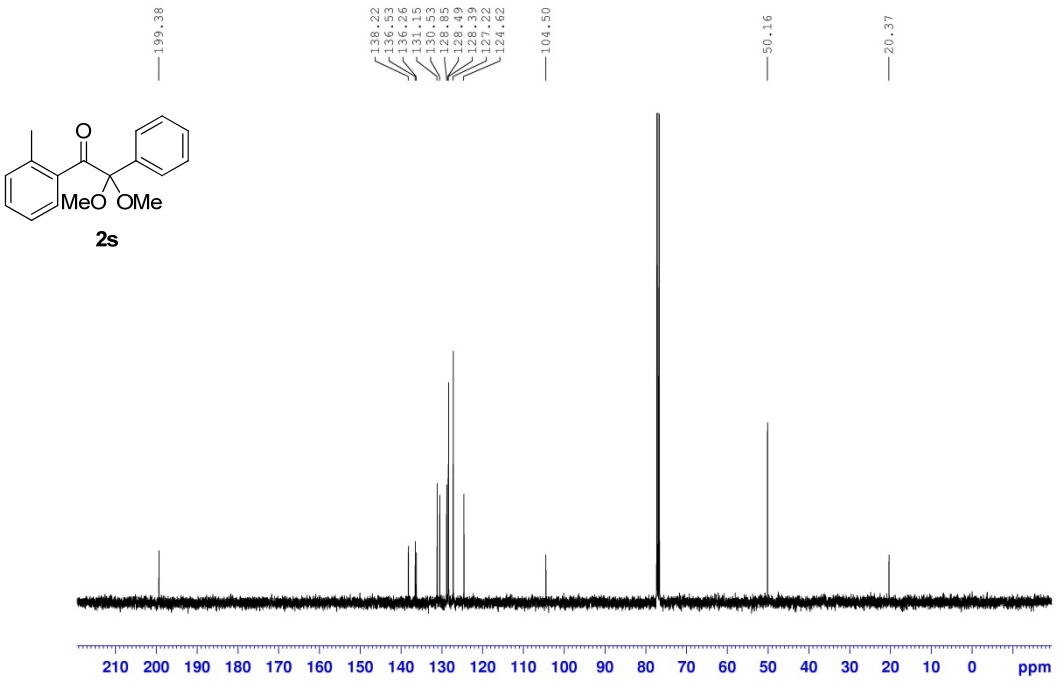

7.995
7.974
7.631
7.627
7.609
7.607
7.373
7.369
7.365
7.352
7.333
7.318
7.314
7.311
7.303
7.297
7.114
7.094
3.219
2.320
O
MeO
OMe
10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
1.98
3.06
1.97
6.06
3.04

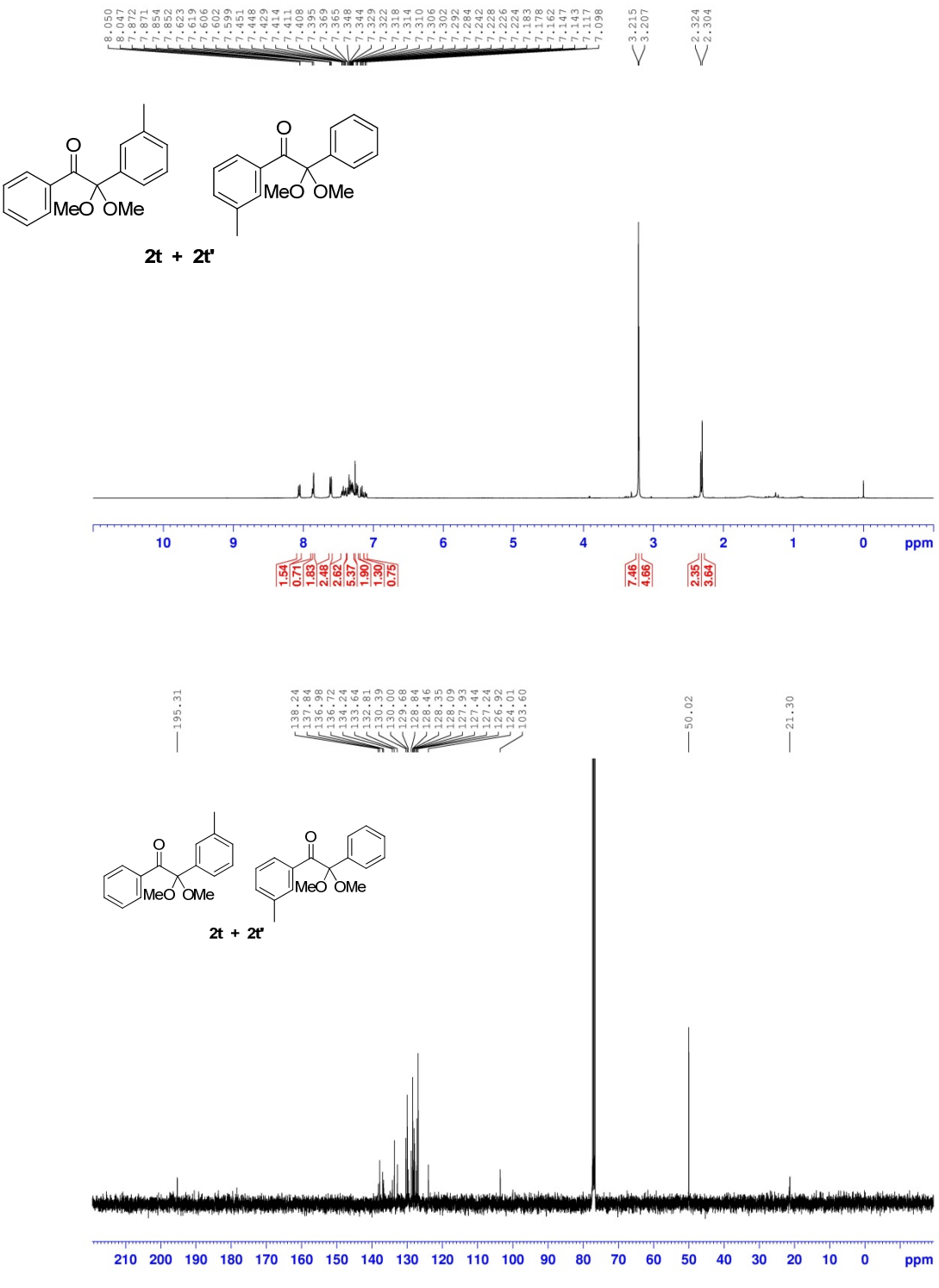
2r


194.63
143.69
137.08
130.17
128.84
128.80
128.45
126.90
103.54
50.01
21.57
O
MeO
OMe
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

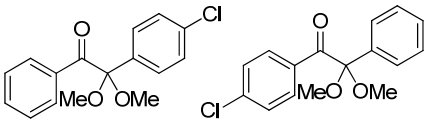
2r


7.615
7.595
7.541
7.536
7.521
7.517
7.352
7.344
7.340
7.330
7.321
7.316
7.311
7.297
7.260
7.244
7.228
7.225
7.130
7.111
7.091
7.072
7.053
3.279
2.166
O
MeO OMe
2s
10 9 8 7 6 5 4 3 2 1 0 ppm
1.06
2.08
2.98
1.25
1.02
1.00
5.95
3.00

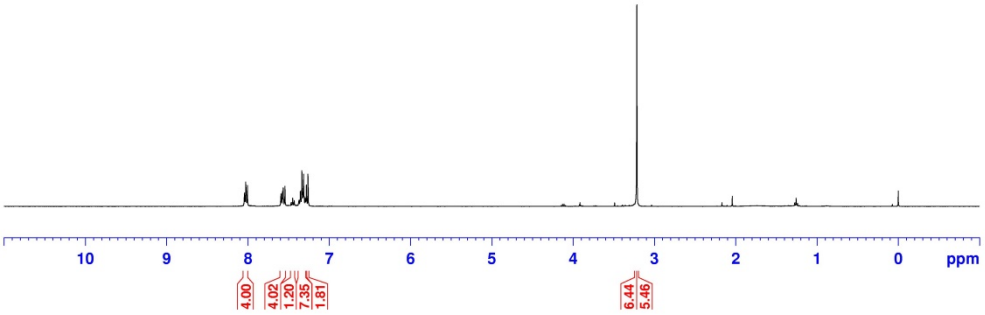

199.38
138.22
136.53
136.26
131.15
130.53
128.85
128.49
128.39
127.22
124.62
104.50
50.16
20.37
O
MeO OMe
2s
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


8.050
8.047
7.872
7.871
7.854
7.852
7.623
7.619
7.606
7.602
7.599
7.451
7.448
7.429
7.414
7.411
7.408
7.395
7.369
7.365
7.348
7.344
7.329
7.322
7.318
7.314
7.310
7.306
7.302
7.292
7.284
7.242
7.228
7.226
7.224
7.183
7.178
7.162
7.147
7.143
7.117
7.098
3.215
3.207
2.324
2.304
MeO OMe
MeO OMe
2t + 2t'
10 9 8 7 6 5 4 3 2 1 0 ppm
1.54
0.71
1.83
2.48
2.62
5.37
1.90
1.30
0.75
7.46
4.66
2.35
3.64
195.31
138.24
137.84
136.98
136.72
134.24
133.64
132.81
130.39
130.00
129.68
128.84
128.46
128.35
128.09
127.93
127.44
127.24
126.92
124.01
103.60
50.02
21.30
MeO OMe
MeO OMe
2t + 2t'
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

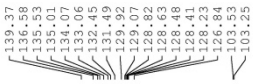

8.046
8.043
8.035
8.029
8.025
8.022
8.012
8.007
7.597
7.593
7.588
7.576
7.573
7.568
7.563
7.551
7.546
7.469
7.451
7.436
7.432
7.429
7.378
7.373
7.356
7.338
7.326
7.321
7.316
7.309
7.297
7.288
7.282
7.277
7.263
7.260
3.218
3.215


O
Cl
MeO
OMe
O
MeO
OMe
Cl

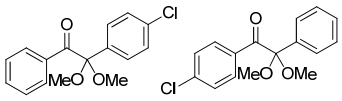
2u+2u'


