Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Base-promoted C–C bond cleavage for the synthesis of 2,3,4-trisubstituted pyrroles from *N*-propargyl *β*-enaminones

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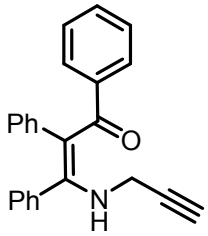
1. General information:

All the solvents were used without further purification. The other commercial chemicals were used without further purification. All reactions were performed under an inert atmosphere of nitrogen in flame-dried glassware, unless otherwise stated. Analytical thin layer chromatography was performed on 0.25 mm silica gel 60-F254. Visualization was carried out with UV light and Vogel's permanganate. ^{1}H NMR spectra were recorded on Bruker DRX-500 instrument (500 MHz). ^{13}C NMR spectra were recorded on Bruker DRX-500 instrument (126MHz) were fully decoupled by broad band proton decoupling. High-resolution mass spectra (HRMS) were recorded on an Agilent 1290 Mass spectrometer using ESI-TOF (electrospray ionization-time of flight). NMR spectra were recorded in $CDCl_3$. ^{1}H NMR spectra were referenced to residual $CHCl_3$ at 7.26 ppm, and ^{13}C NMR spectra were referenced to the central peak of $CDCl_3$ at 77.0 ppm. Chemical shifts (δ) are reported in ppm, and coupling constants (J) are in Hertz (Hz). Multiplicities are reported using the following abbreviations: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet.

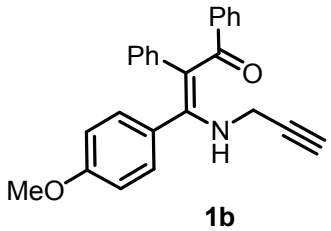
2.1 General procedure for the synthesis of 1a-1e, 1aa-1ag.

To a mixture of the *N*-propargyl enaminone (2.0 mmol, 1.0 eq.) and CsF (759.5 mg, 5.0 mmol) in acetonitrile (10 mL, 0.2 M) in an oven dried 50 mL glass vial was added the *o*-silyl aryltriflate (745.9 mg, 2.5 mmol). The mixture was stirred at room temperature for 24 h, and was monitored by TLC. After completion of the reaction, the mixture was dissolved in H_2O (10 mL) and was extracted with EtOAc (3 x 20 mL). The combined EtOAc extracts were dried over Na_2SO_4 and concentrated. The crude product was purified by silica gel column using EtOAc/hexanes (1:50 v/v) as eluent to afford the desired product.



1a

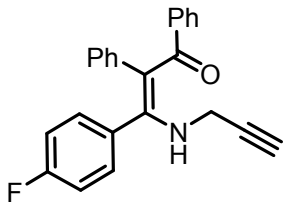
(*Z*)-1,2,3-triphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1a). The title compound as a yellow solid (593.8 mg, 88%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.41 (t, *J* = 6.2 Hz, 1H), 7.20 – 7.16 (m, 5H), 7.15 – 7.03 (m, 5H), 6.85 – 6.77 (m, 3H), 6.76 – 6.72 (m, 2H), 3.82 (dd, *J* = 6.0, 2.5 Hz, 2H), 2.29 (t, *J* = 2.5 Hz, 1H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.7, 165.7, 142.4, 139.2, 133.4, 133.3, 128.6, 128.5, 128.5, 128.1, 128.0, 127.1, 127.0, 125.1, 110.2, 79.6, 72.4, 72.3, 34.3; HRMS (ESI-TOF) calcd for $C_{24}H_{20}NO^+$ $[M+H]^+$: 338.1539, found: 338.1539.



1b

(*Z*)-3-(4-methoxyphenyl)-1,2-diphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1b). The title compound as a yellow solid (572.9 mg, 78%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.43 (t, *J* = 5.8 Hz, 1H), 7.19 – 7.14 (m, 2H), 7.14 – 7.11 (m, 1H), 7.07 (dd, *J* = 8.1, 6.6 Hz, 2H), 7.04 – 6.99 (m, 2H), 6.87 – 6.81 (m, 3H), 6.76 – 6.69 (m, 4H), 3.86 (dd, *J* = 6.0, 2.5 Hz,

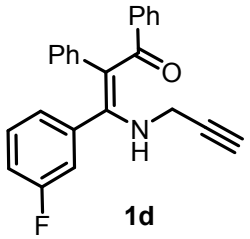
2H), 3.73 (d, *J* = 1.9 Hz, 3H), 2.31 (t, *J* = 2.5 Hz, 1H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.7, 165.9, 159.5, 142.6, 139.5, 133.3, 130.1, 128.5, 128.1, 127.1, 127.1, 125.7, 125.0, 113.5, 110.5, 79.8, 72.3, 55.1, 34.4; HRMS (ESI-TOF) calcd for $C_{25}H_{22}NO_2^+$ $[M+H]^+$: 368.1645, found: 368.1647.



1c

(*Z*)-3-(4-fluorophenyl)-1,2-diphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1c).

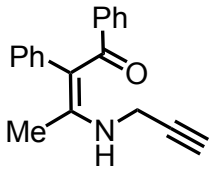
The title compound as a yellow solid (532.1 mg, 75%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.36 (t, *J* = 6.2 Hz, 1H), 7.17 (q, *J* = 1.4 Hz, 1H), 7.16 (d, *J* = 1.6 Hz, 1H), 7.15 – 7.13 (m, 1H), 7.12 – 7.05 (m, 4H), 6.94 – 6.88 (m, 2H), 6.88 – 6.84 (m, 3H), 6.74– 6.69 (m, 2H), 3.83 (dd, *J* = 6.1, 2.6 Hz, 2H), 2.31 (t, *J* = 2.5 Hz, 1H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 194.0, 164.7, 162.4 (d, *J* = 249.2 Hz), 142.3, 139.1, 133.3, 130.7 (d, *J* = 6.9 Hz), 129.5 (d, *J* = 3.7 Hz), 128.8, 128.1, 127.2 (d, *J* = 9.3 Hz), 125.3, 115.3 (d, *J* = 21.7 Hz), 110.6, 79.6, 72.5, 34.3; HRMS (ESI-TOF) calcd for $C_{24}H_{19}FNO^+$ $[M+H]^+$: 356.1445, found: 356.1444.



1d

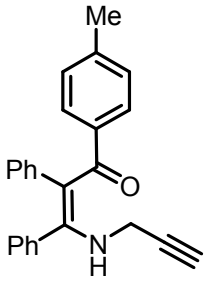
(*Z*)-3-(3-fluorophenyl)-1,2-diphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1d).

The title compound as a yellow solid (504.9 mg, 71%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.44 – 12.08 (m, 1H), 7.24 – 7.12 (m, 4H), 7.08 (t, *J* = 7.5 Hz, 2H), 6.96 – 6.81 (m, 6H), 6.79 – 6.70 (m, 2H), 3.83 (dd, *J* = 6.1, 2.5 Hz, 2H), 2.32 (t, *J* = 2.6 Hz, 1H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 194.1, 163.9, 162.2 (d, *J* = 248.0 Hz), 142.2, 138.8, 135.4 (d, *J* = 7.8 Hz), 133.2, 129.9 (d, *J* = 8.3 Hz), 128.8, 128.2, 127.2 (d, *J* = 10.0 Hz), 125.4, 124.5 (d, *J* = 3.2 Hz), 115.9 (d, *J* = 22.7 Hz), 115.6 (d, *J* = 20.9 Hz), 110.4, 79.5, 72.6, 34.4; HRMS (ESI-TOF) calcd for $C_{24}H_{19}FNO^+$ $[M+H]^+$: 356.1445, found: 356.1448.



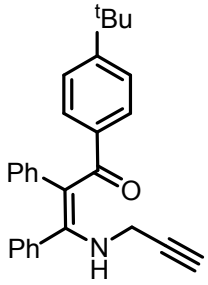
1e

(*Z*)-1,2-diphenyl-3-(prop-2-ynylamino)but-2-en-1-one (1e). The title compound as a yellow solid (457.1 mg, 83%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.62 (t, *J* = 6.0 Hz, 1H), 7.17 – 7.08 (m, 6H), 7.07 – 6.99 (m, 4H), 4.15 (dd, *J* = 5.9, 2.6 Hz, 2H), 2.35 (t, *J* = 2.6 Hz, 1H), 1.99 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 192.3, 164.3, 142.6, 139.9, 133.0, 128.2, 127.9, 127.9, 127.1, 126.0, 110.1, 79.0, 72.4, 32.9, 17.0; HRMS (ESI-TOF) calcd for $C_{19}H_{18}NO^{+}$ $[M+H]^{+}$: 276.1383, found: 276.2382.



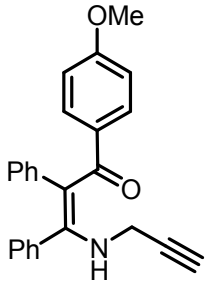
1aa

(*Z*)-2,3-diphenyl-3-(prop-2-ynylamino)-1-p-tolylprop-2-en-1-one (1aa). The title compound as a yellow solid (562.8 mg , 80%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.39 (t, *J* = 6.2 Hz, 1H), 7.23 – 7.17 (m, 3H), 7.12 – 7.06 (m, 4H), 6.88 (d, *J* = 7.9 Hz, 2H), 6.86 – 6.82 (m, 3H), 6.75 (dd, *J* = 6.6, 3.0 Hz, 2H), 3.82 (dd, *J* = 6.0, 2.6 Hz, 2H), 2.29 (t, *J* = 2.5 Hz, 1H), 2.22 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.6, 165.5, 139.6, 139.5, 138.8, 133.6, 133.3, 128.6, 128.6, 128.4, 128.0, 127.8, 127.1, 125.1, 110.3, 79.8, 72.3, 34.4, 21.3; HRMS (ESI-TOF) calcd for $C_{25}H_{22}NO^{+}$ $[M+H]^{+}$: 352.1696, found: 352.1697.



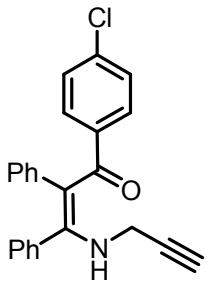
1ab

(*Z*)-1-(4-tert-butylphenyl)-2,3-diphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1ab). The title compound as a yellow solid (629.5 mg, 80%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.41 (t, *J* = 6.0 Hz, 1H), 7.20 (dd, *J* = 4.7, 1.8 Hz, 3H), 7.15 – 7.06 (m, 6H), 6.88 – 6.81 (m, 3H), 6.80 – 6.73 (m, 2H), 3.92 – 3.75 (m, 2H), 2.30 (td, *J* = 2.5, 0.8 Hz, 1H), 1.21 (d, *J* = 0.8 Hz, 9H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.5, 165.5, 151.9, 139.4, 139.4, 133.6, 133.3, 128.6, 128.4, 128.2, 128.0, 127.1, 125.0, 124.1, 110.3, 79.8, 76.8, 72.3, 34.6, 34.4, 31.1; HRMS (ESI-TOF) calcd for $C_{28}H_{28}NO^{+}$ $[M+H]^{+}$: 394.2164, found: 394.2164.



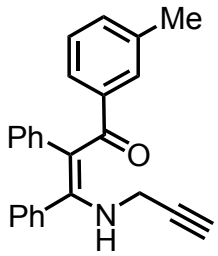
1ac

(*Z*)-1-(4-methoxyphenyl)-2,3-diphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1ac). The title compound as a yellow solid (609.5 mg, 83%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.34 (t, *J* = 5.9 Hz, 1H), 7.23 – 7.18 (m, 3H), 7.18 – 7.15 (m, 2H), 7.12 – 7.06 (m, 2H), 6.86 (dd, *J* = 5.2, 1.9 Hz, 3H), 6.80 – 6.74 (m, 2H), 6.62 – 6.56 (m, 2H), 3.81 (dd, *J* = 6.1, 2.6 Hz, 2H), 3.71 (s, 3H), 2.29 (t, *J* = 2.5 Hz, 1H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 192.7, 165.4, 160.0, 139.6, 134.8, 133.6, 133.3, 130.4, 128.6, 128.4, 128.0, 127.2, 125.1, 112.4, 110.1, 79.8, 72.2, 55.1, 34.3; HRMS (ESI-TOF) calcd for $C_{25}H_{22}NO^{+}$ $[M+H]^{+}$: 368.1645, found: 368.1646.



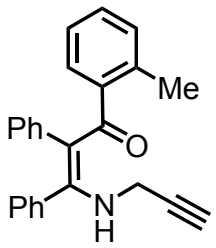
1ad

(*Z*)-1-(4-chlorophenyl)-2,3-diphenyl-3-(prop-2-ynylamino)prop-2-en-1-one (1ad). The title compound as a yellow solid (669.5 mg, 90%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.43 (t, *J* = 6.0 Hz, 1H), 7.23 – 7.19 (m, 3H), 7.12 (d, *J* = 2.0 Hz, 1H), 7.11 (d, *J* = 2.0 Hz, 1H), 7.10 – 7.07 (m, 2H), 7.06 – 7.03 (m, 2H), 6.90 – 6.82 (m, 3H), 6.76 – 6.70 (m, 2H), 3.84 (dd, *J* = 6.0, 2.5 Hz, 2H), 2.31 (t, *J* = 2.5 Hz, 1H).^{13}C NMR (126 MHz, Chloroform-*d*) δ 192.0, 166.2, 140.7, 138.9, 134.6, 133.2, 129.7, 128.6, 128.4, 128.1, 127.4, 127.3, 125.3, 110.0, 79.5, 72.5, 34.4; HRMS (ESI-TOF) calcd for $C_{24}H_{19}ClNO^{+}$ $[M+H]^{+}$: 372.1150, found: 372.1148.



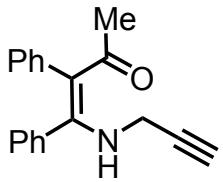
1ae

(*Z*)-2,3-diphenyl-3-(prop-2-ynylamino)-1-m-tolylprop-2-en-1-one (1ae). The title compound as a yellow solid (527.2 mg, 75%). ^{1}H NMR (500 MHz, Chloroform-d) δ 12.39 (t, J = 6.1 Hz, 1H), 7.22 – 7.16 (m, 3H), 7.12 – 7.05 (m, 3H), 6.97 – 6.86 (m, 3H), 6.85 – 6.80 (m, 3H), 6.77 – 6.72 (m, 2H), 3.82 (dd, J = 6.0, 2.5 Hz, 2H), 2.29 (t, J = 2.5 Hz, 1H), 2.16 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-d) δ 193.9, 165.6, 142.3, 139.3, 136.7, 133.5, 133.3, 129.4, 129.0, 128.6, 128.4, 128.0, 127.0, 126.8, 125.3, 125.0, 110.4, 79.7, 72.3, 34.3, 21.2; HRMS (ESI-TOF) calcd for $C_{25}H_{22}NO^{+}$ $[M+H]^{+}$: 352.1696, found: 352.1694.



1af

(*Z*)-2,3-diphenyl-3-(prop-2-ynylamino)-1-o-tolylprop-2-en-1-one (1af). The title compound as a yellow solid (541.2 mg, 77%). ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.36 (t, *J* = 6.0 Hz, 1H), 7.21– 7.16 (m, 3H), 7.15 – 7.10 (m, 2H), 7.00 – 6.93 (m, 2H), 6.90 – 6.83 (m, 2H), 6.77 – 6.72 (m, 3H), 6.71 – 6.66 (m, 2H), 3.85 (dd, *J* = 6.1, 2.5 Hz, 2H), 2.31 (s, 1H), 2.30 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 196.5, 165.6, 142.6, 138.4, 133.7, 133.4, 132.9, 129.7, 128.7, 128.6, 128.0, 127.5, 126.8, 126.7, 125.0, 124.4, 111.5, 79.7, 72.3, 34.4, 19.5; HRMS (ESI-TOF) calcd for $C_{25}H_{22}NO^{+}$ $[M+H]^{+}$: 352.1696, found: 352.1697.



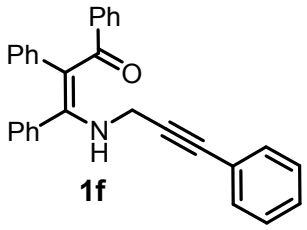
1ag

(*Z*)-3,4-diphenyl-4-(prop-2-ynylamino)but-3-en-2-one (1ag). The title compound as a yellow solid (490.2 mg 89%). ^{1}H NMR (500 MHz, Chloroform-d) δ 11.78 (t, J = 6.3 Hz, 1H), 7.18 – 7.12 (m, 3H), 7.07 – 7.01 (m, 4H), 7.01 – 6.92 (m, 3H), 3.72 (dd, J = 6.1, 2.5 Hz, 2H), 2.25 (t, J = 2.5 Hz, 1H), 1.94 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-d) δ 197.5, 163.1, 139.6, 133.3, 132.6, 128.4, 128.3, 127.9, 127.6, 125.8, 111.1, 80.0, 72.0, 34.1, 29.6; HRMS (ESI-TOF) calcd for $C_{19}H_{18}NO^{+}$ $[M+H]^{+}$: 276.1383, found: 276.2384.

2.2 General procedure for the synthesis of (1f-1r).

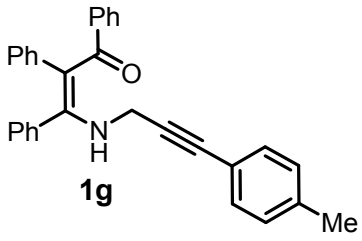
To a 15 mL oven-dried vial were added **1a** (337.4 mg, 1.0 mmol), aryl iodide (1.2 mmol), $Pd(PPh_3)_2Cl_2$ (35.0 mg, 0.05 mmol), CuI (9.5 mg, 0.05 mmol), Et_3N (15.8 mg, 1.5 mmol), and DMF (1 mL). The mixture was stirred at room temperature under nitrogen atmosphere for 12 h, and was monitored by TLC. After completion of the reaction, the mixture was dissolved in H_2O (10 mL) and was extracted with EtOAc (3 x 20 mL). The combined EtOAc extracts

were dried over Na_2SO_4 and concentrated. The crude product was purified by silica gel column using a EtOAc/hexanes (1:50 v/v) as eluent to afford the desired product.



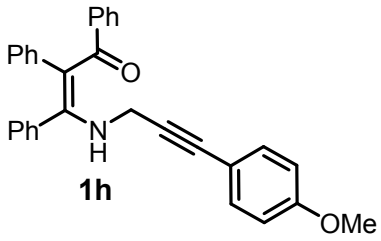
1f

(*Z*)-1,2,3-triphenyl-3-(3-phenylprop-2-ynylamino)prop-2-en-1-one (1f). The title compound as a yellow solid (207.2 mg, 53%); ^{1}H NMR (500 MHz, Chloroform-d) δ 12.51 (t, J = 6.7 Hz, 1H), 7.45 – 7.39 (m, 2H), 7.31 (s, 2H), 7.25 – 7.04 (m, 11H), 6.83 (d, J = 5.1 Hz, 3H), 6.78 – 6.73 (m, 2H), 4.06 (d, J = 5.8 Hz, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.7, 165.9, 142.5, 139.3, 133.6, 133.4, 131.7, 128.6, 128.6, 128.5, 128.4, 128.2, 128.2, 128.0, 127.1, 127.0, 125.1, 122.6, 110.2, 85.0, 84.0, 35.2; HRMS (ESI-TOF) calcd for $C_{30}H_{24}NO^+$ $[M+H]^+$: 414.1852, found: 414.1854.



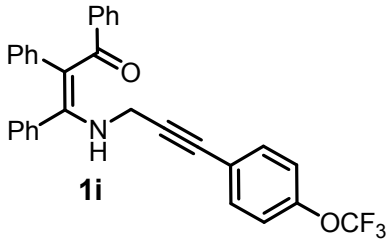
1g

(*Z*)-1,2,3-triphenyl-3-(3-p-tolylprop-2-ynylamino)prop-2-en-1-one (1g). The title compound as a yellow solid (321.1 mg, 75%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.49 (t, *J* = 5.9 Hz, 1H), 7.35 – 7.29 (m, 2H), 7.23 – 7.17 (m, 5H), 7.16 – 7.12 (m, 4H), 7.11 – 7.04 (m, 3H), 6.83 (dd, *J* = 4.9, 1.9 Hz, 3H), 6.75 (dd, *J* = 6.7, 3.0 Hz, 2H), 4.05 (d, *J* = 5.9 Hz, 2H), 2.35 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.6, 165.9, 142.5, 139.3, 138.5, 133.6, 133.4, 131.6, 129.0, 128.6, 128.6, 128.4, 128.2, 128.0, 127.1, 127.0, 125.0, 119.5, 110.1, 84.3, 84.1, 35.3, 21.5; HRMS (ESI-TOF) calcd for $C_{31}H_{26}NO^+$ $[M+H]^+$: 428.2009, found: 428.2008.



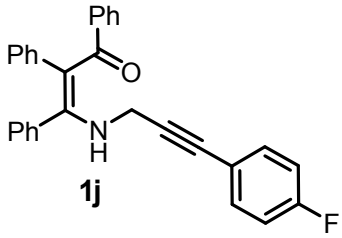
1h

(*Z*)-3-(3-(4-methoxyphenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1h). The title compound as a yellow solid (271.3 mg, 62%); ^{1}H NMR (500 MHz, Chloroform-d) δ 12.49 (q, J = 5.1, 4.5 Hz, 1H), 7.38 – 7.33 (m, 2H), 7.23 – 7.16 (m, 5H), 7.15– 7.11(m, 3H), 7.05– 7.04 (m, 2H), 6.86 – 6.80 (m, 5H), 6.77– 6.72 (m, 2H), 4.04 (d, J = 5.9 Hz, 2H), 3.80 (d, J = 0.9 Hz, 3H); ^{13}C NMR (126 MHz, Chloroform-d) δ 193.6, 165.9, 159.7, 142.5, 139.3, 133.6, 133.4, 133.1, 128.6, 128.54, 128.4, 128.2, 128.0, 127.1, 127.0, 125.0, 114.7, 113.9, 110.1, 83.9, 83.6, 55.3, 35.3; HRMS (ESI-TOF) calcd for $C_{31}H_{26}NO_2^+$ $[M+H]^+$: 444.1958, found: 444.1963.



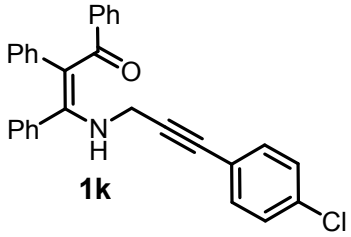
1i

(*Z*)-1,2,3-triphenyl-3-(3-(4-(trifluoromethoxy)phenyl)prop-2-ynylamino)prop-2-en-1-one (1i). The title compound as a yellow solid (248.5 mg, 50%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.49 (t, *J* = 5.5 Hz, 1H), 7.48 – 7.43 (m, 2H), 7.24 – 7.12 (m, 10H), 7.11 – 7.06 (m, 2H), 6.86 – 6.81 (m, 3H), 6.79 – 6.73 (m, 2H), 4.06 (d, *J* = 6.4 Hz, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.8, 165.8, 149.0, 148.9, 142.4, 139.2, 133.5, 133.3, 133.2, 128.6, 128.6, 128.5, 128.3, 128.1, 128.0, 127.1, 127.1, 125.1, 120.7, 120.3 (q, *J* = 257.7 Hz), 110.3, 86.0, 82.5, 35.1; HRMS (ESI-TOF) calcd for $C_{31}H_{23}F_3NO_2^+$ $[M+H]^+$: 498.1675, found: 498.1673.



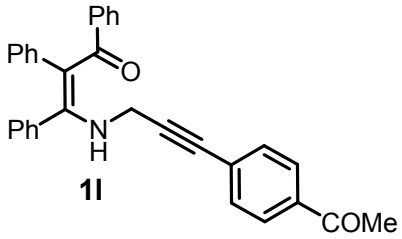
1j

(*Z*)-3-(3-(4-fluorophenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1j). The title compound as a yellow solid (323.6 mg, 75%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.49 (t, *J* = 5.8 Hz, 1H), 7.43 – 7.38 (m, 2H), 7.22 (dd, *J* = 5.1, 1.9 Hz, 3H), 7.21 – 7.17 (m, 2H), 7.17 – 7.11 (m, 3H), 7.08 (dd, *J* = 8.1, 6.7 Hz, 2H), 7.04 – 6.97 (m, 2H), 6.87 – 6.80 (m, 3H), 6.78 – 6.72 (m, 2H), 4.05 (d, *J* = 5.8 Hz, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.7, 165.8, 162.6 (d, *J* = 249.5 Hz), 142.5, 139.3, 133.7, 133.6 (d, *J* = 2.7 Hz), 133.3, 128.6, 128.6, 128.5, 128.1 (d, *J* = 20.0 Hz), 127.1 (d, *J* = 10.8 Hz), 125.1, 118.7 (d, *J* = 3.4 Hz), 115.7, 115.5, 110.3, 84.7, 82.9, 35.2; HRMS (ESI-TOF) calcd for $C_{30}H_{23}FNO^{+}$ $[M+H]^{+}$: 432.1758, found: 432.1760.



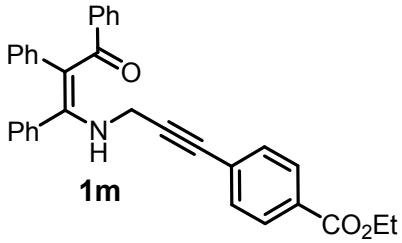
1k

(*Z*)-3-(3-(4-chlorophenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1k). The title compound as a yellow solid (313.7 mg, 70%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.49 (t, *J* = 6.1 Hz, 1H), 7.37 – 7.32 (m, 2H), 7.31 – 7.26 (m, 2H), 7.22 (dd, *J* = 5.1, 1.9 Hz, 3H), 7.20 – 7.16 (m, 2H), 7.16 – 7.10 (m, 3H), 7.08 (dd, *J* = 8.1, 6.7 Hz, 2H), 6.84 (dd, *J* = 4.7, 1.9 Hz, 3H), 6.78 – 6.73 (m, 2H), 4.05 (d, *J* = 5.9 Hz, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.8, 165.8, 142.4, 139.2, 134.5, 133.6, 133.3, 132.9, 128.6, 128.6, 128.6, 128.5, 128.2, 128.0, 127.2, 127.1, 125.1, 121.1, 110.3, 86.1, 82.9, 35.2; HRMS (ESI-TOF) calcd for $C_{30}H_{23}ClNO^{+}$ $[M+H]^{+}$: 448.1463, found: 448.1464.



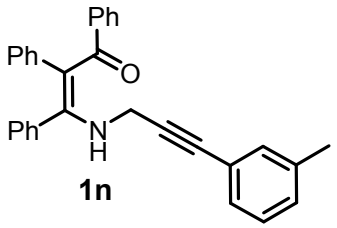
1l

(*Z*)-methyl4-(3-(3-oxo-1,2,3-triphenylprop-1-enylamino)prop-1-ynyl)benzoate (1l). The title compound as a yellow solid (276.4 mg, 70%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.50 (t, *J* = 5.9 Hz, 1H), 7.90 (d, *J* = 8.0 Hz, 2H), 7.50 (d, *J* = 8.1 Hz, 2H), 7.24 – 7.17 (m, 5H), 7.16 – 7.12(m, 3H), 7.10 – 7.05 (m, 2H), 6.85 – 6.82 (m, 3H), 6.78 – 6.74 (m, 2H), 4.09 (d, *J* = 5.9 Hz, 2H), 2.60 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 197.2, 193.9, 165.8, 142.4, 139.2, 136.4, 133.5, 133.3, 131.8, 128.7, 128.6, 128.5, 128.2, 128.0, 127.4, 127.2, 127.1, 125.1, 110.4, 88.4, 83.2, 35.2, 26.6; HRMS (ESI-TOF) calcd for $C_{32}H_{26}NO_2^+$ $[M+H]^+$: 456.1958, found: 456.1958.



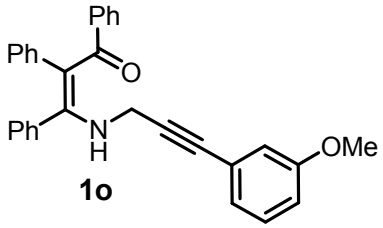
1m

(*Z*)-ethyl 4-(3-(3-oxo-1,2,3-triphenylprop-1-enylamino)prop-1-ynyl)benzoate (1m). The title compound as a yellow solid (325.2 mg, 68%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.50 (t, *J* = 6.0 Hz, 1H), 7.99 (d, *J* = 8.3 Hz, 2H), 7.48 (d, *J* = 8.3 Hz, 2H), 7.24 – 7.05 (m, 10H), 6.84 (dd, *J* = 4.9, 1.9 Hz, 3H), 6.76 (dd, *J* = 6.6, 3.0 Hz, 2H), 4.38 (q, *J* = 7.1 Hz, 2H), 4.08 (d, *J* = 5.9 Hz, 2H), 1.39 (t, *J* = 7.1 Hz, 3H)； ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.8, 166.0, 165.8, 142.4, 139.2, 133.6, 133.3, 131.6, 130.1, 129.4, 128.7, 128.6, 128.5, 128.2, 128.0, 127.2, 127.1, 127.1, 125.1, 110.4, 88.0, 83.3, 61.1, 35.2, 14.3; HRMS (ESI-TOF) calcd for $C_{33}H_{28}NO_3^+$ $[M+H]^+$: 486.2064, found: 486.2064.