10
9
8
7
6
5
4
3
2
1
0
ppm
4.00
4.02
1.20
7.35
1.81
6.44
5.46

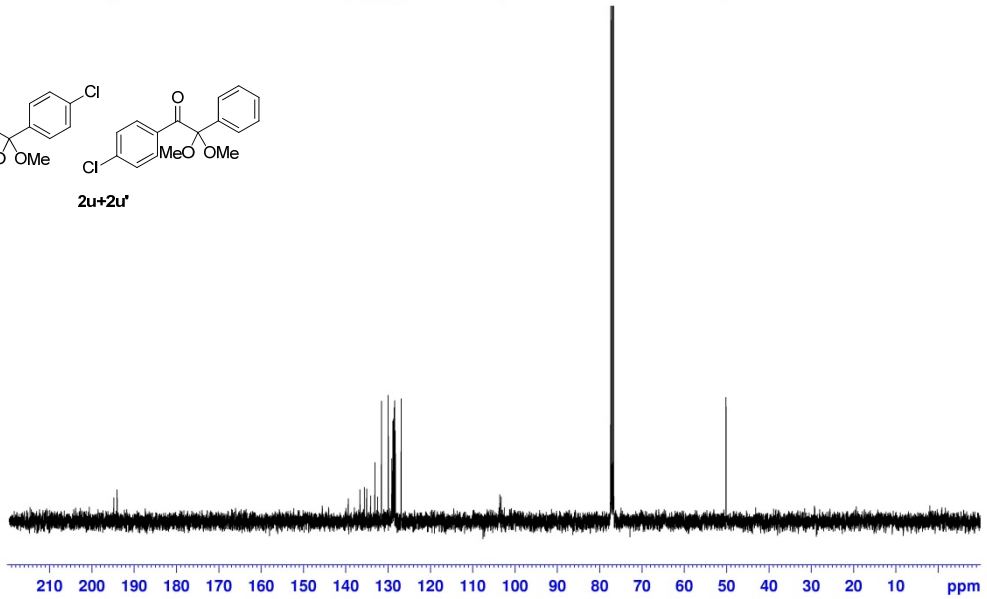

194.77
193.98


139.37
136.58
135.53
135.01
134.07
133.06
132.45
131.49
129.92
129.07
128.82
128.63
128.48
128.41
128.23
126.84
103.53
103.25

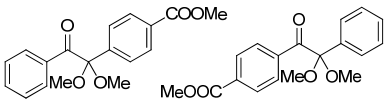

50.11
50.09


O
Cl
MeO
OMe
O
MeO
OMe
Cl

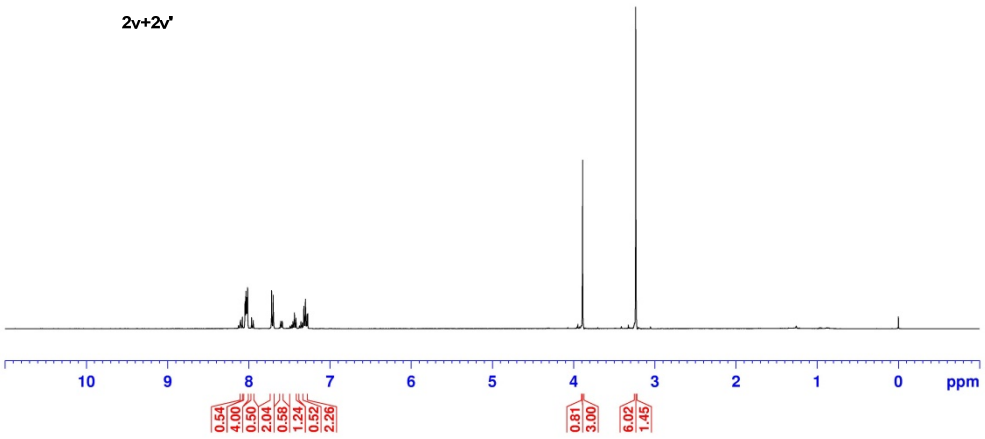
2u+2u'

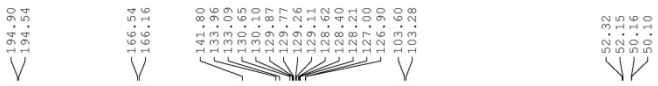

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

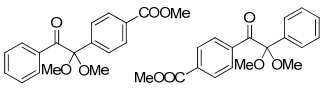

8.105
8.101
8.079
8.045
8.037
8.032
8.027
8.024
8.020
8.015
7.966
7.945
7.720
7.715
7.703
7.698
7.611
7.607
7.590
7.587
7.493
7.473
7.457
7.454
7.438
7.423
7.420
7.417
7.380
7.375
7.358
7.339
7.322
7.302
7.288
7.284
7.274
3.892
3.889
3.235
3.231


COOMe
O
MeO
OMe
MeOOC
O
MeO
OMe

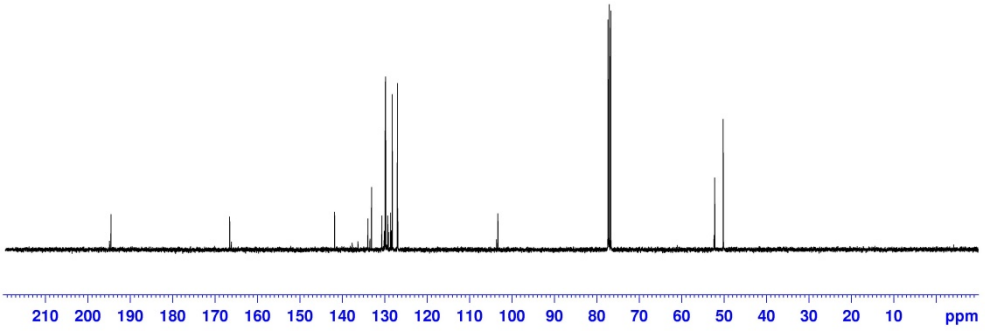
2v+2v'

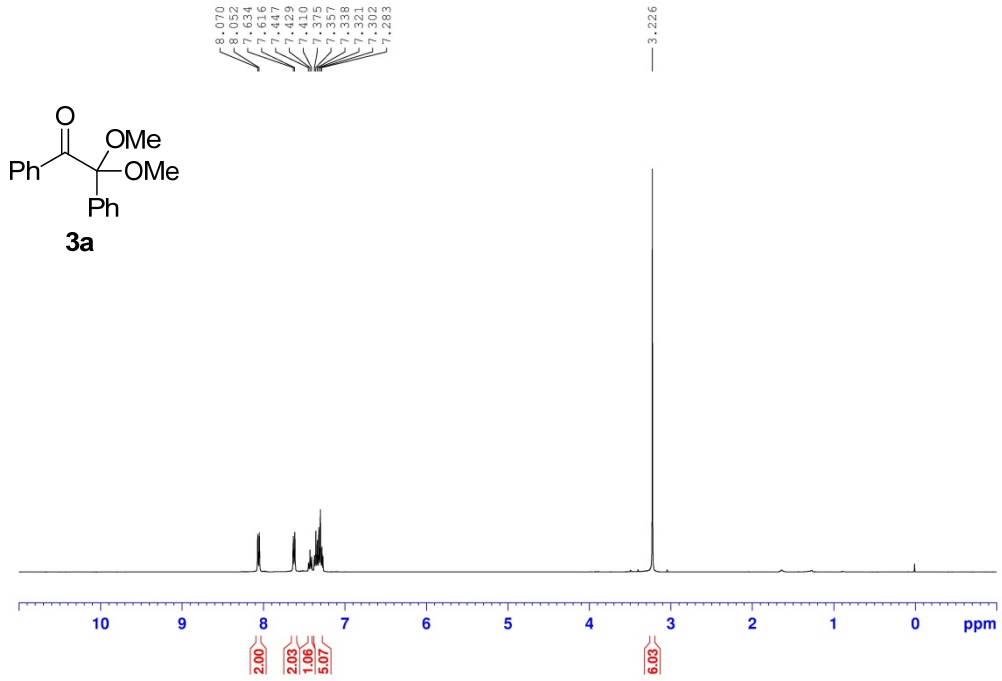

10
9
8
7
6
5
4
3
2
1
0
ppm
0.54
4.00
0.50
2.04
0.58
1.24
0.52
2.26
0.81
3.00
6.02
1.45

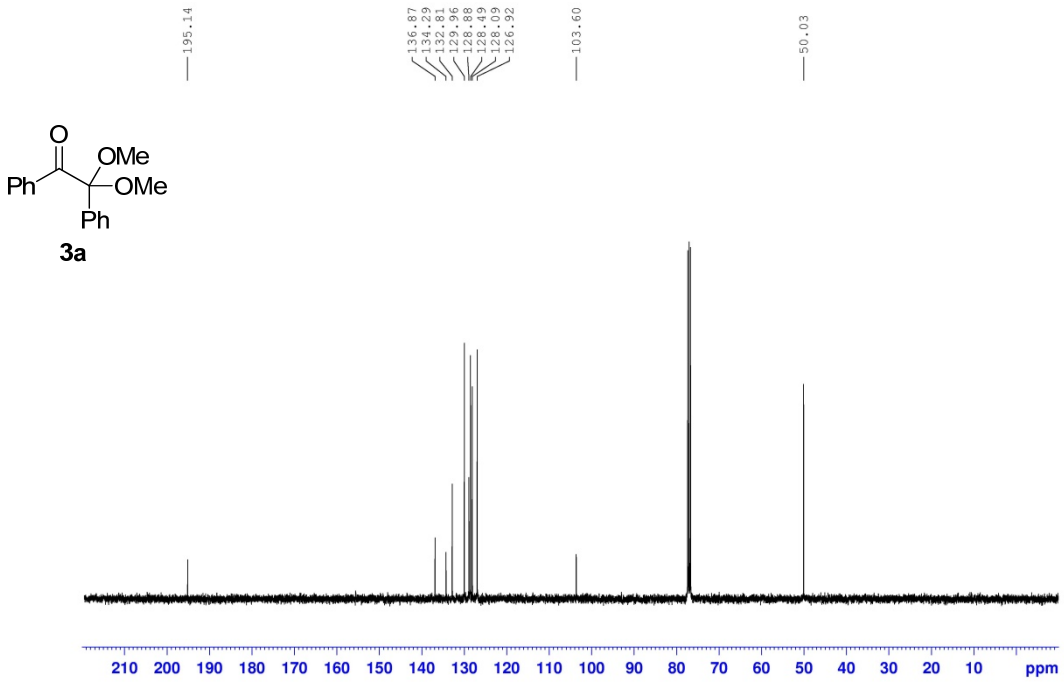

194.90
194.54
166.54
166.16
141.80
133.96
133.09
130.65
130.10
129.87
129.77
129.26
129.11
128.62
128.40
128.21
127.00
126.90
103.60
103.28
52.32
52.15
50.16
50.10