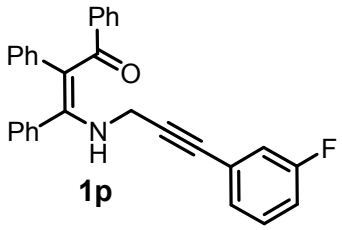
1n

(*Z*)-1,2,3-triphenyl-3-(3-m-tolylprop-2-ynylamino)prop-2-en-1-one (1n). The title compound as a yellow solid (294.3 mg, 69%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.49 (t, *J* = 6.0 Hz, 1H), 7.25 – 7.17 (m, 8H), 7.16 – 7.11 (m, 4H), 7.07 (dd, *J* = 8.1, 6.6 Hz, 2H), 6.83 (dd, *J* = 5.0, 1.9 Hz, 3H), 6.75 (dd, *J* = 6.6, 3.0 Hz, 2H), 4.05 (d, *J* = 5.9 Hz, 2H), 2.33 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.6, 165.9, 142.5, 139.3, 137.9, 133.6, 133.4, 132.3, 129.3, 128.7, 128.6, 128.6, 128.5, 128.2, 128.1, 128.0, 127.1, 127.0, 125.0, 122.4, 110.2, 84.6, 84.1, 35.3, 21.2; HRMS (ESI-TOF) calcd for $C_{31}H_{26}NO^{+}$ $[M+H]^{+}$: 428.2009, found: 428.2009.



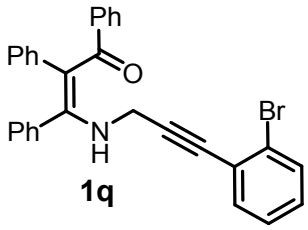
1o

(*Z*)-3-(3-(3-methoxyphenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1o). The title compound as a yellow solid (301.3 mg, 68%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.49 (s, 1H), 7.24 – 7.12 (m, 10H), 7.08 (t, *J* = 7.4 Hz, 2H), 7.02 (d, *J* = 7.6 Hz, 1H), 6.96 (dd, *J* = 2.6, 1.4 Hz, 1H), 6.90 – 6.86 (m, 1H), 6.83 (dd, *J* = 4.9, 1.9 Hz, 3H), 6.75 (dd, *J* = 6.6, 3.0 Hz, 2H), 4.06 (d, *J* = 5.7 Hz,2H), 3.81 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.6, 165.8, 159.2, 142.5, 139.2, 133.6, 133.3, 129.3, 128.6, 128.5, 128.4, 128.1, 128.0, 127.1, 127.0, 125.0, 124.2, 123.5, 116.5, 115.0, 110.2, 84.8, 83.8, 55.2, 35.2; HRMS (ESI-TOF) calcd for $C_{31}H_{26}NO_{2}^{+}$ $[M+H]^{+}$: 444.1958, found: 444.1956.



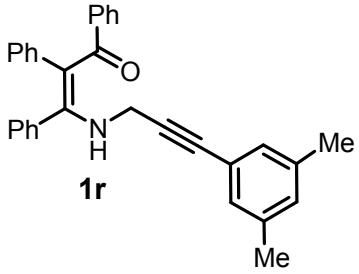
1p

(*Z*)-3-(3-(2-fluorophenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1p). The title compound as a yellow solid (215.4 mg, 50%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ12.49 (s, 1H), 7.31 – 7.00 (m, 14H), 6.84 (m, 3H), 6.76 (m, 2H), 4.06 (d, *J* = 5.9 Hz, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.8, 165.8, 162.3 (d, *J* = 247.0 Hz), 142.5, 139.2, 133.6, 133.3, 129.9 (d, *J* = 8.6 Hz), 128.7, 128.6, 128.5, 128.2, 128.0, 127.6 (d, *J* = 3.1 Hz), 127.1 (d, *J* = 9.9 Hz), 125.1, 124.5, 118.5 (d, *J* = 22.7 Hz), 115.8 (d, *J* = 21.3 Hz), 110.4, 86.1, 82.8, 35.1; HRMS (ESI-TOF) calcd for $C_{30}H_{23}FNO^{+}$ $[M+H]^{+}$:432.1758, found:432.1760



1q

(*Z*)-3-(3-(2-bromophenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1q). The title compound as a yellow solid (295.4 mg, 60%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.50 (s, 1H), 7.58 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.47 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.27 (dd, *J* = 7.5, 1.2 Hz, 1H), 7.25 – 7.12 (m, 9H), 7.08 (t, *J* = 7.4 Hz, 2H), 6.84 (dd, *J* = 5.0, 1.9 Hz, 3H), 6.76 (dd, *J* = 6.7, 3.0 Hz, 2H), 4.11 (d, *J* = 6.0 Hz, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 193.8, 165.9, 142.5, 139.3, 133.7, 133.6, 133.4, 132.4, 129.6, 128.8, 128.8, 128.6, 128.5, 128.2, 128.0, 127.2, 127.1, 127.0, 125.6, 125.1, 124.7, 89.8, 82.6, 35.3; HRMS (ESI-TOF) calcd for $C_{30}H_{23}BrNO^{+}$ $[M+H]^{+}$: 492.0958, found: 492.0961.



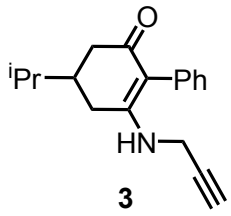
1r

(*Z*)-3-(3-(3,5-dimethylphenyl)prop-2-ynylamino)-1,2,3-triphenylprop-2-en-1-one (1r). The title compound as a yellow solid (281.6 mg, 64%). ^{1}H NMR (500 MHz, Chloroform-*d*) δ 12.48 (t, *J* = 6.2 Hz, 1H), 7.23 – 7.11 (m, 8H), 7.10 – 7.05 (m, 4H), 6.96 – 6.94 (m, 1H), 6.85 – 6.80 (m, 3H), 6.77 – 6.73 (m, 2H), 4.04 (d, *J* = 6.0 Hz, 2H), 2.29 (s, 6H); ^{13}C NMR (126

MHz, Chloroform-*d*) δ 193.6, 165.9, 142.6, 139.4, 137.8, 133.7, 133.4, 130.3, 129.4, 128.7, 128.6, 128.5, 128.2, 128.0, 127.1, 127.1, 125.1, 122.2, 110.2, 84.3, 84.3, 35.3, 21.1; HRMS (ESI-TOF) calcd for $C_{32}H_{28}NO^+$ $[M+H]^+$: 442.2165, found: 442.2166.

2.3 General procedure for the synthesis of 3

To a mixture of the 5-isopropyl-3-(prop-2-ynylamino)cyclohex-2-enone (382.5 mg, 2.0 mmol, 1.0 eq.) and CsF (759.5 mg, 5.0 mmol) in acetonitrile (10 mL, 0.2 M) in an oven dried 50 mL glass vial was added the *o*-silyl aryltriflate (745.9 mg, 2.5 mmol). The mixture was stirred at room temperature for 24 h, and was monitored by TLC. After completion of the reaction, the mixture was dissolved in H_2O (10 mL) and was extracted with EtOAc (3 x 20 mL). The combined EtOAc extracts were dried over Na_2SO_4 and concentrated. The crude product was purified by silica gel column using EtOAc/hexanes (1:5 v/v) as eluent to afford the desired product **3**.



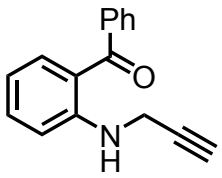
3

5-isopropyl-2-phenyl-3-(prop-2-ynylamino)cyclohex-2-enone (3). The title compound as a yellow solid (192.5 mg, 36%). ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.39 (t, *J* = 7.6 Hz, 2H), 7.28 (t, *J* = 5.4 Hz, 1H), 7.14 (d, *J* = 6.9 Hz, 2H), 4.90 (t, *J* = 6.3 Hz, 1H), 3.87 (dd, *J* = 6.3, 2.5 Hz, 2H), 2.75 (dd, *J* = 16.7, 2.8 Hz, 1H), 2.54 (dd, *J* = 15.9, 2.4 Hz, 1H), 2.37 – 2.27 (m, 2H), 2.19 (dd, *J* = 16.0, 13.0 Hz, 1H), 2.04 – 1.93 (m, 1H), 1.73 – 1.63 (m, 1H), 1.01 (d, *J* = 6.9 Hz, 3H), 0.99 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 194.4, 160.5, 134.2, 131.1, 129.0, 127.1, 114.1, 79.3, 72.4, 40.3, 39.6, 32.6, 32.0, 28.8, 19.7, 19.3; HRMS (ESI-TOF) calcd for $C_{18}H_{22}NO^+$ $[M+H]^+$: 268.1696, found: 268.1694.

2.4 General procedure for the synthesis of 4

A solution of (2-aminophenyl)(phenyl)methanone (986.2 mg, 5 mmol, 1 eq.), propargyl bromide (890.2 mg, 7.5 mmol, 1.5 eq.), and K_2CO_3 (1.38g, 10 mmol, 2.0 eq.) in DMF (15 mL) was stirred at 60℃ for 12 h. Upon completion, the reaction mixture was cooled to room

temperature and the mixture was filtered through a celite. The mixture was extracted with EtOAc for 3 times. The organic layer was washed with brine and dried over anhydrous Na_2SO_4. After filtration, the filtrate was concentrated under reduced pressure and the residue was purified by a flash column chromatography on silica gel (eluent: petroleum ether / ethyl acetate = 50 / 1) to afford the product **4**.

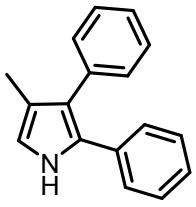


4

phenyl(2-(prop-2-ynylamino)phenyl)methanone (4). The title compound as a yellow solid (647.1 mg, 55%). ^{1}H NMR (500 MHz, Chloroform-d) δ 8.65 (s, 1H), 7.59 (d, J = 7.5 Hz, 2H), 7.49 (dd, J = 7.8, 5.5 Hz, 2H), 7.42 (t, J = 7.7 Hz, 3H), 6.87 (d, J = 8.5 Hz, 1H), 6.62 (t, J = 7.5 Hz, 1H), 4.06 (s, 2H), 2.24 (s, 1H); ^{13}C NMR (126 MHz, Chloroform-d) δ 199.2, 150.3, 140.1, 135.3, 134.8, 130.8, 129.0, 127.9, 118.2, 114.9, 111.8, 80.1, 71.3, 32.3; HRMS (ESI-TOF) calcd for $C_{16}H_{14}NO^+$ $[M+H]^+$: 236.107, found: 236.106.

2.5 General procedure for the synthesis of 2,3,4-trisubstituted pyrroles (2a-r).

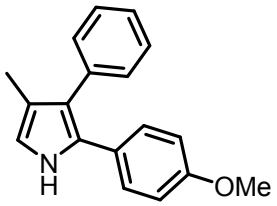
To a 15 mL oven-dried vial were added the substrates (0.1 mmol), KO^{t}Bu (13.5 mg, 0.12 mmol), and acetonitrile (0.5 mL). The mixture was stirred at 50 ^{o}C under nitrogen atmosphere for 12 h, and was monitored by TLC. After completion of the reaction, the mixture was purified by silica gel column using EtOAc/hexanes (1:50 v/v) as eluent to afford the desired product (**2a-r**).



2a

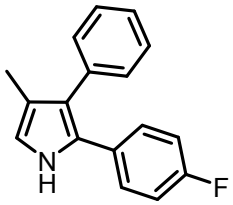
4-methyl-2,3-diphenyl-1H-pyrrole (2a). The title compound as a white solied (yield=87%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.07 (s, 3H), 7.34 – 7.29 (m, 5H), 7.27 (d, *J* = 1.6 Hz, 3H), 7.26 – 7.18 (m, 15H), 7.17 – 7.13 (m, 2H), 6.71 (dd, *J* = 2.5, 1.2 Hz, 2H), 2.09 (d, *J* =

1.0 Hz, 7H), 1.57 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 136.2, 133.3, 130.4, 128.8, 128.5, 128.2, 126.8, 126.2, 125.9, 122.2, 119.7, 116.2, 11.0; HRMS (ESI-TOF) calcd for $C_{17}H_{16}N^+$ $[M+H]^+$:234.1277, found:234.1280.



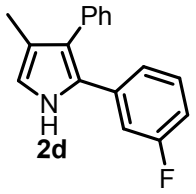
2b

2-(4-methoxyphenyl)-4-methyl-3-phenyl-1H-pyrrole (2b). The title compound as a gray solied (yield=72%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.99 (s, 1H), 7.34 – 7.19 (m, 5H), 7.15 – 7.10 (m, 2H), 6.81 – 6.74 (m, 2H), 6.68 (dd, *J* = 2.5, 1.2 Hz, 1H), 3.77 (s, 3H), 2.09 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 158.2, 136.3, 130.3, 128.8, 128.2, 128.1, 126.0, 125.7, 121.3, 119.4, 115.6, 114.0, 55.2, 11.0; HRMS (ESI-TOF) calcd for $C_{18}H_{18}NO^+$ $[M+H]^+$:264.1383, found:264.1386.



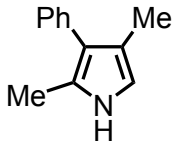
2c

2-(4-fluorophenyl)-4-methyl-3-phenyl-1H-pyrrole (2c). The title compound as a white solied (yield=79%).^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.99 (s, 1H), 7.34 – 7.28 (m, 2H), 7.25 – 7.21 (m, 3H), 7.16 – 7.12 (m, 2H), 6.71 – 6.67 (m, 2H), 6.69 (dd, *J* = 2.5, 1.1 Hz, 1H), 2.08 (dd, *J* = 2.6, 0.9 Hz, 3H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ 161.42 (d, *J* = 246.0 Hz), 135.94, 130.29, 129.48 (d, *J* = 3.3 Hz), 128.50 (d, *J* = 7.8 Hz), 128.23, 127.89, 125.96, 122.14, 119.61, 116.14, 115.45 (d, *J* = 21.5 Hz), 10.94; HRMS (ESI-TOF) calcd for $C_{17}H_{15}FN^+$ $[M+H]^+$:252.1183, found:252.1181.



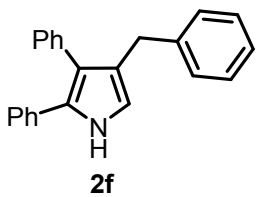
2d

2-(3-fluorophenyl)-4-methyl-3-phenyl-1H-pyrrole (2d). The title compound as a white solied (yield=74%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.07 (s, 1H), 7.36 – 7.31 (m, 2H), 7.29 – 7.22 (m, 3H), 7.20 – 7.13 (m, 1H), 6.97 – 6.93 (m, 1H), 6.89 – 6.78 (m, 2H), 6.72 (dd, *J* = 2.5, 1.1 Hz, 2H), 2.06 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 162.8 (d, *J* = 245.1 Hz), 135.7, 135.4 (d, *J* = 8.3 Hz), 130.3, 129.9 (d, *J* = 8.7 Hz), 128.3, 127.4 (d, *J* = 2.5 Hz), 126.2, 123.1, 122.2 (d, *J* = 2.8 Hz), 120.0, 116.7, 113.3 (d, *J* = 22.6 Hz), 112.9 (d, *J* = 21.3 Hz), 10.8; HRMS (ESI-TOF) calcd for $C_{17}H_{15}FN^{+}$ $[M+H]^{+}$:252.1183, found:252.1185.



2e

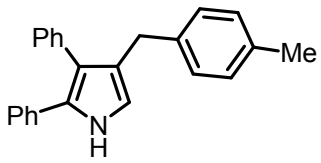
2,4-dimethyl-3-phenyl-1H-pyrrole (2e). The title compound as a colerless liquid (yield=60%); ^{1}H NMR (500 MHz, Chloroform-d) δ 7.73 (s, 1H), 7.41 – 7.36 (m, 2H), 7.32 – 7.28 (m, 2H), 7.25 – 7.21 (m, 1H), 6.52 (dd, J = 2.4, 1.1 Hz, 1H), 2.27 (s, 3H), 2.09 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-d) δ 136.4, 129.7, 128.0, 125.3, 124.7, 121.3, 117.7, 113.7, 12.1, 11.2; HRMS (ESI-TOF) calcd for C12H14O+ [M+H]+: 174.1039, found: 174.1037.



2f

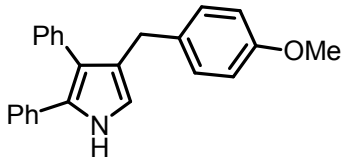
4-benzyl-2,3-diphenyl-1H-pyrrole (2f). The title compound as a white solied (yield=67%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.10 (s, 1H), 7.32 – 7.27 (m, 2H), 7.25 – 7.06 (m, 13H), 6.51 (d, *J* = 2.5 Hz, 1H), 3.79 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 141.9, 136.0, 133.1, 130.6, 128.8, 128.7, 128.5, 128.2, 128.2, 126.6, 126.2, 126.1, 125.6, 124.2, 122.0,

116.7, 32.0; HRMS (ESI-TOF) calcd for $C_{23}H_{19}NNa^+$ $[M+Na]^+$:332.141, found:234.137.



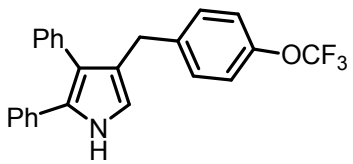
2g

4-(4-methylbenzyl)-2,3-diphenyl-1H-pyrrole (2g). The title compound as a white solied (yield=84%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.10 (s, 1H), 7.32 – 7.27 (m, 2H), 7.24 – 7.11 (m, 8H), 7.06 (s, 4H), 6.50 (d, *J* = 2.5 Hz, 1H), 3.75 (s, 2H), 2.31 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 138.8, 136.1, 135.0, 133.2, 130.6, 128.9, 128.7, 128.7, 128.5, 128.2, 126.7, 126.2, 126.1, 124.5, 122.0, 116.7, 31.5, 21.0; HRMS (ESI-TOF) calcd for $C_{24}H_{22}N^+$ $[M+H]^+$:324.1747, found:324.1749.



2h

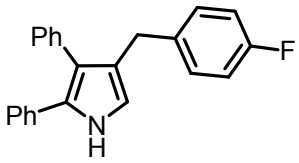
4-(4-methoxybenzyl)-2,3-diphenyl-1H-pyrrole (2h). The title compound as a white solied (yield=79%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.11 (s, 1H), 7.31 – 7.26 (m, 2H), 7.24 – 7.16 (m, 7H), 7.15 – 7.11 (m, 1H), 7.10 – 7.06 (m, 2H), 6.82 – 6.77 (m,2H), 6.50 (d, *J* = 2.5 Hz,1H), 3.78 (s,3H), 3.73 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 157.6, 136.0, 134.0, 133.1, 130.6, 129.6, 128.7, 128.5, 128.2, 126.6, 126.2, 126.1, 124.7, 121.9, 116.6, 113.6, 55.2, 31.1; HRMS (ESI-TOF) calcd for $C_{24}H_{22}NO^+$ $[M+H]^+$:340.1696, found:340.1694.



2i

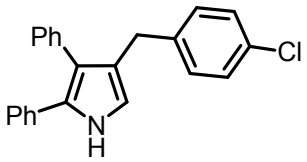
2,3-diphenyl-4-(4-(trifluoromethoxy)benzyl)-1H-pyrrole (2i). The title compound as a white solied (yield=64%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.15 (s, 1H), 7.31 – 7.26 (m, 2H), 7.24 – 7.11 (m, 10H), 7.07 (d, *J* = 8.2 Hz, 2H), 6.55 (d, *J* = 2.5 Hz, 1H), 3.79 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 147.3, 140.7, 135.9, 132.9, 130.5, 129.9, 128.9, 128.5,

128.3, 126.6, 126.3, 126.2, 123.6, 122.0, 120.7, 120.5 (q, J = 256.3 Hz), 116.6, 31.3; HRMS (ESI-TOF) calcd for $C_{24}H_{19}F_3NO^+$ $[M+H]^+$: 394.1413, found: 394.1416.



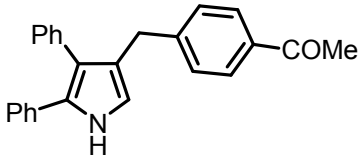
2j

4-(4-fluorobenzyl)-2,3-diphenyl-1H-pyrrole (2j). The title compound as a white solied (yield=76%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.14 (s, 1H), 7.31 – 7.26 (m, 2H), 7.24 – 7.06 (m, 9H), 6.95 – 6.88 (m, 2H), 6.54 – 6.49 (m, 2H), 3.76 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 161.2 (d, J = 243.1 Hz), 137.5 (d, J = 3.2 Hz), 135.9, 133.0, 130.5, 130.0 (d, J = 7.8 Hz), 128.9, 128.5, 128.2, 126.6, 126.3, 126.2, 124.1, 121.9, 116.6, 114.8 (d, J = 21.2 Hz), 31.2; HRMS (ESI-TOF) calcd for $C_{23}H_{19}FN^+$ $[M+H]^+$:328.1496, found:328.1498.



2k

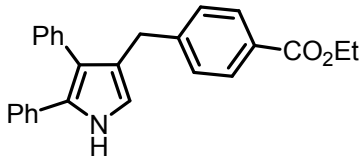
4-(4-chlorobenzyl)-2,3-diphenyl-1H-pyrrole (2k). The title compound as a white solied (yield=83%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.13 (s, 1H), 7.32 – 7.26 (m, 2H), 7.25 – 7.11 (m, 10H), 7.10 – 7.03 (m, 2H), 6.52 (d, J = 2.5 Hz, 1H), 3.75 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 140.4, 135.9, 133.0, 131.3, 130.5, 130.1, 128.9, 128.5, 128.3, 128.2, 126.6, 126.3, 126.2, 123.6, 122.0, 116.6, 31.4; HRMS (ESI-TOF) calcd for $C_{23}H_{19}ClN^+$ $[M+H]^+$:344.1201, found:344.1202.



2l

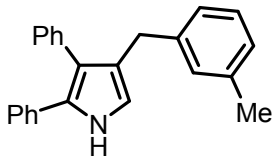
Methyl 4-((4,5-diphenyl-1H-pyrrol-3-yl)methyl)benzoate (2l). The title compound as a white solied (yield=62%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.24 (s, 1H), 7.83 (d, J = 8.2

Hz, 2), 7.28 (m, 2H), 7.24 – 7.13 (m, 10H), 6.54 (d, *J* = 2.6 Hz, 2H), 3.84 (s, 2H), 2.56 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 198.0, 147.8, 135.8, 134.9, 132.9, 130.5, 128.9, 128.9, 128.5, 128.4, 128.3, 126.6, 126.3, 126.2, 123.0, 122.0, 116.7, 32.0, 26.5; HRMS (ESI-TOF) calcd for $C_{25}H_{22}NO^+$ $[M+H]^+$:352.1696, found:352.1698.



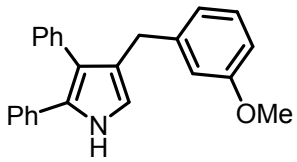
2m

Ethyl 4-((4,5-diphenyl-1H-pyrrol-3-yl)methyl)benzoate (2m). The title compound as a white soiled (yield=57%)**;** ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.19 (s, 1H), 7.92 (d, *J* = 8.2 Hz, 2H), 7.31 – 7.12 (m, 124H), 6.53 (d, *J* = 2.5 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 3.84 (s, 2H), 1.38 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 166.8, 147.4, 135.8, 132.9, 130.5, 129.5, 128.9, 128.7, 128.5, 128.3, 128.0, 126.6, 126.3, 126.2, 123.2, 122.0, 116.7, 60.7, 32.1, 14.3; HRMS (ESI-TOF) calcd for $C_{26}H_{23}NO_2Na^+$ $[M+Na]^+$:404.1621, found:404.1624.



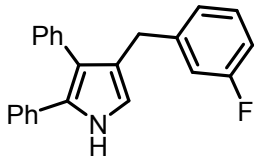
2n

4-(3-methylbenzyl)-2,3-diphenyl-1H-pyrrole (2n). The title compound as a white solied (yield=49%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.11 (s, 1H), 7.32 – 7.27 (m, 2H), 7.24 (d, *J* = 1.9 Hz, 2H), 7.23 – 7.20 (m, 2H), 7.20 – 7.18 (m, 2H), 7.17 – 7.10 (m, 3H), 7.01 – 6.94 (m, 3H), 6.51 (d, *J* = 2.5 Hz, 1H), 3.75 (s, 2H), 2.29 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 141.8, 137.7, 136.1, 133.1, 130.6, 129.6, 128.7, 128.5, 128.2, 128.1, 126.6, 126.4, 126.1, 126.1, 125.8, 124.3, 122.0, 116.7, 31.9, 21.4; HRMS (ESI-TOF) calcd for $C_{24}H_{22}N^+$ $[M+H]^+$:324.1747, found:324.1749.



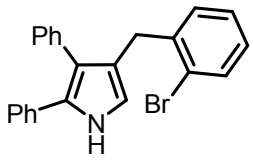
2o

4-(3-methoxybenzyl)-2,3-diphenyl-1H-pyrrole (2o). The title compound as a white solied (yield=72%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.13 (s, 1H), 7.33 – 7.27 (m, 2H), 7.24 – 7.10 (m, 9H), 6.77 (d, *J* = 7.6 Hz, 1H), 6.71 (d, *J* = 7.3 Hz, 2H), 6.55 (d, *J* = 2.6 Hz, 1H), 3.77 (s, 2H), 3.73 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 159.5, 143.6, 136.0, 133.1, 130.6, 129.1, 128.7, 128.5, 128.2, 126.6, 126.2, 126.1, 123.9, 122.0, 121.2, 116.7, 114.3, 111.2, 55.1, 32.0; HRMS (ESI-TOF) calcd for $C_{24}H_{22}NO^{+}$ $[M+H]^{+}$:340.1696, found:340.1699.



2p

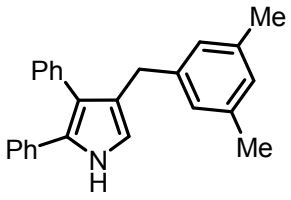
4-(2-fluorobenzyl)-2,3-diphenyl-1H-pyrrole (2p). The title compound as a light yellow solied (yield=66%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.15 (s, 1H), 7.31 – 7.26 (m, 2H), 7.24 – 7.11 (m, 9H), 6.92 (d, *J* = 7.6 Hz, 1H), 6.87 – 6.81 (m, 2H), 6.56 (d, *J* = 2.5 Hz, 1H), 3.78 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 162.9 (d, *J* = 244.7 Hz), 144.6 (d, *J* = 7.2 Hz), 135.9, 133.0, 130.5, 129.4 (d, *J* = 8.3 Hz), 128.9, 128.5, 128.3, 126.6, 126.3, 126.2, 124.3 (d, *J* = 2.7 Hz), 123.3, 122.0, 116.7, 115.5 (d, *J* = 21.2 Hz), 112.5 (d, *J* = 21.0 Hz), 31.7 (d, *J* = 1.8 Hz); HRMS (ESI-TOF) calcd for $C_{23}H_{19}FN^{+}$ $[M+H]^{+}$:328.1496, found:328.1495.



2q

4-(2-bromobenzyl)-2,3-diphenyl-1H-pyrrole (2q). The title compound as white solied (yield=64%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12 (s, 1H), 7.51 (d, *J* = 7.9 Hz, 1H), 7.33 – 7.09 (m, 12H), 7.05 – 6.98 (m, 1H), 6.50 (d, *J* = 2.6 Hz, 1H), 3.90 (s, 2H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 141.2, 135.9, 133.0, 132.5, 130.8, 130.5, 128.8, 128.5, 128.3,

127.4, 127.2, 126.6, 126.2, 126.2, 124.5, 122.3, 122.1, 116.9, 32.3; HRMS (ESI-TOF) calcd for $C_{23}H_{19}BrN^+$ $[M+H]^+$: 388.0695, found: 388.0696.