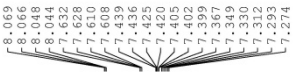

COOMe
O
MeO
OMe
MeOOC
O
MeO
OMe

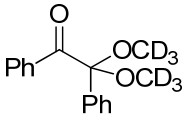
2v+2v'


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

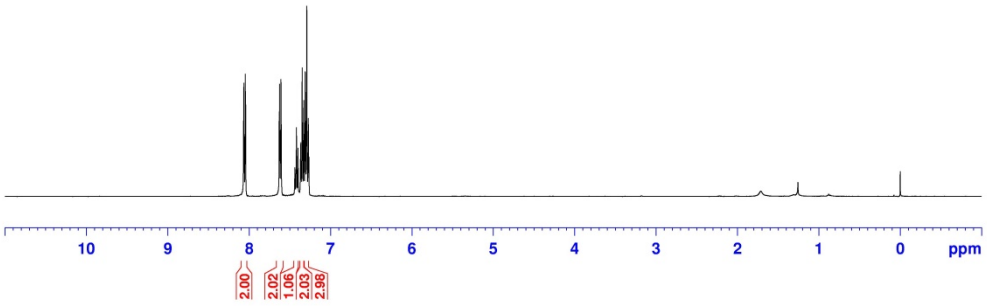

8.070
8.052
7.634
7.616
7.447
7.429
7.410
7.375
7.357
7.338
7.321
7.302
7.283
3.226
O
OMe
Ph
OMe
Ph
3a
10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.03
1.06
5.07
6.03


195.14
136.87
134.29
132.81
129.96
128.88
128.49
128.09
126.92
103.60
50.03
O
OMe
Ph
OMe
Ph
3a
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

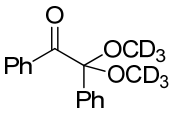

8.069
8.066
8.048
8.044
7.632
7.628
7.610
7.608
7.439
7.436
7.425
7.420
7.405
7.402
7.399
7.367
7.349
7.330
7.312
7.293
7.274


O
Ph
OCD3
OCD3
Ph

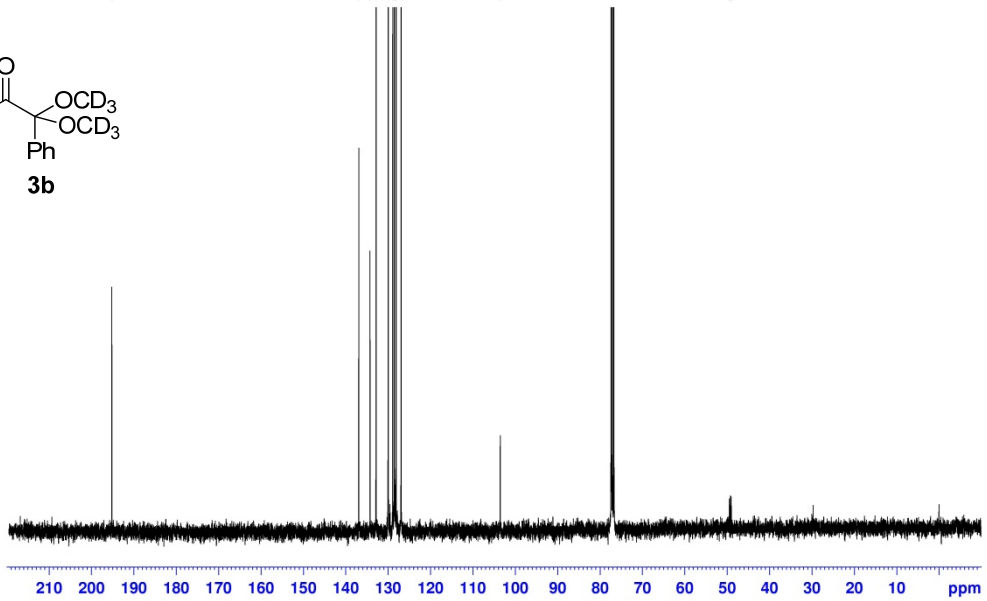
3b

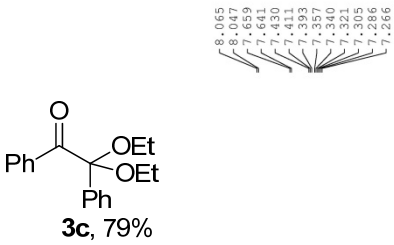

10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.02
1.06
2.03
2.96


195.16
136.87
134.23
132.81
129.95
128.86
128.48
128.08
126.89
103.49
49.41
49.20
48.98


O
Ph
OCD3
OCD3
Ph

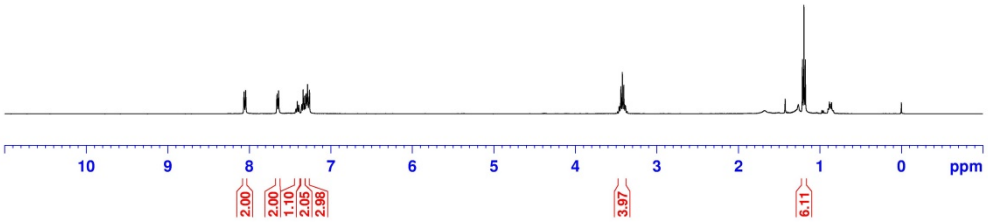
3b

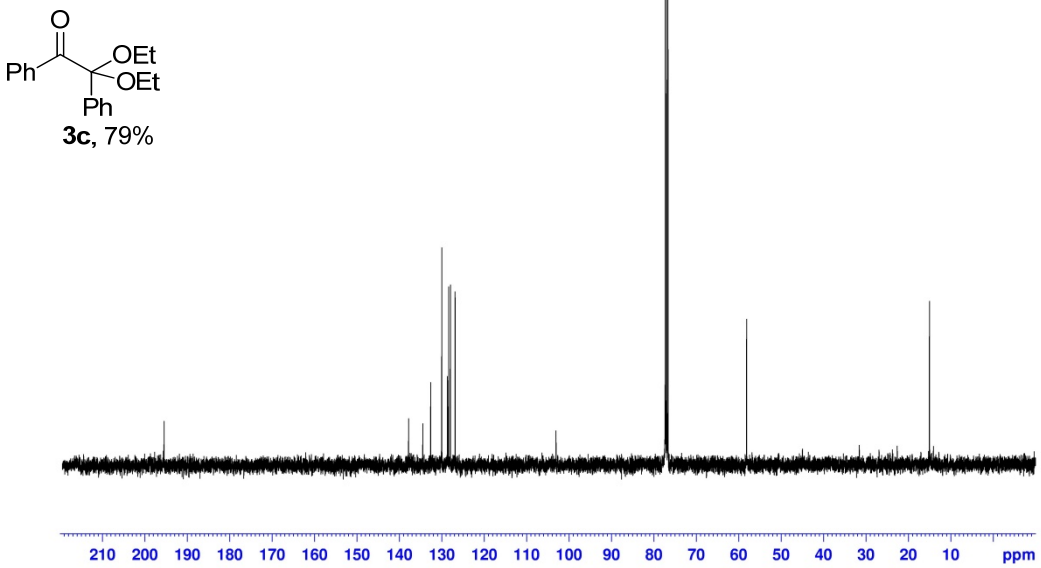

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


O
Ph
OEt
OEt
Ph

3c, 79%

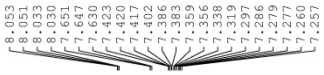

8.065
8.047
7.659
7.641
7.430
7.411
7.393
7.357
7.340
7.321
7.305
7.286
7.266
3.464
3.458
3.441
3.423
3.406
3.388
3.382
1.213
1.195
1.178

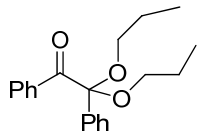

10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.00
1.10
2.05
2.98
3.97
6.11


O
Ph
OEt
OEt
Ph

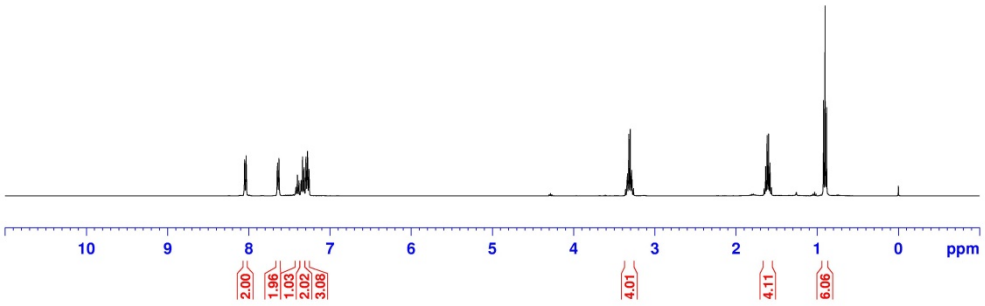
3c, 79%

195.48
137.83
134.50
132.64
130.02
128.69
128.40
127.97
126.87
103.09
58.15
15.03
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

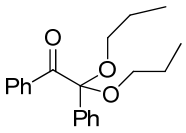

8.053
8.051
8.033
8.030
7.651
7.647
7.630
7.423
7.420
7.417
7.402
7.386
7.383
7.359
7.356
7.338
7.319
7.297
7.286
7.279
7.277
7.260
7.257
3.361
3.344
3.338
3.320
3.303
3.286
3.280
3.263
1.653
1.635
1.617
1.599
1.582
1.564
0.922
0.903
0.885