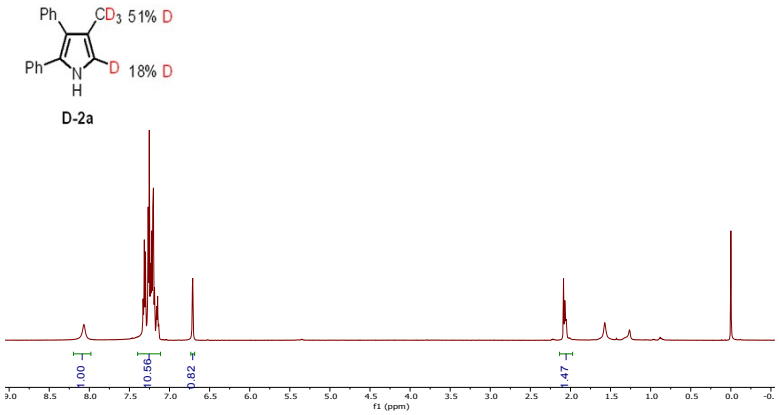


2r

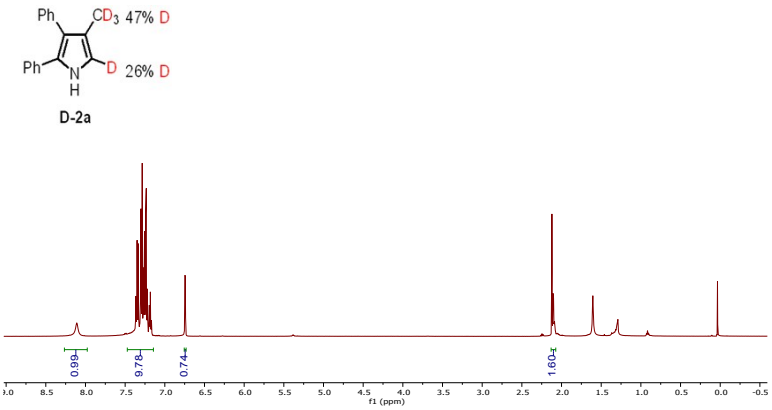
4-(3,5-dimethylbenzyl)-2,3-diphenyl-1H-pyrrole (2r). The title compound as a white solied (yield=70%); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.11 (s, 1H), 7.33 – 7.28 (m, 2H), 7.24 – 7.10 (m, 8H), 6.82 – 6.75 (m, 3H), 6.52 (d, *J* = 2.6 Hz, 1H), 3.71 (s, 2H), 2.25 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 141.7, 137.6, 136.2, 133.2, 130.7, 128.7, 128.5, 128.2, 127.3, 126.7, 126.6, 126.1, 126.1, 124.4, 116.7, 31.8, 21.3; HRMS (ESI-TOF) calcd for $C_{25}H_{24}N^+$ $[M+H]^+$:338.1903, found:338.1904.

3. Control experiments

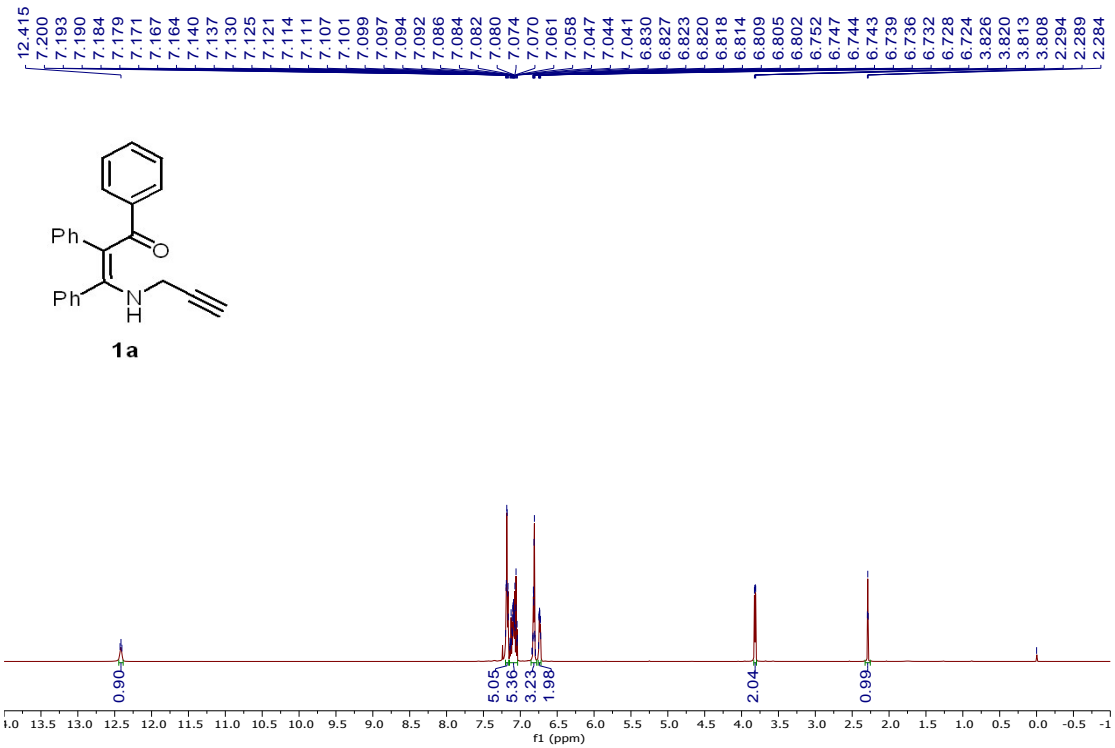
To a 15 mL oven-dried vial were added **1a** (33.7 mg, 0.1 mmol), KO^{t}Bu (13.5 mg, 0.12 mmol), and CD_3CN (0.5 mL). The mixture was stirred at 50 ^{o}C under nitrogen atmosphere for 12 h, and was monitored by TLC. After completion of the reaction, the mixture was purified by silica gel column using EtOAc/hexanes (1:50 v/v) as eluent to afford the desired product D-**2a** (21.0 mg, 90%).

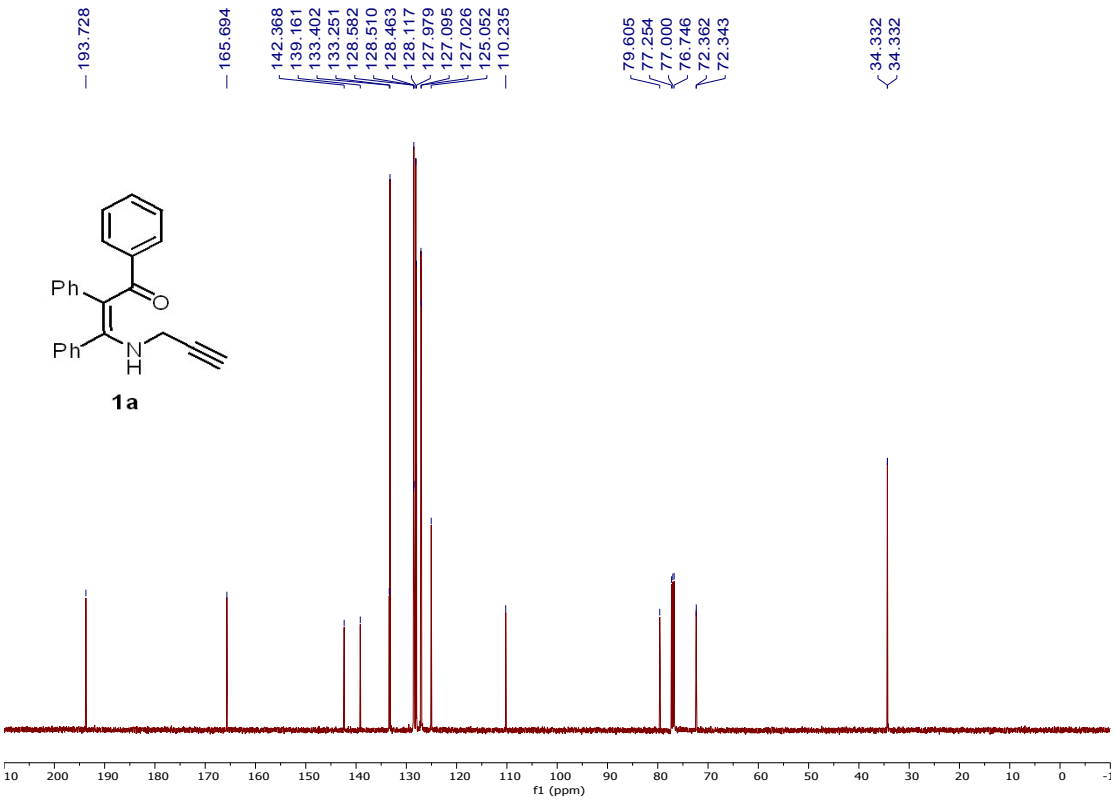


To a 15 mL oven-dried vial were added **1a** (33.7 mg, 0.1 mmol), KO^{t}Bu (13.5 mg, 0.12 mmol), D_2O (20.0 mg, 1.0 mmol), and acetonitrile (0.5 mL). The mixture was stirred at 50 ^{o}C under nitrogen atmosphere for 12 h, and was monitored by TLC. After completion of the reaction, the mixture was purified by silica gel column using EtOAc/hexanes (1:50 v/v) as eluent to afford the desired product D-**2a** (18.4 mg, 79%).



4. ^{1}H and ^{13}C NMR Spectra



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7.166
7.163
7.157
7.153
7.149
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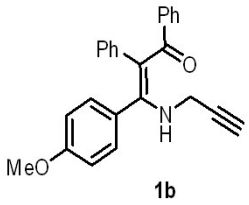
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Ph
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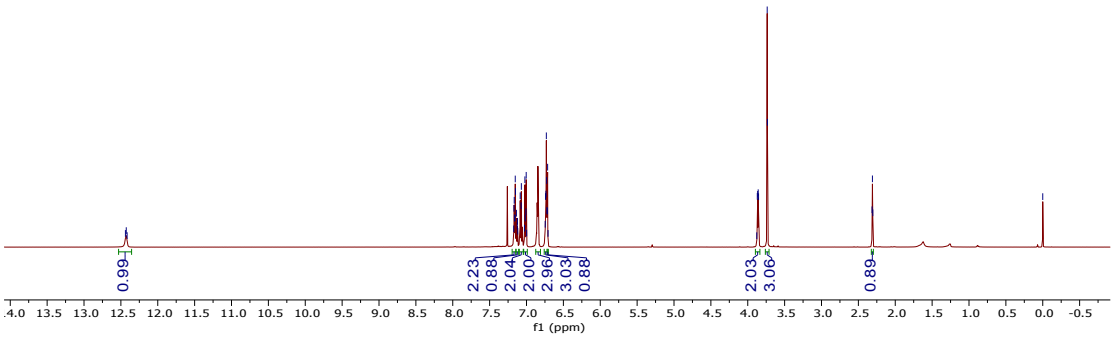
1b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2.04
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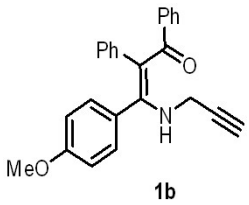
3.03
0.88
2.03
3.06
0.89
f1 (ppm)

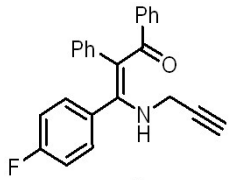

193.659
165.942
159.472
142.571
139.471
133.316
130.063
128.519
128.120
127.121
127.116
125.690
124.979
113.447
110.509
79.821
77.254
77.000
76.746
72.267
55.114
34.365


Ph
Ph
O
N
H
MeO

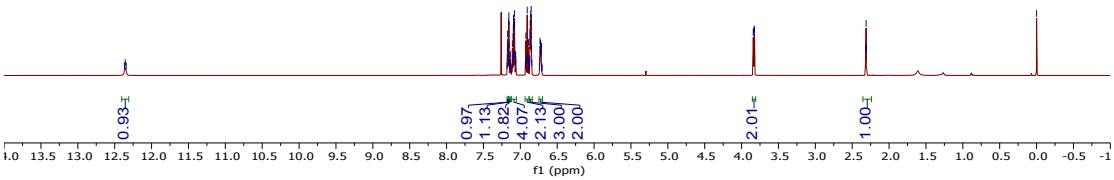
1b

f1 (ppm)

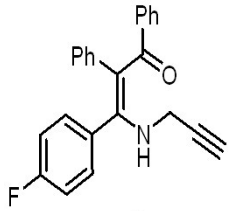

12.356
7.174
7.172
7.169
7.166
7.163
7.158
7.155
7.151
7.146
7.139
7.136
7.133
7.108
7.104
7.097
7.094
7.093
7.090
7.085
7.080
7.077
7.074
7.067
7.063
7.061
6.924
6.920
6.911
6.907
6.903
6.894
6.890
6.871
6.866
6.863
6.859
6.857
6.853
6.851
6.846
6.735
6.733
6.730
6.726
6.725
6.722
6.719
6.717
6.714
3.841
3.836
3.829
3.824
2.316
2.311
2.306
-0.000


Ph
Ph
O
N
H
F

1c


0.93
0.97
1.13
0.82
4.07
2.13
3.00
2.00
2.01
1.00
f1 (ppm)

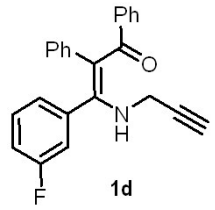

193.959
164.709
163.380
161.398
142.277
139.061
133.258
130.677
130.622
129.488
129.459
128.750
128.134
127.260
127.203
127.186
125.274
115.363
115.191
110.639
79.597
77.254
77.000
76.746
72.448
34.340


Ph
Ph
O
N
H
F

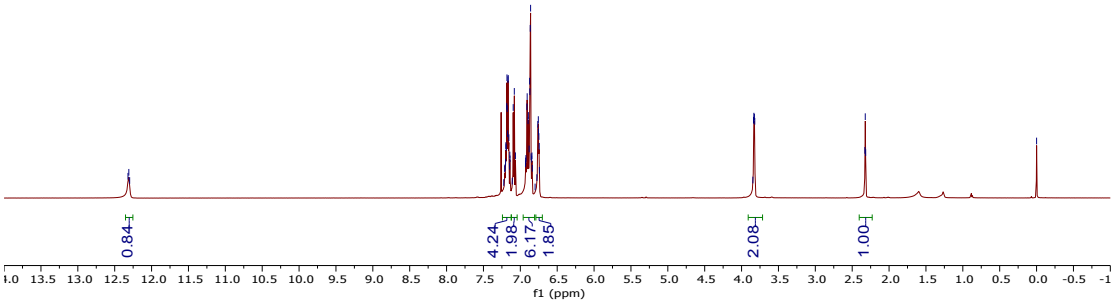
1c

f1 (ppm)

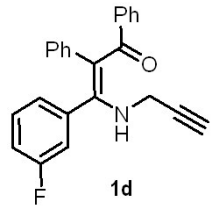

12.320
12.308
12.297
7.224
7.212
7.209
7.201
7.196
7.193
7.184
7.181
7.178
7.172
7.168
7.165
7.156
7.145
7.142
7.140
7.110
7.097
7.082
7.067
6.930
6.928
6.924
6.911
6.907
6.895
6.891
6.881
6.874
6.871
6.866
6.861
6.854
6.846
6.842
6.838
6.800
6.775
6.763
6.756
6.753
6.748
6.744
6.741
3.847
3.838
3.833
3.826
3.821
2.328
2.323
2.318
-0.000


Ph
Ph
O
N
H
F

1d


0.84
4.24
1.98
6.17
1.85
2.08
1.00
f1 (ppm)

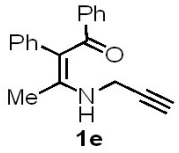

142.160
138.773
135.465
135.403
133.151
129.881
129.815
128.815
128.147
127.269
127.189
125.428
124.515
124.489
116.016
115.836
115.703
115.537
110.348
79.467
77.254
77.000
76.747
72.557
34.356