O
Ph
O
O
Ph

3d


10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
1.96
1.03
2.02
3.08
4.01
4.11
6.06


195.51
137.98
134.61
132.57
130.00
128.64
128.36
127.92
126.86
102.74
63.94
22.78
10.72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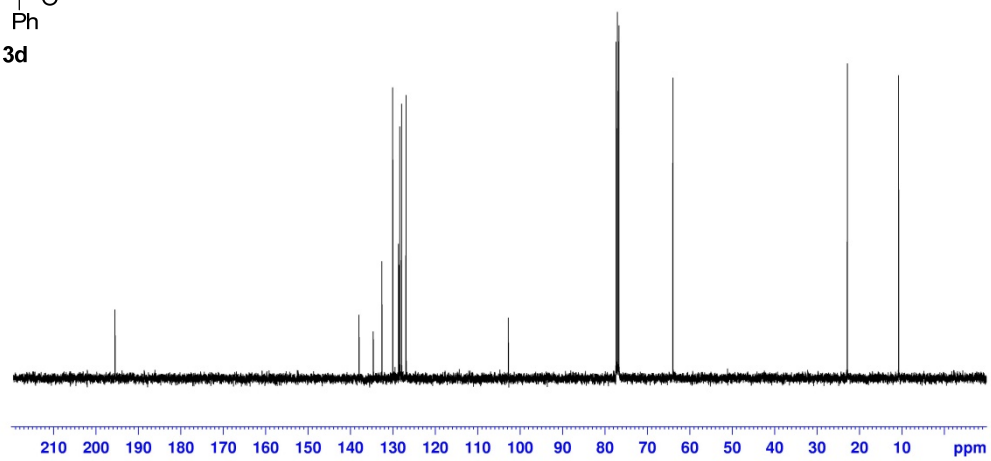
Ph
O
O
Ph

3d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50
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30
20
10
ppm


8.039
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8.018
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7.635
7.618
7.421
7.403
7.387
7.384
7.353
7.335
7.316
7.296
7.277
7.258
3.394
3.377
3.370
3.360
3.353
3.350
3.333
3.326
3.317
3.310
3.293
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1.584
1.577
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1.336
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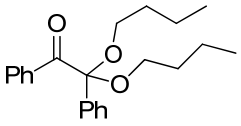
0.841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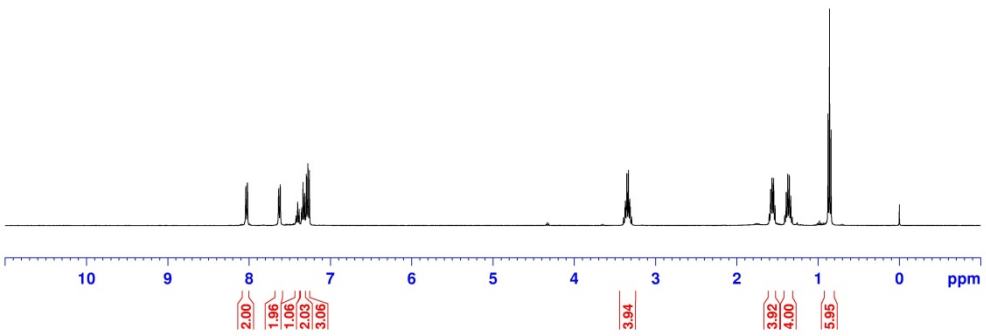
Ph
O
O
Ph

3e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3.06
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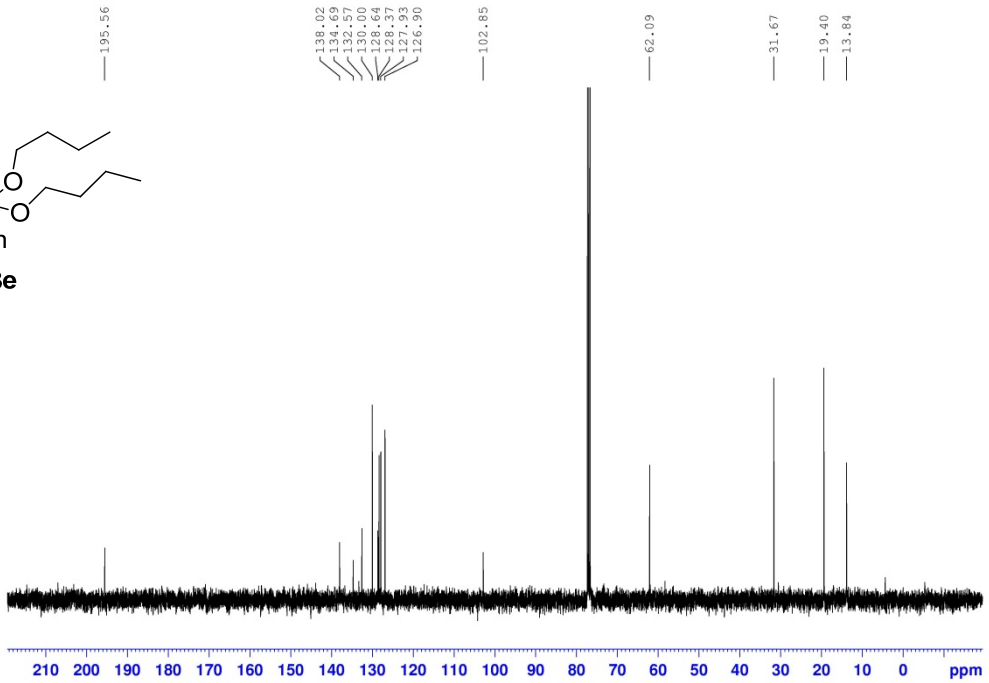
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127.93
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102.85
62.09
31.67
19.40
13.84
210
200
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140
130
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20
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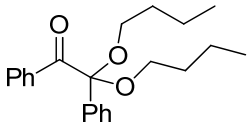
O
Ph
O
O
Ph

3e


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7.599
7.596
7.482
7.464
7.445
7.399
7.392
7.377
7.359
7.341
7.322
4.222
4.206
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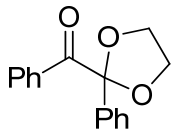
4.193
4.187
4.175
4.165
4.153
4.148
4.143
4.139
4.135
4.119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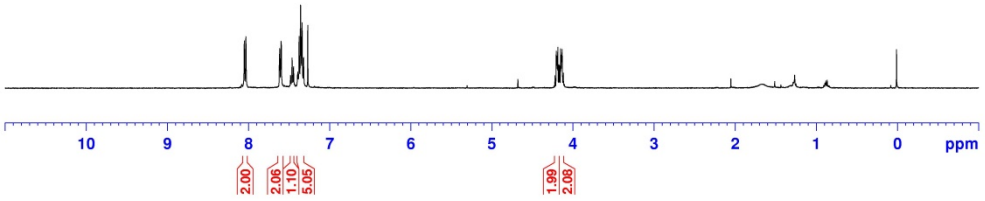
O
Ph
O
Ph

3f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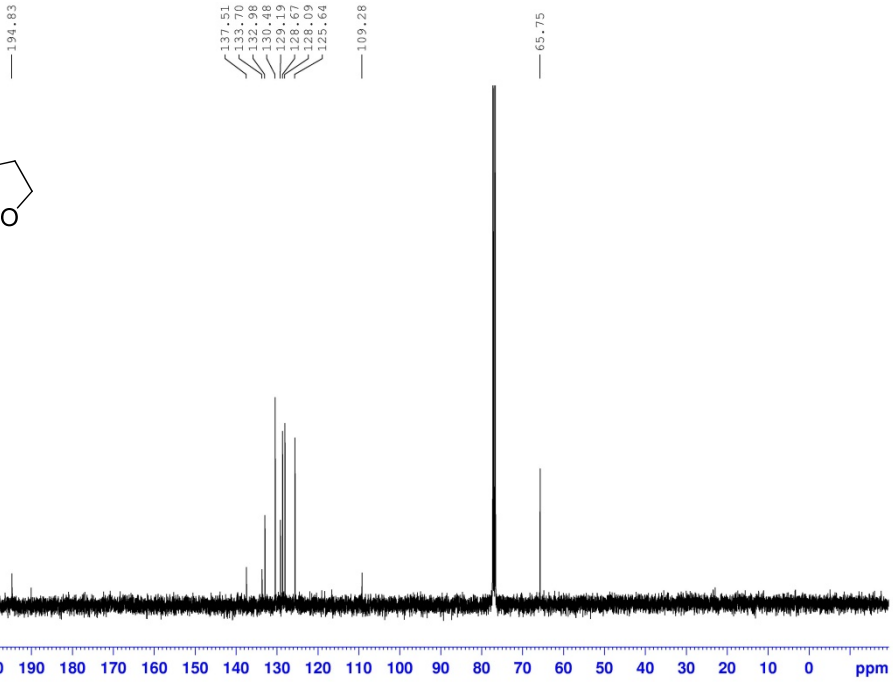
4
3
2
1
0
ppm
2.00
2.06
1.10
5.05
1.99
2.08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129.19
128.67
128.09
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109.28
65.75
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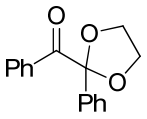
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm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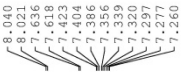
O
Ph
O
Ph