Ph
Ph
O
N
H
F

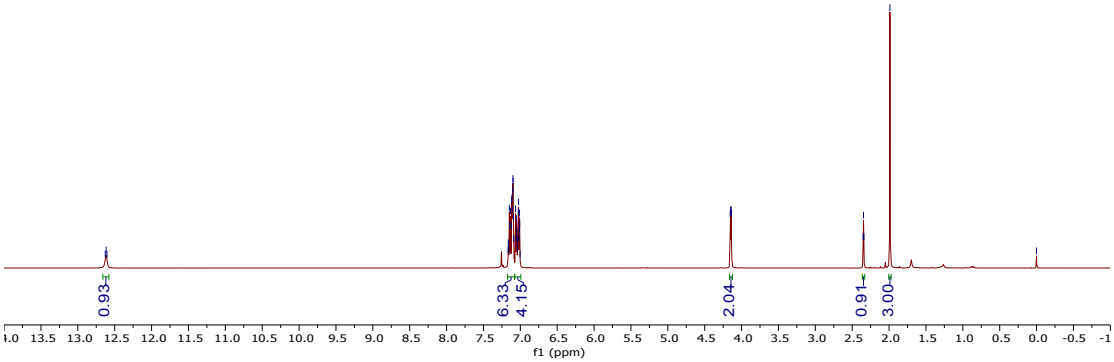
1d

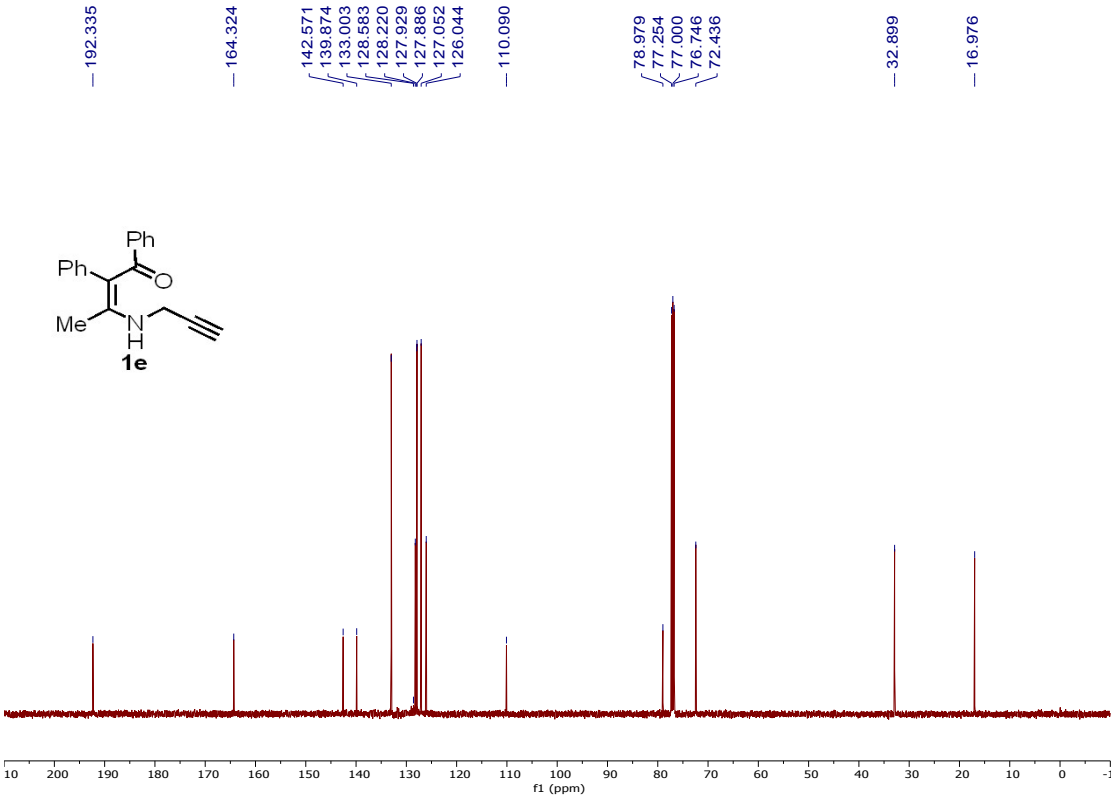
f1 (ppm)


12.628
12.617
12.605
7.166
7.162
7.159
7.149
7.145
7.134
7.121
7.117
7.114
7.107
7.104
7.100
7.098
7.093
7.089
7.065
7.056
7.051
7.047
7.039
7.035
7.027
7.024
7.020
7.014
7.011
7.008
7.003
4.154
4.149
4.142
4.137
2.352
2.346
2.341
1.989
0.000


Ph
Ph
O
Me
N
H

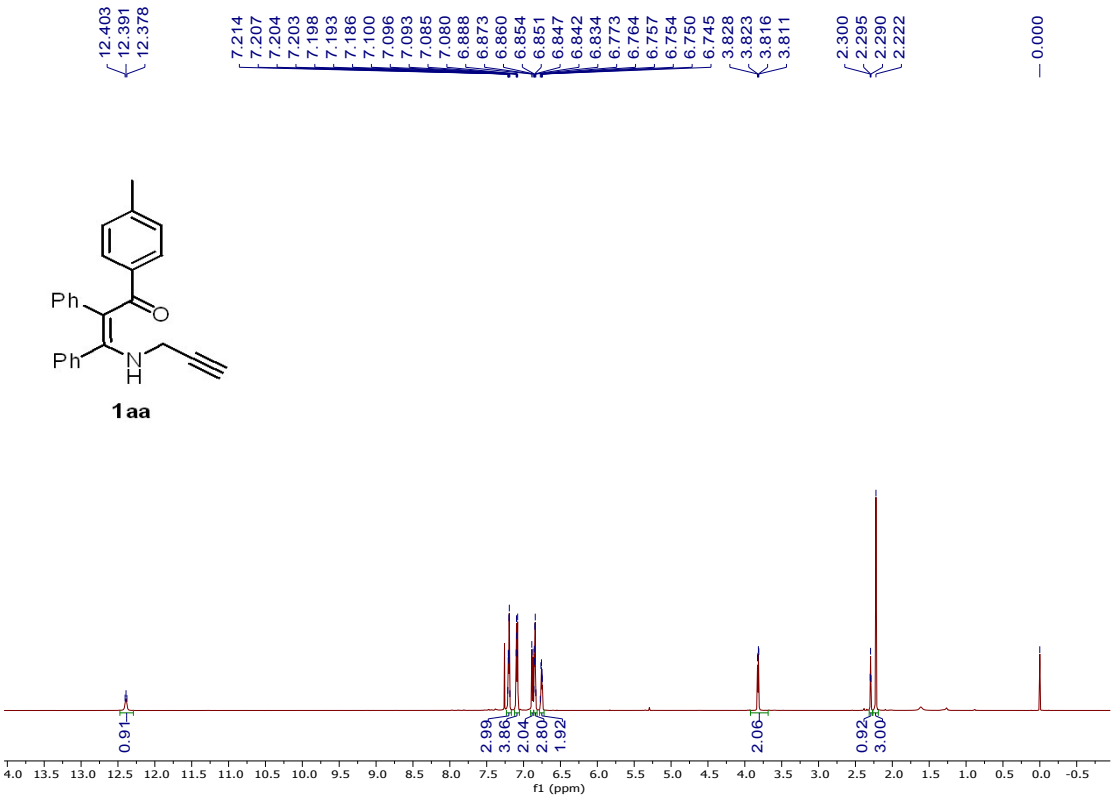
1e

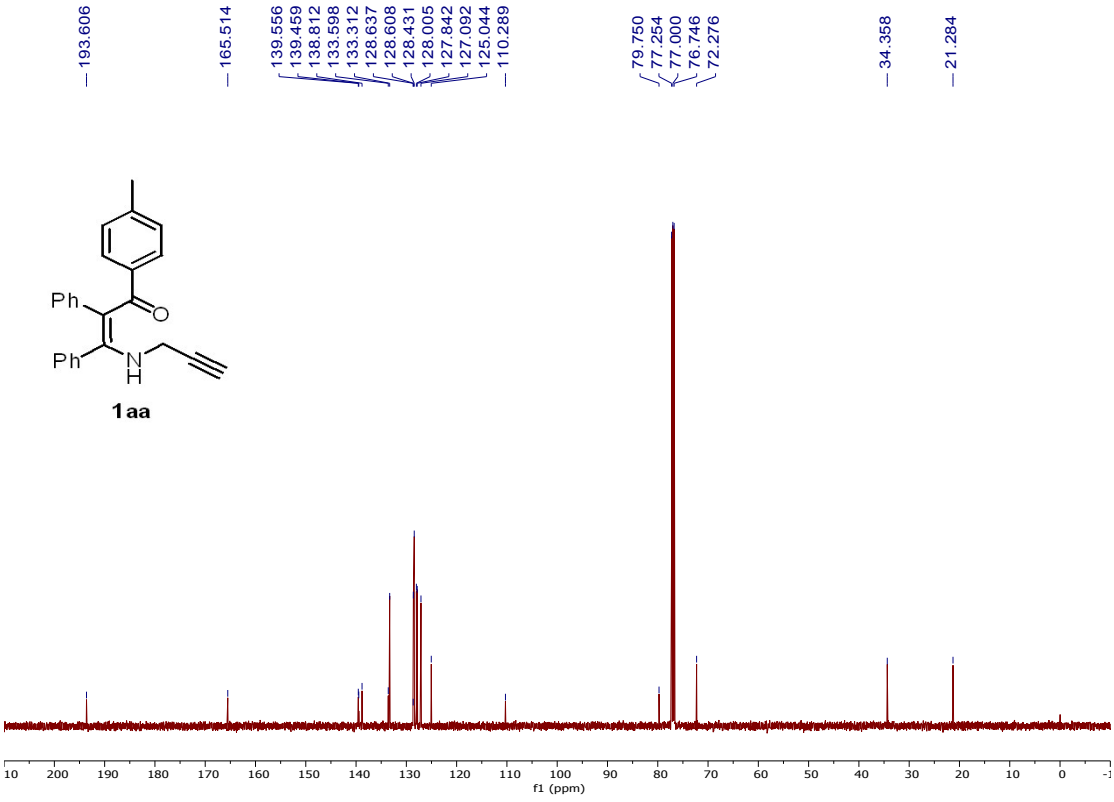

0.93
6.33
4.15
2.04
0.91
3.00
f1 (ppm)

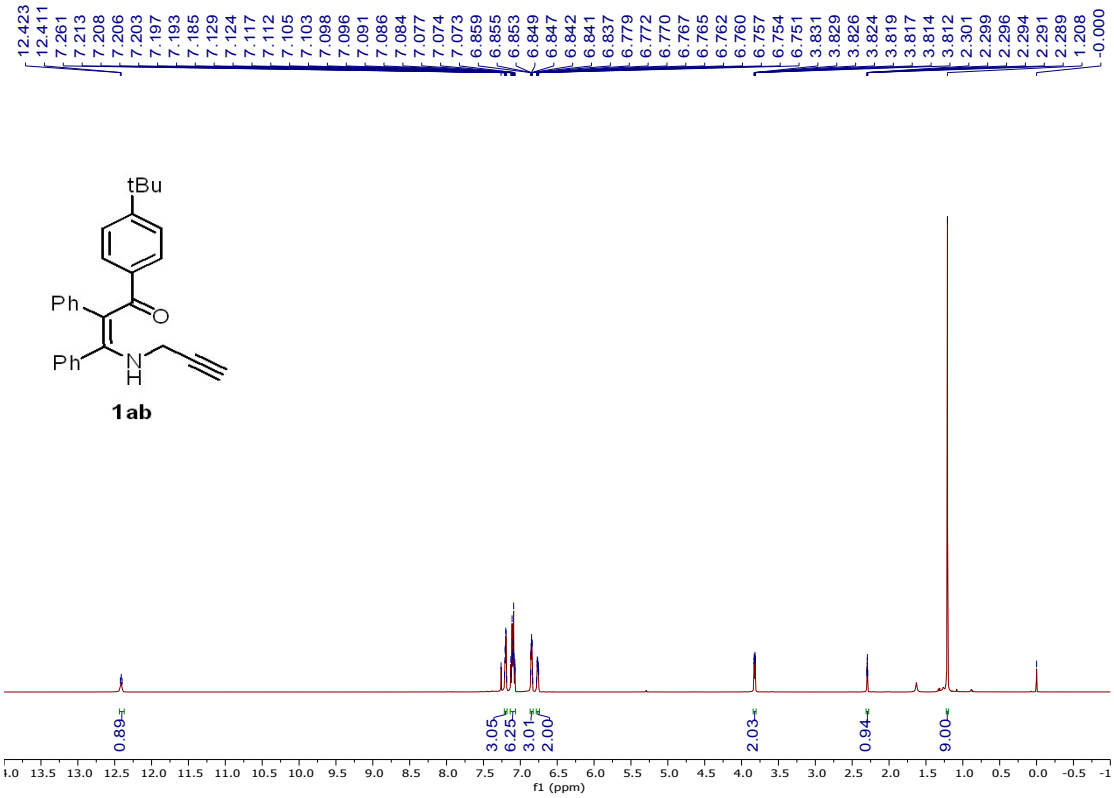

192.335
164.324
142.571
139.874
133.003
128.583
128.220
127.929
127.886
127.052
126.044
110.090
78.979
77.254
77.000
76.746
72.436
32.899
16.976
f1 (ppm)

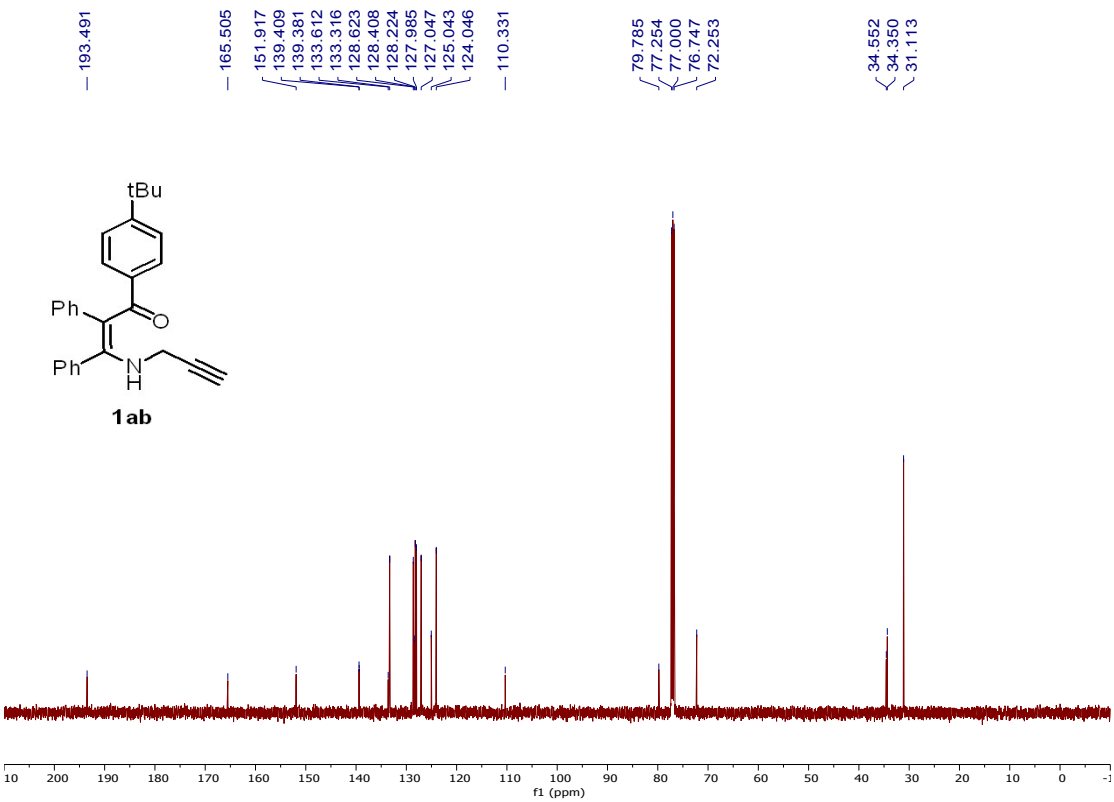
Ph
Ph
O
Me
N
H

1e

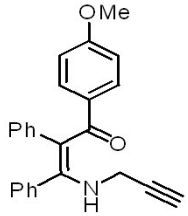

12.403
12.391
12.378
7.214
7.207
7.204
7.203
7.198
7.193
7.186
7.100
7.096
7.093
7.085
7.080
6.888
6.873
6.860
6.854
6.851
6.847
6.842
6.834
6.773
6.764
6.757
6.754
6.750
6.745
3.828
3.823
3.816
3.811
2.300
2.295
2.290
2.222
0.000
Ph
Ph
O
N
H
1aa
0.91
2.99
3.86
2.04
2.80
1.92
2.06
0.92
3.00
f1 (ppm)


193.606
165.514
139.556
139.459
138.812
133.598
133.312
128.637
128.608
128.431
128.005
127.842
127.092
125.044
110.289
79.750
77.254
77.000
76.746
72.276
34.358
21.284
Ph
Ph
O
N
H
1aa
f1 (ppm)

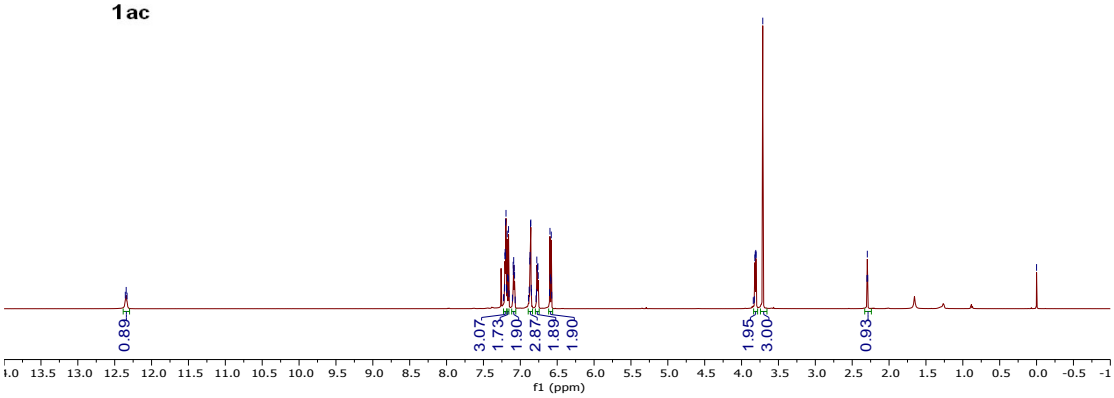

12.423
12.411
7.261
7.213
7.208
7.206
7.203
7.197
7.193
7.185
7.129
7.124
7.117
7.112
7.105
7.103
7.098
7.096
7.091
7.086
7.084
7.077
7.074
7.073
6.859
6.855
6.853
6.849
6.847
6.842
6.841
6.837
6.779
6.772
6.770
6.767
6.765
6.762
6.760
6.757
6.754
6.751
3.831
3.829
3.826
3.824
3.819
3.817
3.814
3.812
2.301
2.299
2.296
2.294
2.291
2.289
1.208
-0.000
tBu
Ph
O
Ph
N
H
1ab
0.89
3.05
6.25
3.01
2.00
2.03
0.94
9.00
f1 (ppm)

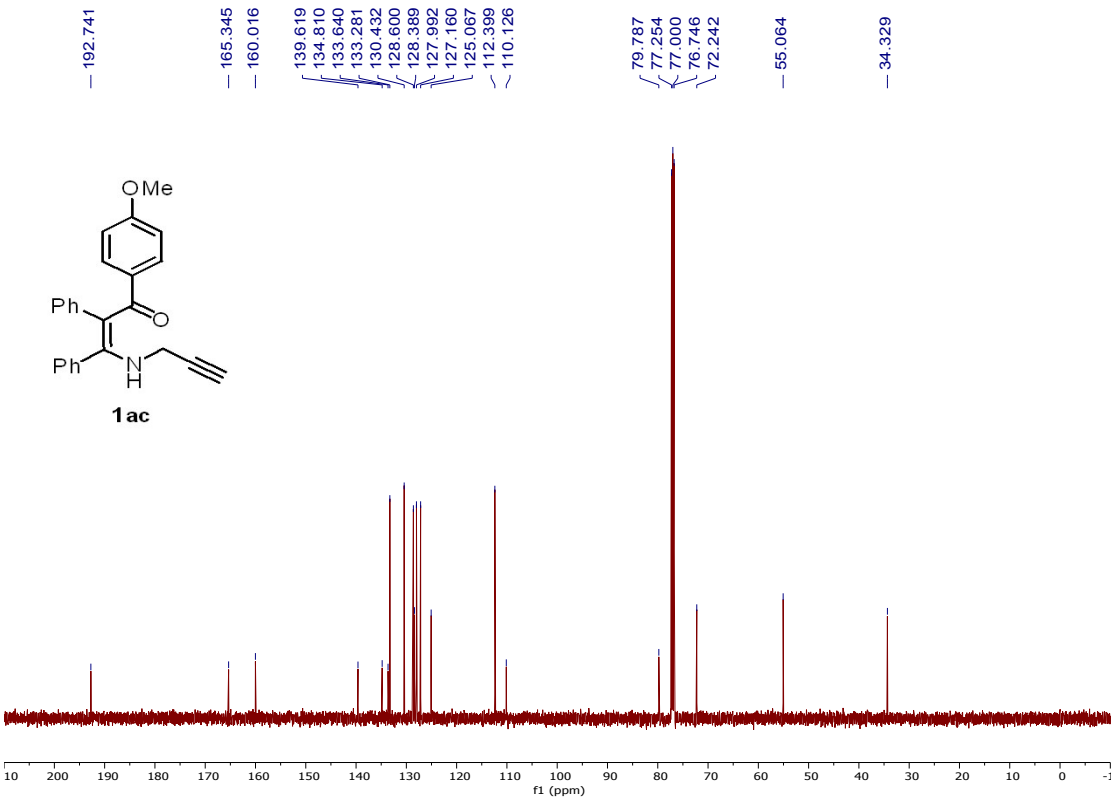

193.491
165.505
151.917
139.409
139.381
133.612
133.316
128.623
128.408
128.224
127.985
127.047
125.043
124.046
110.331
79.785
77.254
77.000
76.747
72.253
34.552
34.350
31.113
tBu
Ph
O
Ph
N
H
1ab
f1 (ppm)


12.356
12.344
12.332
7.227
7.224
7.215
7.212
7.208
7.206
7.204
7.199
7.194
7.187
7.184
7.177
7.173
7.164
7.160
7.154
7.107
7.098
7.095
7.090
7.082
7.078
7.070
6.890
6.880
6.872
6.868
6.862
6.858
6.852
6.849
6.787
6.781
6.776
6.770
6.768
6.761
6.757
6.604
6.598
6.594
6.585
6.580
6.574
3.841
3.827
3.820
3.815
3.808
3.802
3.713
2.300
2.295
2.290
0.000


OMe
Ph
O
Ph
N
H

1ac

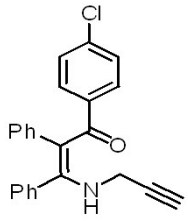

0.89
3.07
1.73
1.90
2.87
1.89
1.90
1.95
3.00
0.93
f1 (ppm)


192.741
165.345
160.016
139.619
134.810
133.640
133.281
130.432
128.600
128.389
127.992
127.160
125.067
112.399
110.126
79.787
77.254
77.000
76.746
72.242
55.064
34.329
f1 (ppm)

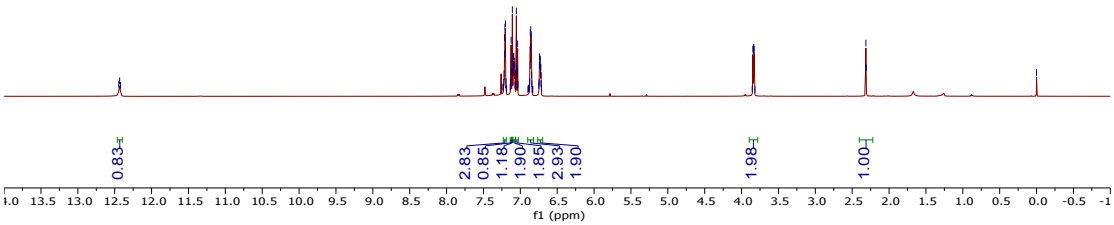
OMe
Ph
O
Ph
N
H

1ac

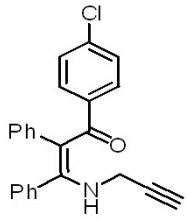

12.445
12.433
12.421
7.232
7.224
7.220
7.215
7.212
7.208
7.202
7.194
7.136
7.130
7.125
7.121
7.112
7.108
7.103
7.096
7.093
7.089
7.085
7.082
7.077
7.071
7.069
7.059
7.054
7.050
7.041
7.037
7.032
6.873
6.868
6.865
6.861
6.859
6.852
6.847
6.844
6.750
6.746
6.741
6.738
6.736
6.732
6.729
6.725
6.722
6.719
3.846
3.841
3.834
3.829
2.320
2.315
2.310
0.001


Cl
Ph
O
Ph
N
H

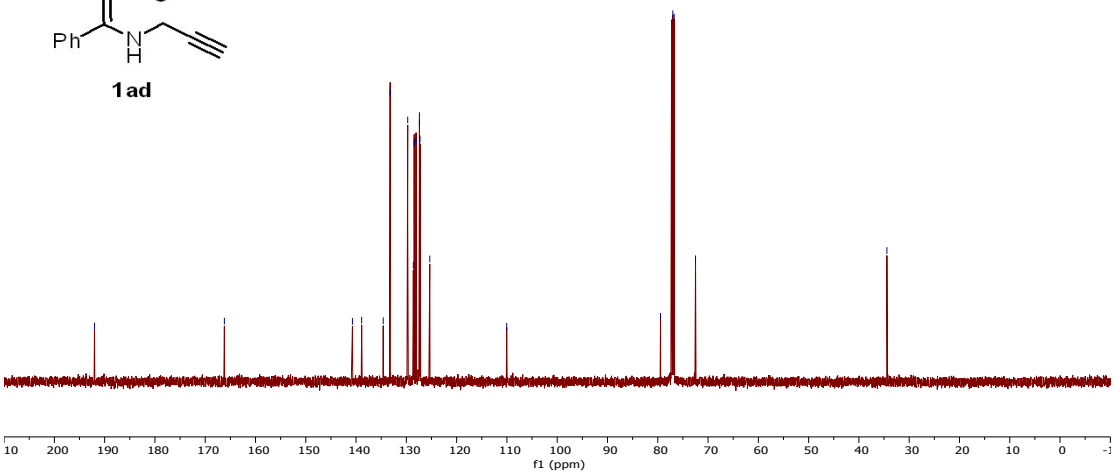
1ad

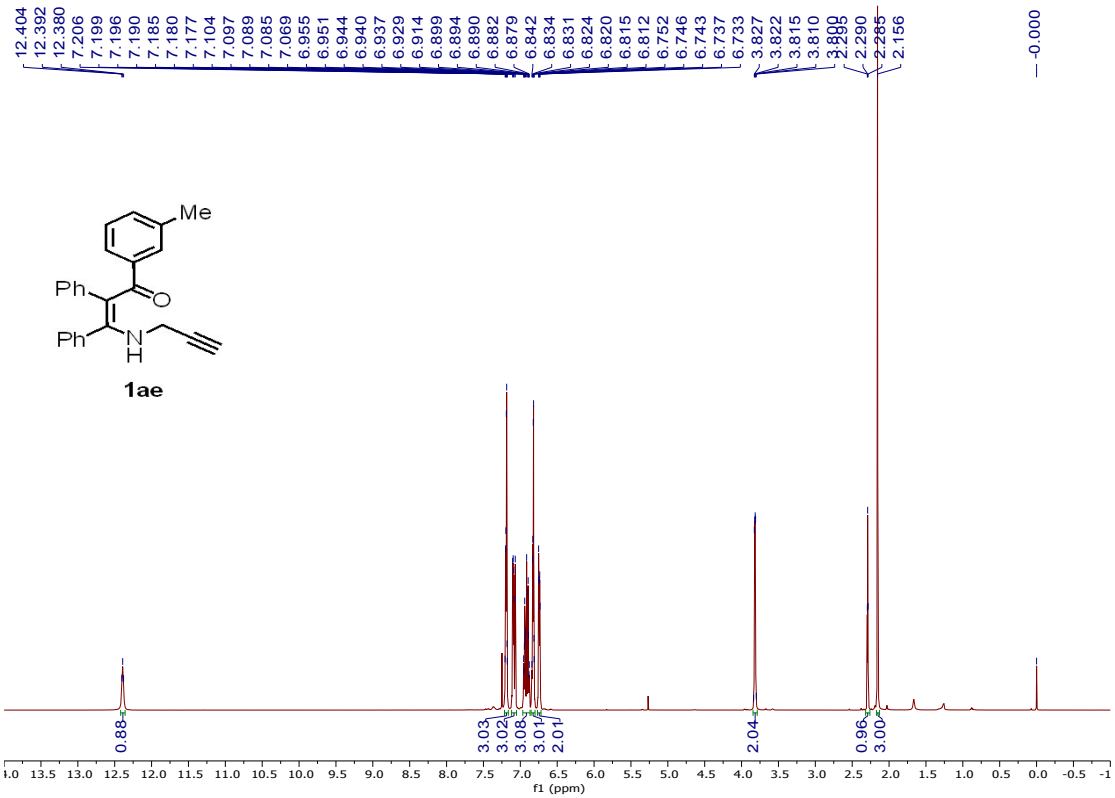

0.83
2.83
0.85
1.18
1.90
1.85
2.93
1.90
1.98
1.00
f1 (ppm)