3f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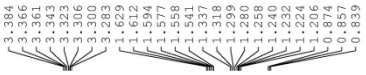
7.618
7.423
7.404
7.386
7.356
7.339
7.320
7.297
7.277
7.260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3.361
3.343
3.323
3.306
3.300
3.283
1.629
1.612
1.594
1.577
1.558
1.541
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1.224
1.206
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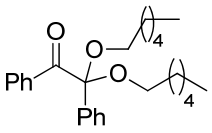
0.857
0.839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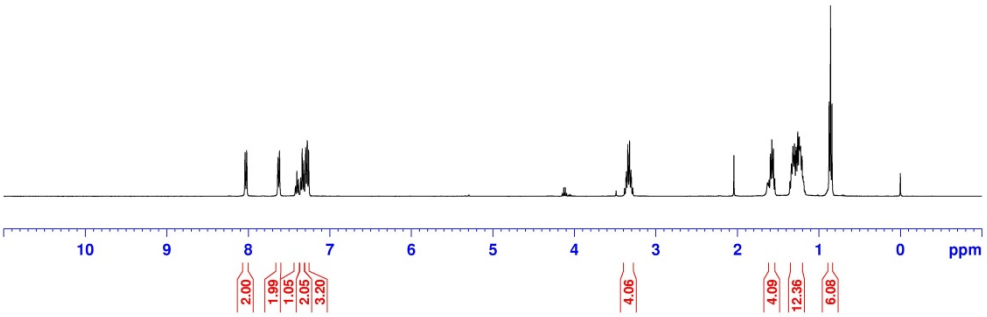
O
4
Ph
O
4
Ph

3g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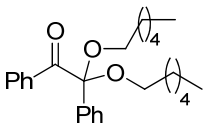
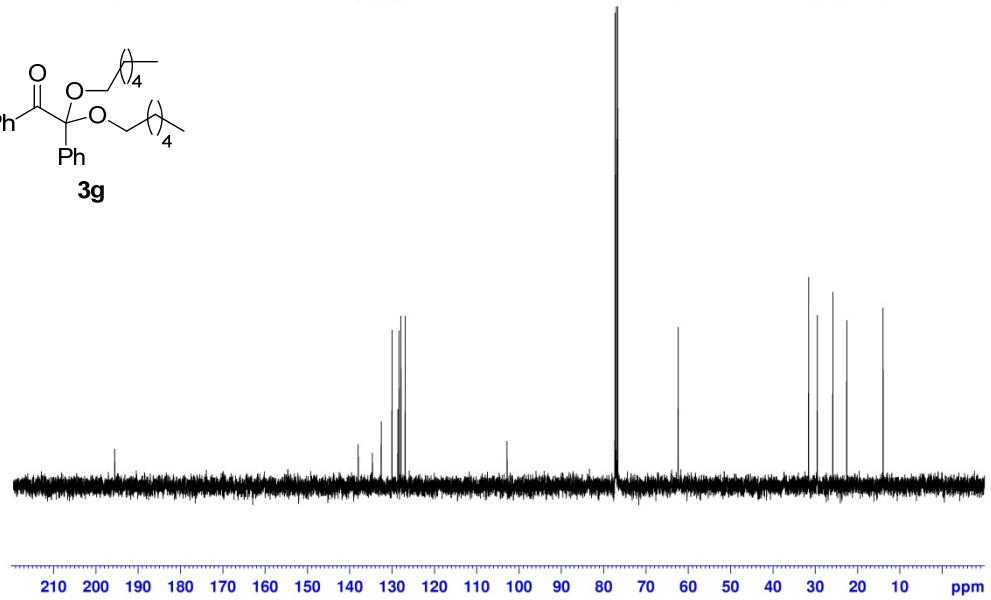
8
7
6
5
4
3
2
1
0
ppm
2.00
1.99
1.05
2.05
3.20
4.06
4.09
12.36
6.08


195.57
138.01
134.66
132.57
130.01
128.64
128.37
127.92
126.89
102.84
62.39
31.56
29.51
25.85
22.55
13.99


O
O
4
Ph
O
4
Ph

3g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200
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180
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150
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120
110
100
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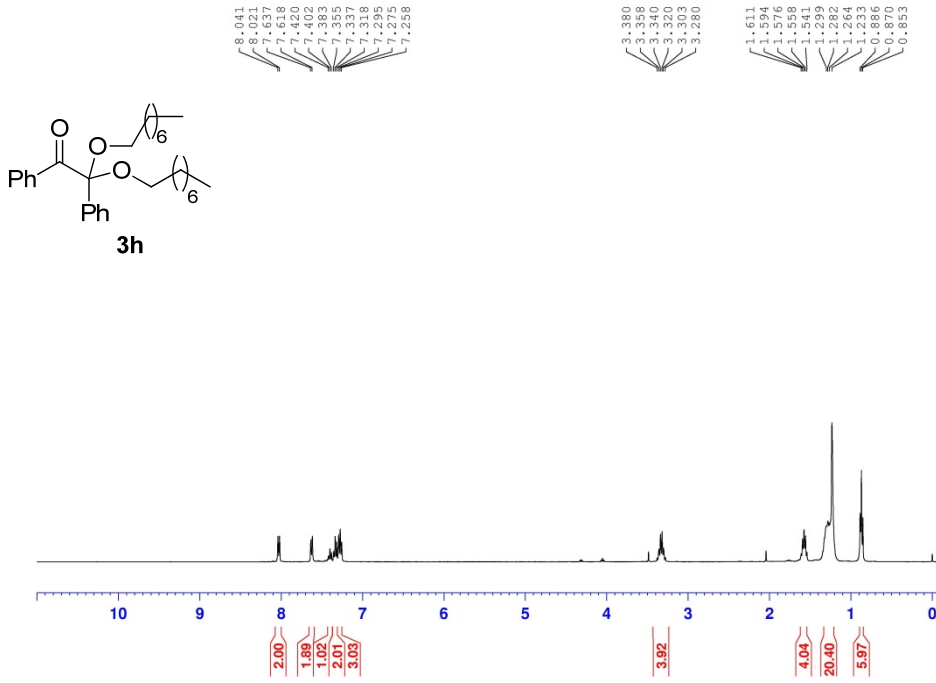
80
70
60
50
40
30
20
10
ppm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7.618
7.420
7.402
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7.355
7.337
7.318
7.295
7.275
7.258
3.380
3.358
3.340
3.320
3.303
3.280
1.611
1.594
1.576
1.558
1.541
1.299
1.282
1.264
1.233
0.886
0.870
0.853
O
O
6
Ph
O
6
Ph
10
9
8
7
6
5
4
3
2
1
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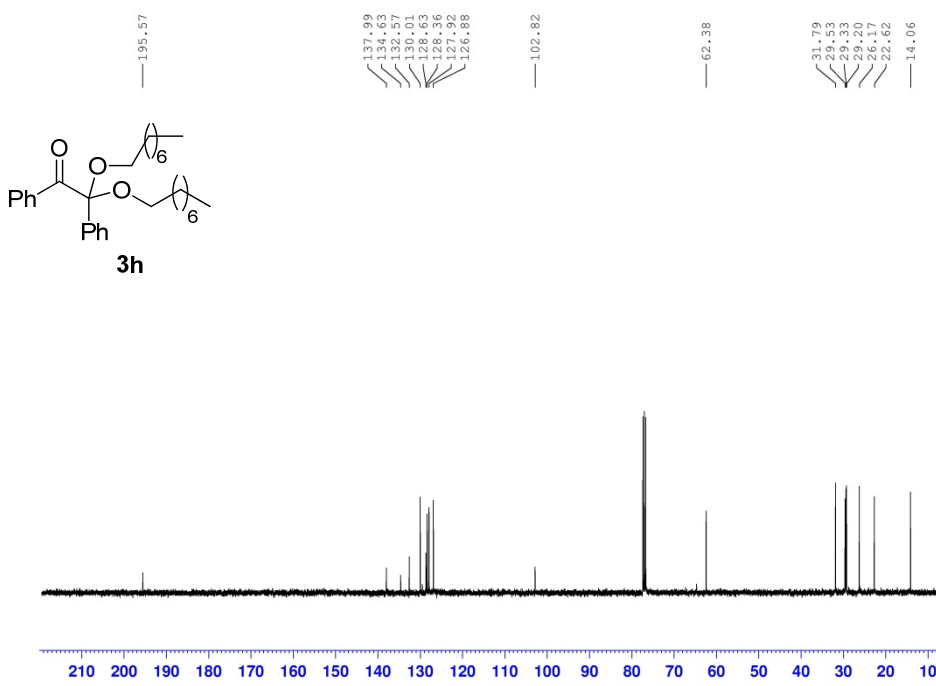
ppm
2.00
1.89
1.02
2.01
3.03
3.92
4.04
20.40
5.97

3h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132.57
130.01
128.63
128.36
127.92
126.88
102.82
62.38
31.79
29.53
29.33
29.20
26.17
22.62
14.06
O
O
6
Ph
O
6
Ph
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

3h


7.943
7.940
7.927
7.922
7.919
7.549
7.545
7.528
7.525
7.361
7.358
7.355
7.344
7.339
7.335
7.324
7.321
7.317
7.315
7.309
7.293
7.287
7.273
7.268
7.263
7.252
7.233
7.229
7.213
7.199
7.194
4.157
4.142
4.126
4.111
4.096
4.080
4.065
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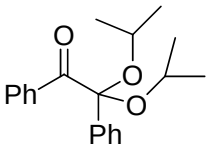
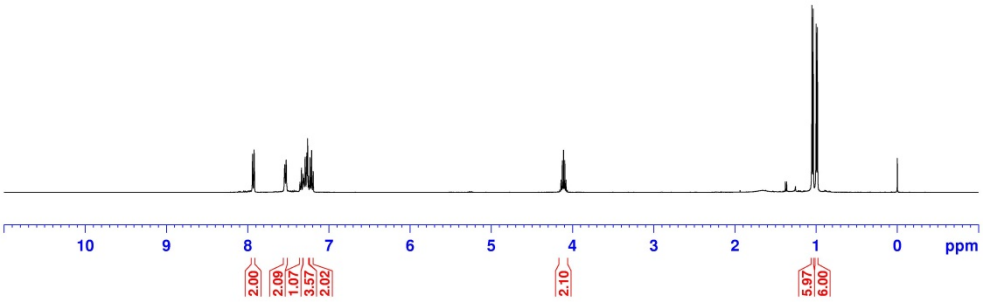
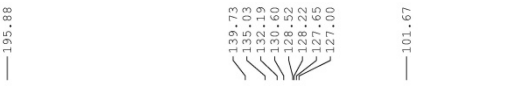
1.036
1.000
0.984


O
Ph
O
O
Ph

3i


10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.09
1.07
3.57
2.02
2.10
5.97
6.00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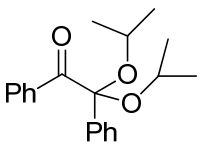
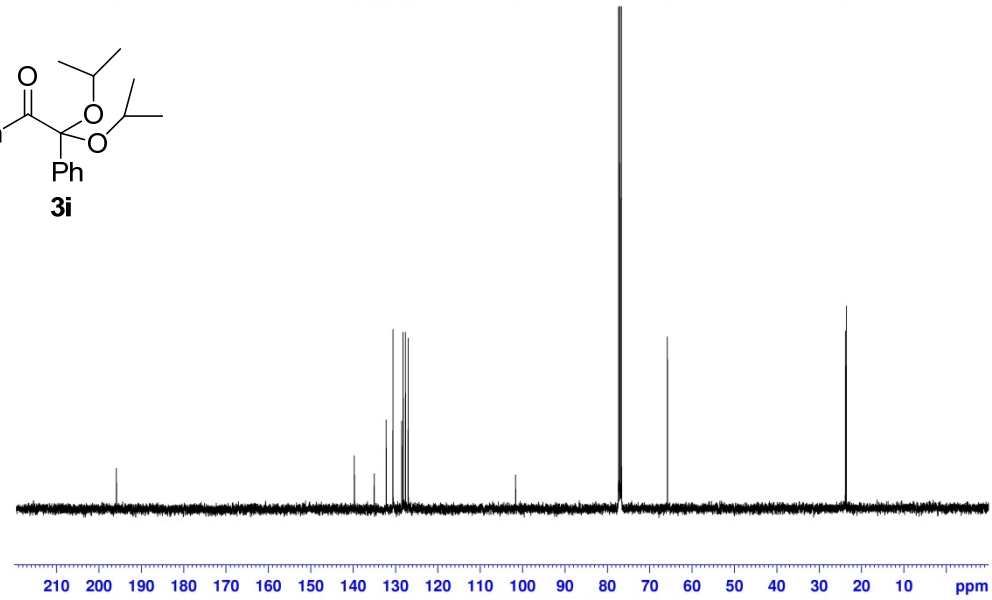
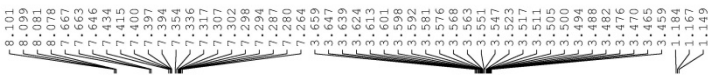
128.52
128.22
127.65
127.00
101.67
65.81
23.78
23.58


O
Ph
O
O
Ph

3i


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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7.434
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7.400
7.397
7.394
7.354
7.336
7.317
7.307
7.302
7.298
7.294
7.287
7.280
7.264
3.659
3.647
3.639
3.624
3.613
3.601
3.598
3.592
3.581
3.576
3.568
3.563
3.551
3.547
3.523
3.517
3.511
3.505
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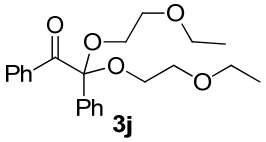
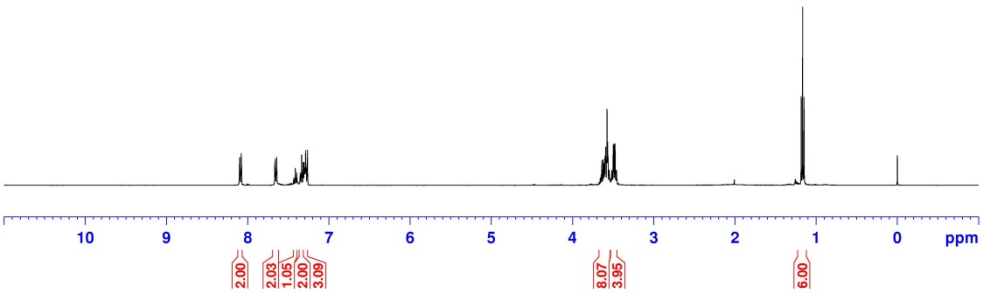
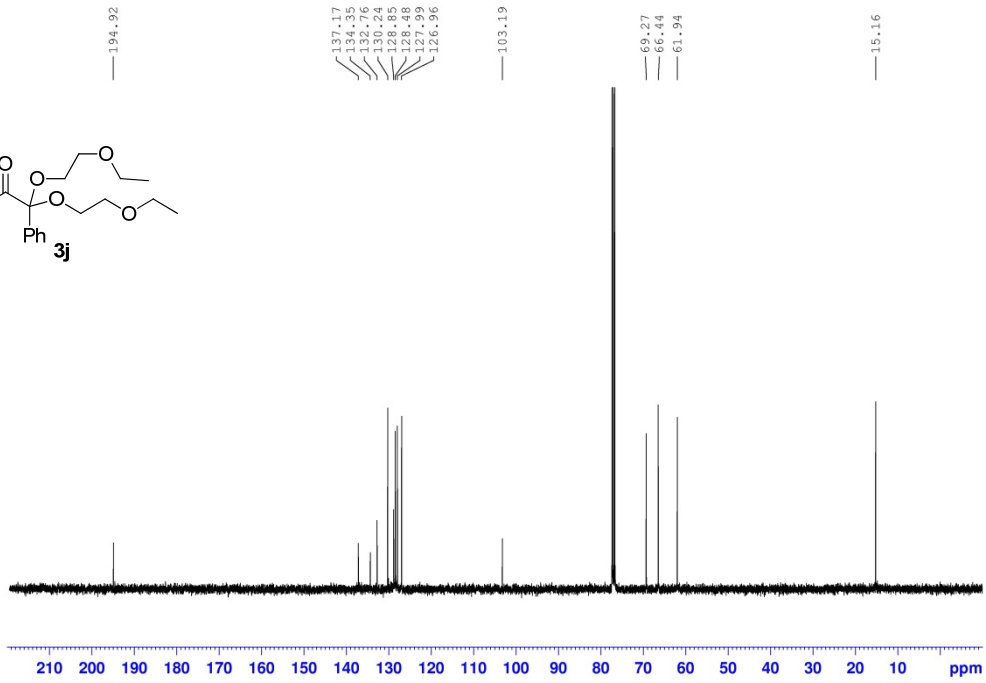
3.476
3.470
3.465
3.459
1.184
1.167
1.149


O
O
O
O
Ph
Ph

3j


10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.03
1.05
2.00
3.09
8.07
3.95
6.00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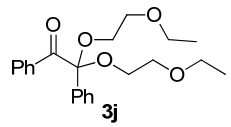
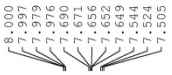
132.76
130.24
128.85
128.48
127.99
126.96
103.19
69.27
66.44
61.94
15.16
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


O
O
O
O
Ph
Ph

3j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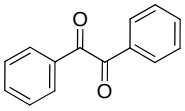
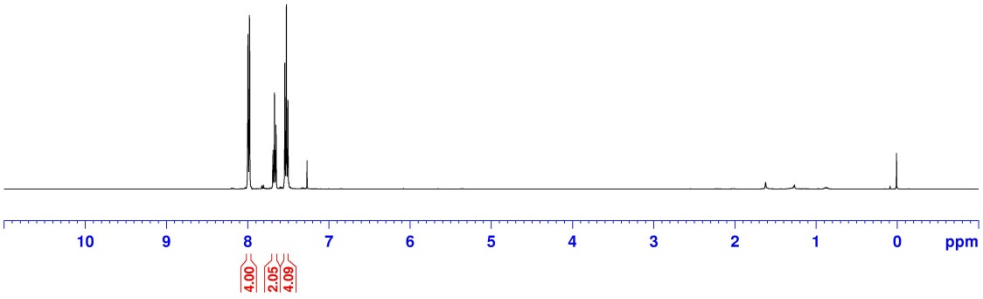
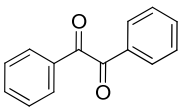
7.544
7.524
7.505


O
O

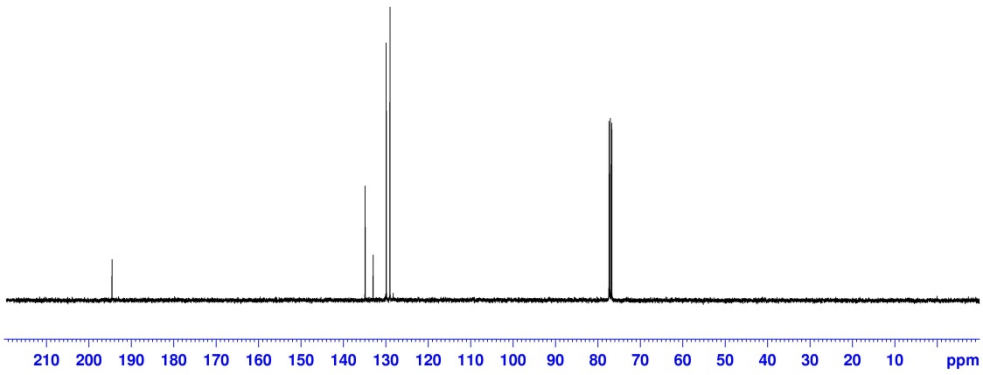
4a

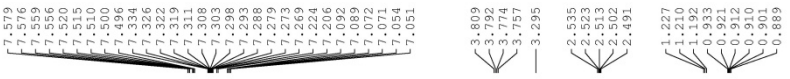

10
9
8
7
6
5
4
3
2
1
0
ppm
4.00
2.05
4.09


194.55
134.87
132.97
129.88
129.00


O
O

4a


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


7.579
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7.559
7.556
7.520
7.515
7.500
7.496
7.334
7.326
7.322
7.319
7.311
7.308
7.303
7.298
7.293
7.288
7.279
7.273
7.269
7.224
7.206
7.092
7.089
7.072
7.071
7.054
7.051
3.809
3.792
3.774
3.757
3.295
2.535
2.523
2.513
2.502
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1.210
1.192
1.133
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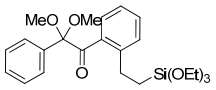
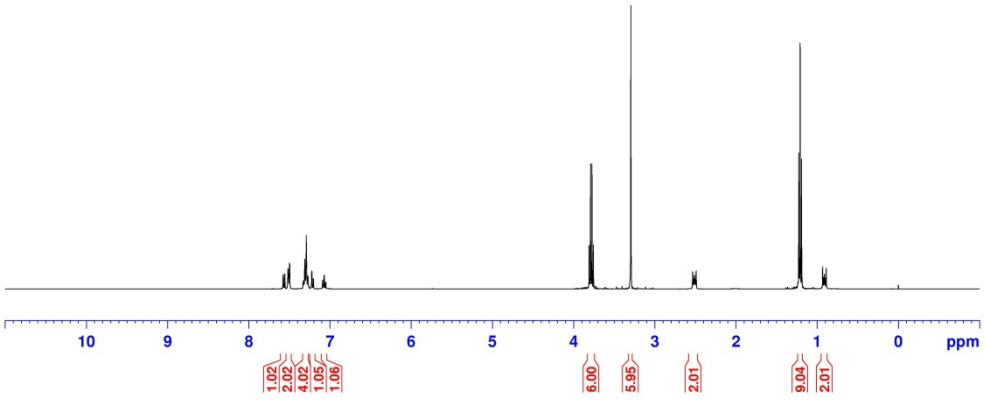
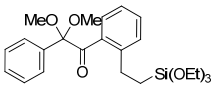
0.911
0.910
0.901
0.889