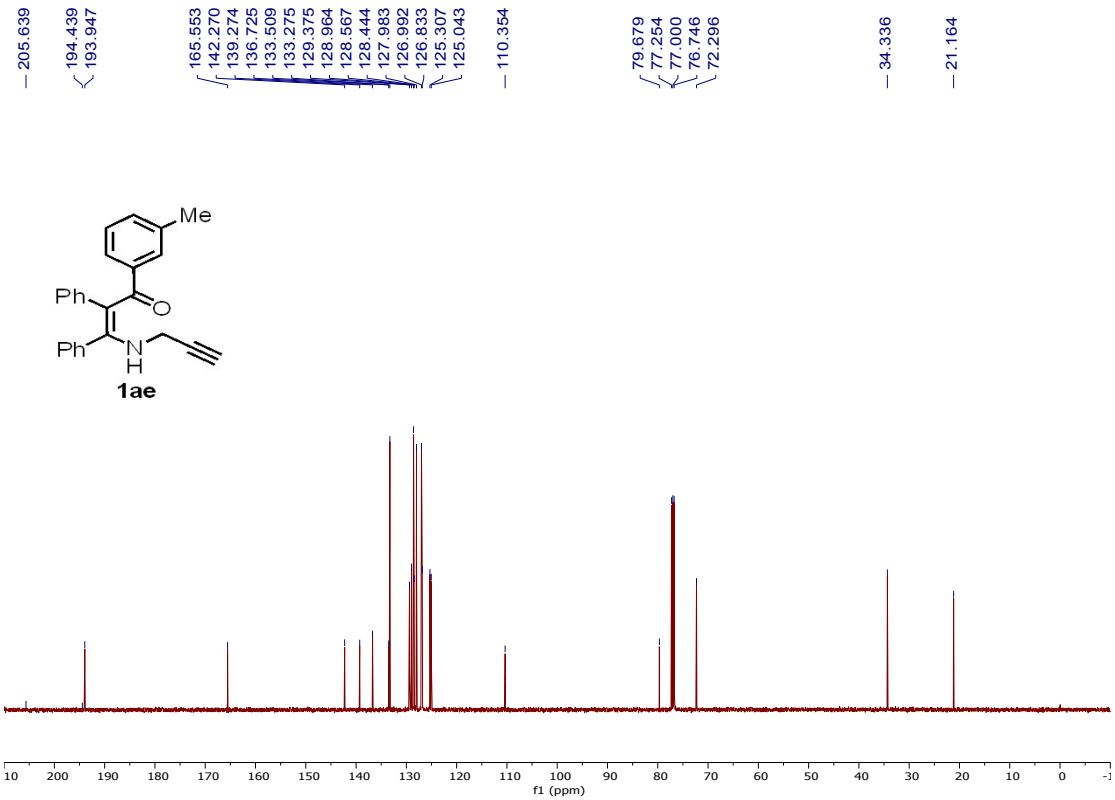

192.023
166.190
140.724
138.886
134.599
133.222
129.728
128.616
128.445
128.073
127.398
127.280
125.341
110.041
79.455
77.255
77.001
76.747
72.489
34.432


Cl
Ph
O
Ph
N
H

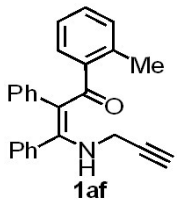
1ad


f1 (ppm)

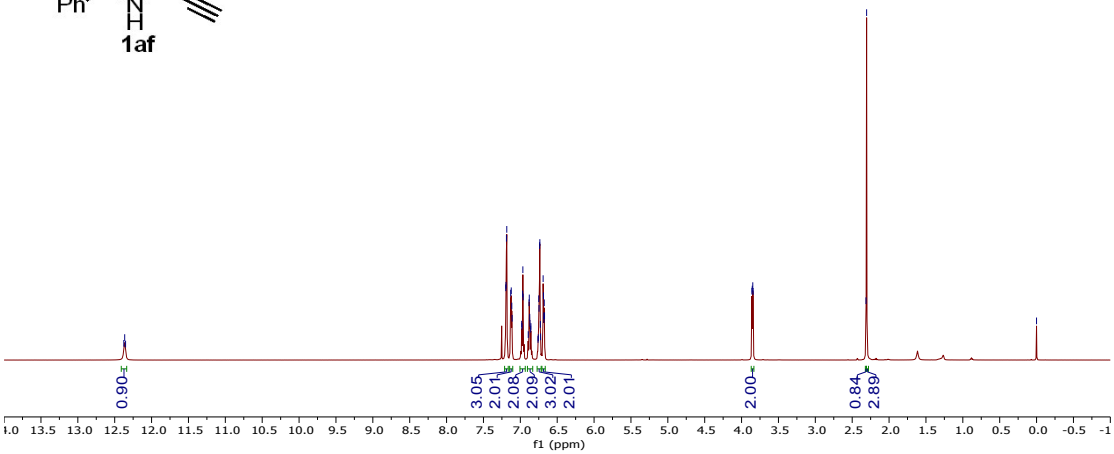

12.404
12.392
12.380
7.206
7.199
7.196
7.190
7.185
7.180
7.177
7.104
7.097
7.089
7.085
7.069
6.955
6.951
6.944
6.940
6.937
6.929
6.914
6.899
6.894
6.890
6.882
6.879
6.842
6.834
6.831
6.824
6.820
6.815
6.812
6.752
6.746
6.743
6.737
6.733
3.827
3.822
3.815
3.810
2.295
2.290
2.285
2.156
-0.000
Me
Ph
Ph
N
H
O
1ae
0.88
3.03
3.02
3.08
3.01
2.01
2.04
0.96
3.00
f1 (ppm)


205.639
194.439
193.947
165.553
142.270
139.274
136.725
133.509
133.275
129.375
128.964
128.567
128.444
127.983
126.992
126.833
125.307
125.043
110.354
79.679
77.254
77.000
76.746
72.296
34.336
21.164
Me
Ph
Ph
N
H
O
1ae
f1 (ppm)

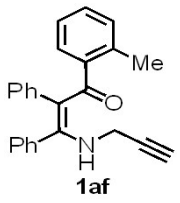

12.377
12.364
12.352
7.197
7.194
7.188
7.184
7.130
7.123
7.116
7.111
6.981
6.978
6.969
6.966
6.962
6.893
6.881
6.879
6.873
6.869
6.860
6.857
6.760
6.757
6.750
6.747
6.738
6.735
6.728
6.725
6.691
6.686
6.681
6.679
6.676
6.672
3.860
3.855
3.848
3.843
2.313
2.304
0.000


Me
Ph
O
Ph
N
H

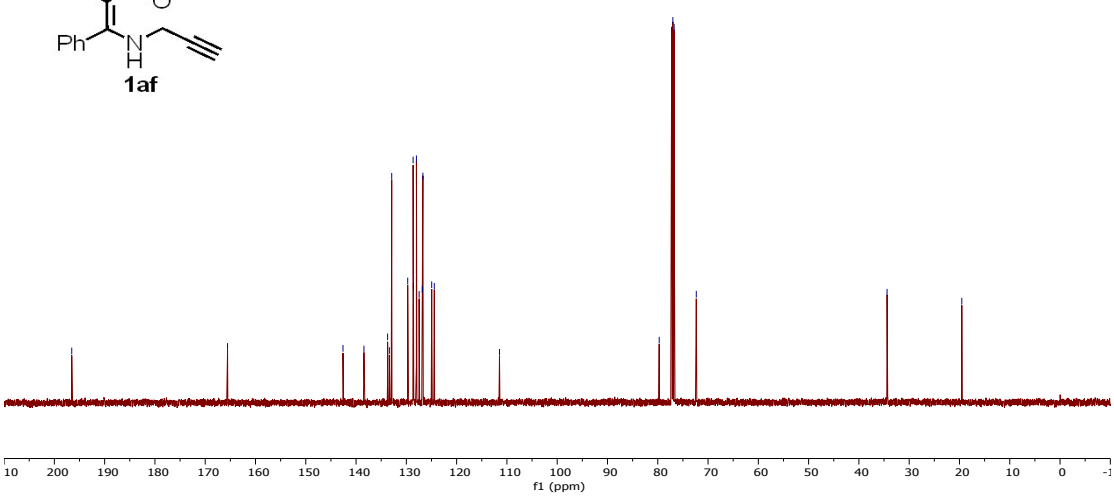
1af


0.90
3.05
2.01
2.08
2.09
3.02
2.01
2.00
0.84
2.89
f1 (ppm)

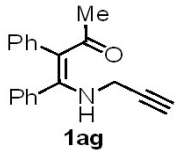

196.543
165.559
142.601
138.434
133.725
133.380
132.909
129.728
128.656
128.587
127.998
127.456
126.826
126.709
124.958
124.441
111.480
79.718
77.255
77.000
76.747
72.341
34.398
19.534


Me
Ph
O
Ph
N
H

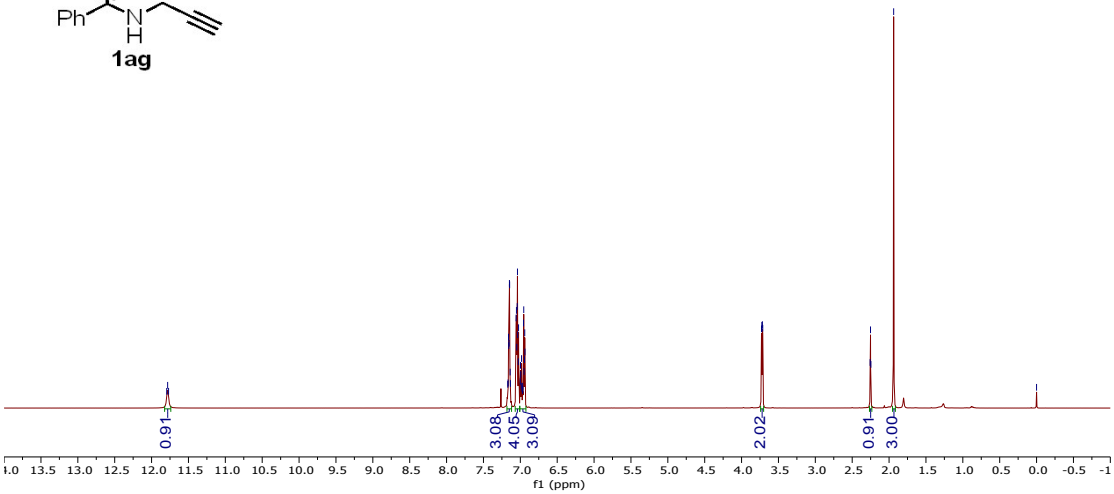
1af


f1 (ppm)

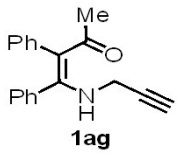

11.795
11.782
11.769
7.170
7.167
7.160
7.157
7.152
7.148
7.145
7.138
7.134
7.057
7.053
7.048
7.042
7.039
7.036
7.027
7.024
7.001
6.998
6.995
6.988
6.983
6.978
6.971
6.968
6.965
6.957
6.953
6.949
6.943
6.940
6.937
3.730
3.725
3.718
3.713
2.257
2.252
2.247
1.938
0.000


Me
Ph
O
Ph
N
H

1ag

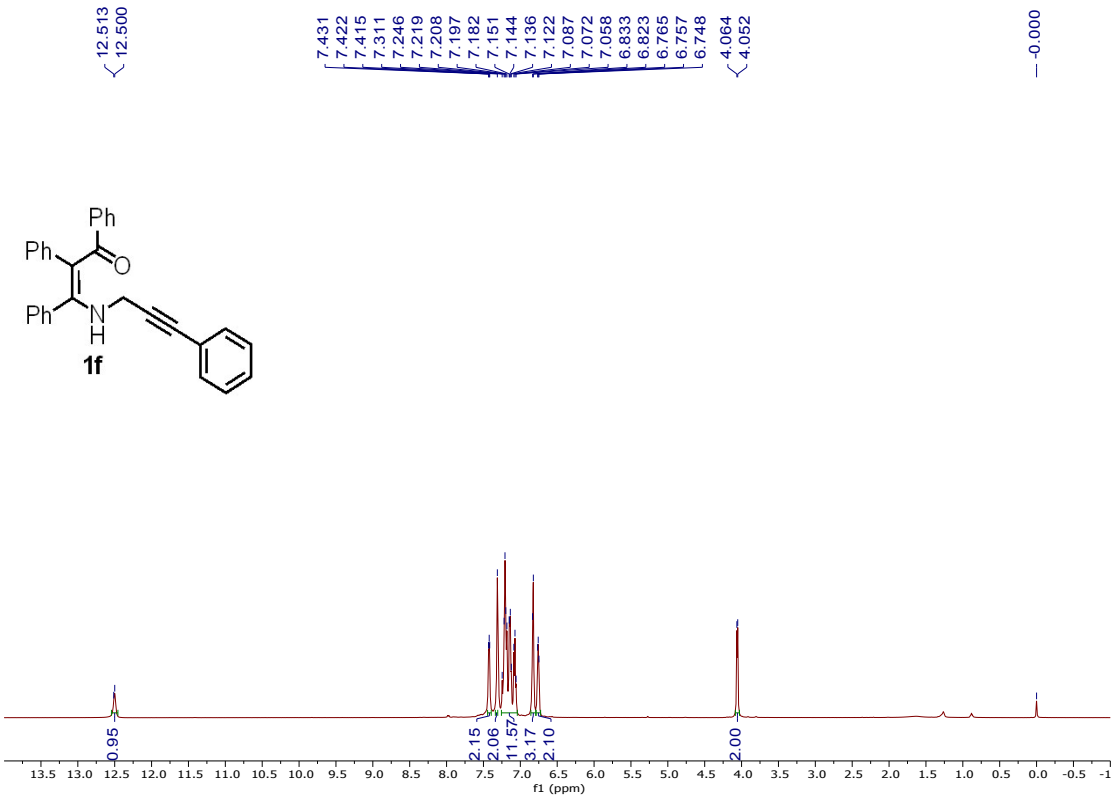

0.91
3.08
4.05
3.09
2.02
0.91
3.00
f1 (ppm)