MeO
OMe
O
Si(OEt)3

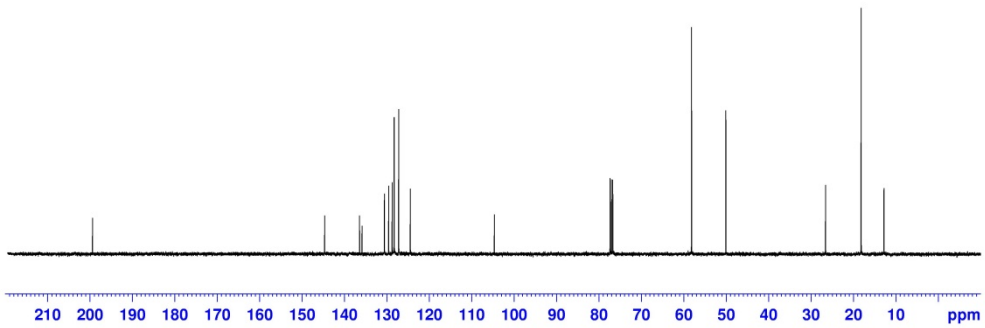
4b


10
9
8
7
6
5
4
3
2
1
0
ppm
1.02
2.02
4.02
1.05
1.06
6.00
5.95
2.01
9.04
2.01


199.38
144.64
136.42
135.82
130.55
129.54
128.73
128.27
128.25
127.18
124.44
104.62
58.18
50.08
26.57
18.19
12.80


MeO
OMe
O
Si(OEt)3

4b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180
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130
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100
90
80
70
60
50
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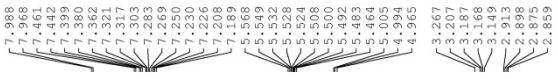
30
20
10
ppm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7.461
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7.399
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7.321
7.317
7.303
7.283
7.269
7.250
7.230
7.226
7.208
7.189
5.568
5.549
5.532
5.528
5.524
5.508
5.500
5.492
5.483
5.464
5.005
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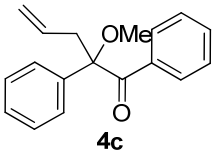
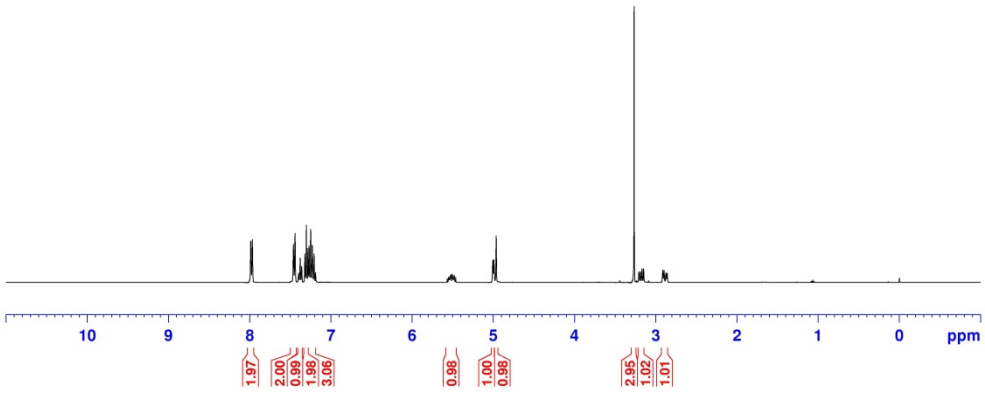
4.965
3.267
3.207
3.187
3.168
3.149
2.913
2.898
2.875
2.859


OMe
O

4c


10
9
8
7
6
5
4
3
2
1
0
ppm
1.97
2.00
0.99
1.98
3.06
0.98
1.00
0.98
2.95
1.02
1.01


200.59
140.52
134.90
132.56
132.21
129.97
128.31
127.97
127.32
125.25
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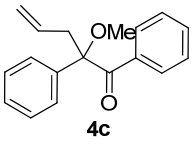
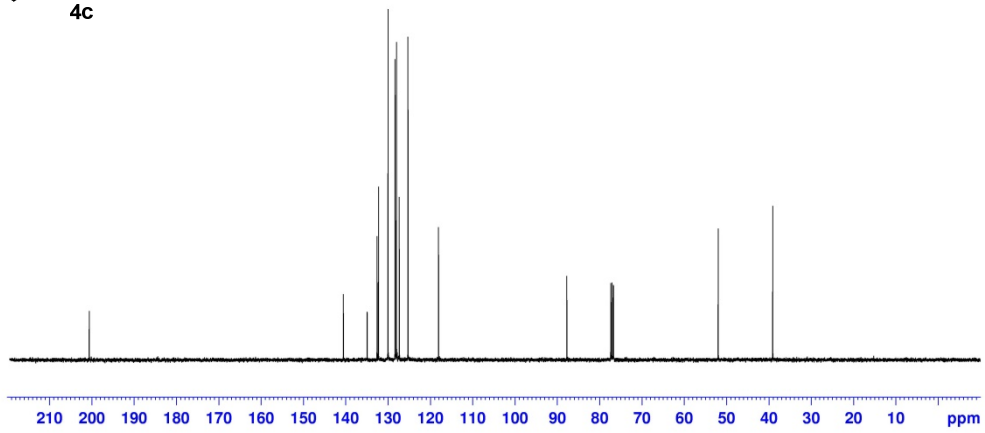
87.71
51.93
39.04


OMe
O

4c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200
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160
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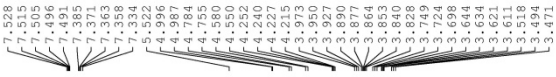
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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7.515
7.505
7.496
7.491
7.385
7.371
7.363
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7.334
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4.996
4.987
4.784
4.755
4.580
4.550
4.252
4.240
4.227
4.215
3.973
3.950
3.927
3.890
3.877
3.864
3.853
3.840
3.828
3.749
3.724
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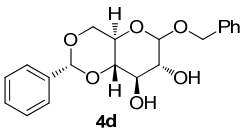
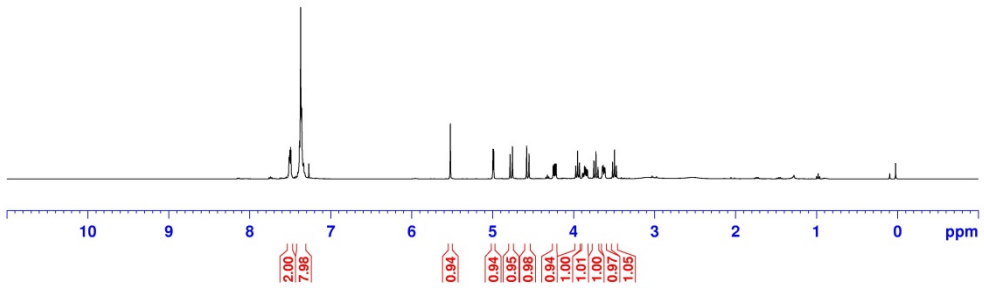
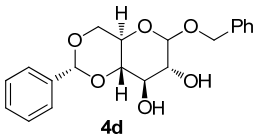
3.634
3.621
3.611
3.518
3.494
3.471


H
O
O
Ph
O
O
H
OH
OH

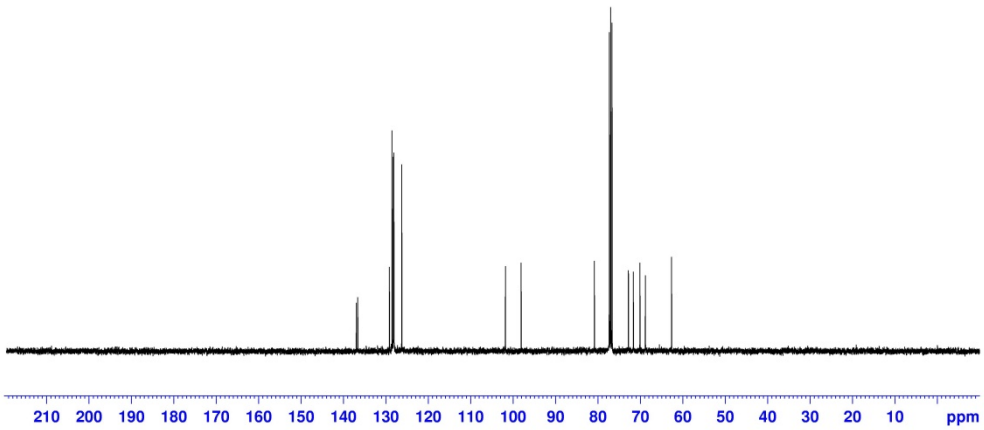
4d

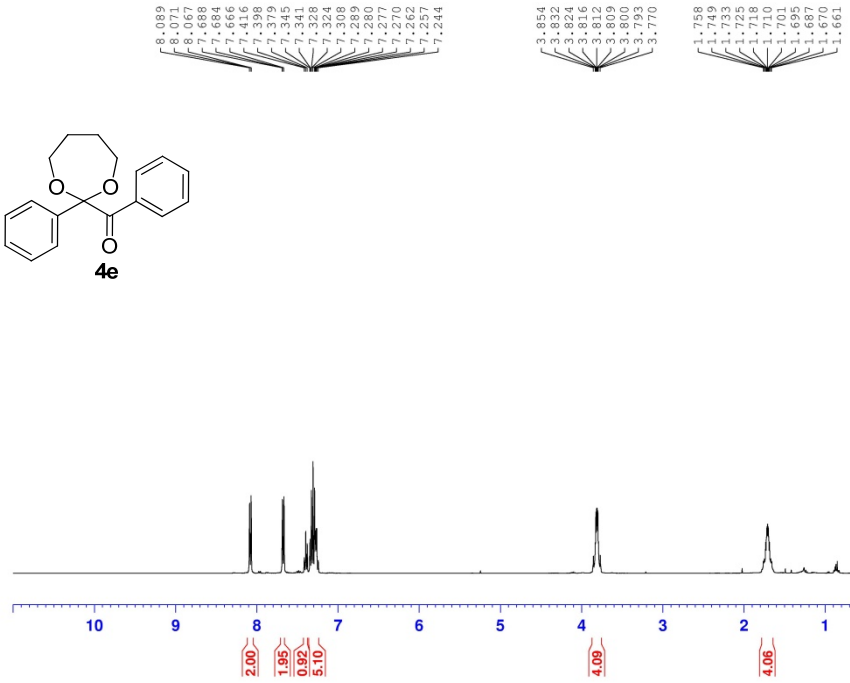

10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
7.98
0.94
0.94
0.95
0.98
0.94
1.00
1.01
1.00
0.97
1.05

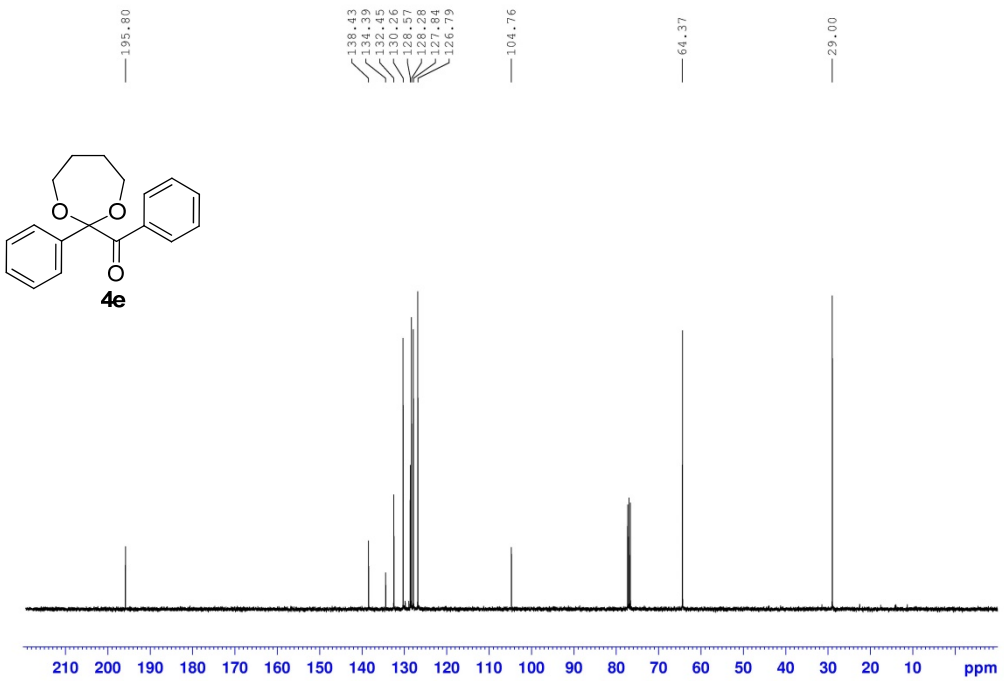

136.98
136.65
129.18
128.57
128.27
128.18
128.13
126.27
101.83
98.12
80.86
72.82
71.66
70.11
68.82
62.66

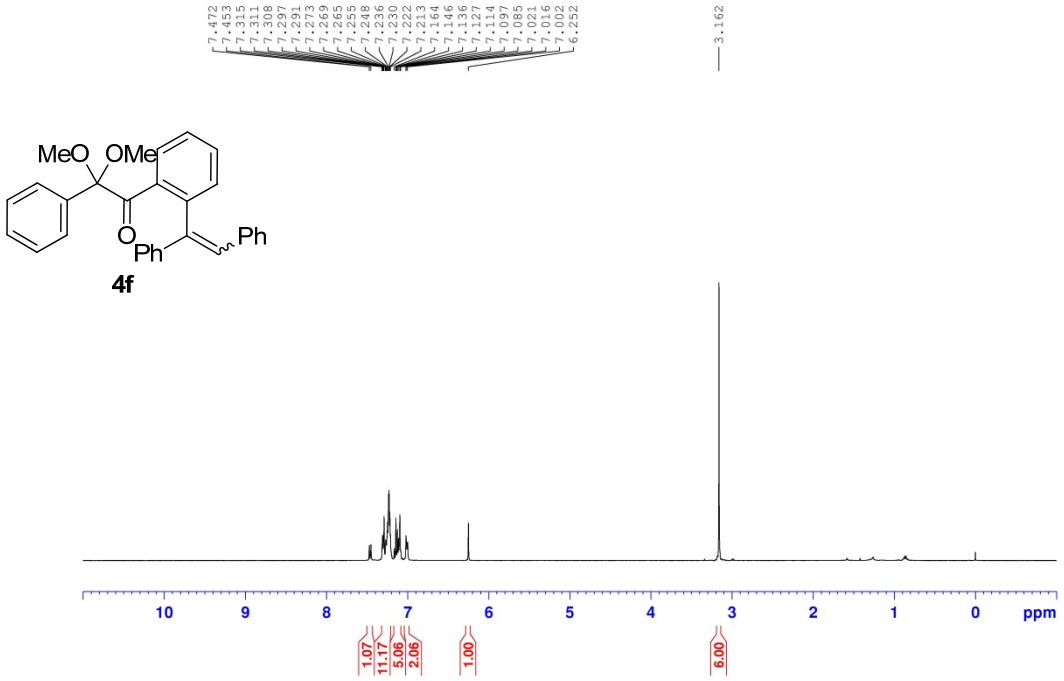

H
O
O
Ph
O
O
H
OH
OH

4d


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


8.089
8.071
8.067
7.688
7.684
7.666
7.416
7.398
7.379
7.345
7.341
7.328
7.324
7.308
7.289
7.280
7.277
7.270
7.262
7.257
7.244
3.854
3.832
3.824
3.816
3.812
3.809
3.800
3.793
3.770
1.758
1.749
1.733
1.725
1.718
1.710
1.701
1.695
1.687
1.670
1.661
4e
10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
1.95
0.92
5.10
4.09
4.06


195.80
138.43
134.39
132.45
130.26
128.57
128.28
127.84
126.79
104.76
64.37
29.00
4e
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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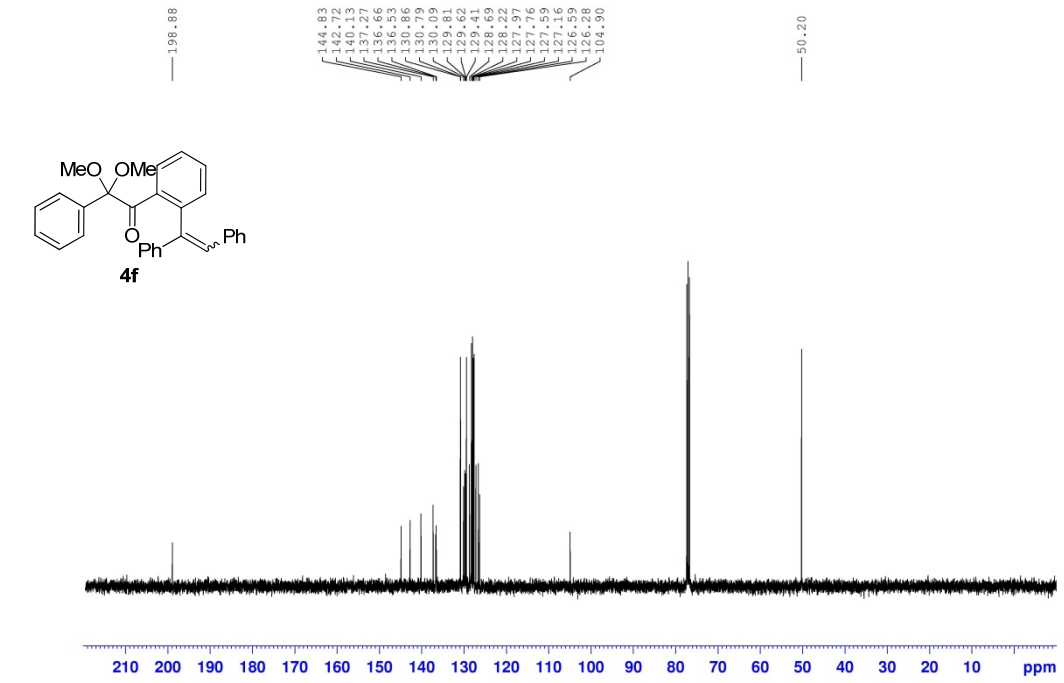
7.311
7.308
7.297
7.291
7.273
7.269
7.265
7.255
7.248
7.236
7.230
7.222
7.213
7.164
7.146
7.136
7.127
7.114
7.097
7.085
7.021
7.016
7.002
6.252
3.162
MeO
OMe
O
Ph
Ph
4f
10
9
8
7
6
5
4
3
2
1
0
ppm
1.07
11.17
5.06
2.06
1.00
6.00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142.72
140.13
137.27
136.66
136.53
130.86
130.79
130.09
129.81
129.62
129.41
128.69
128.22
127.97
127.76
127.59
127.16
126.59
126.28
104.90
50.20
MeO
OMe
O
Ph
Ph
4f
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm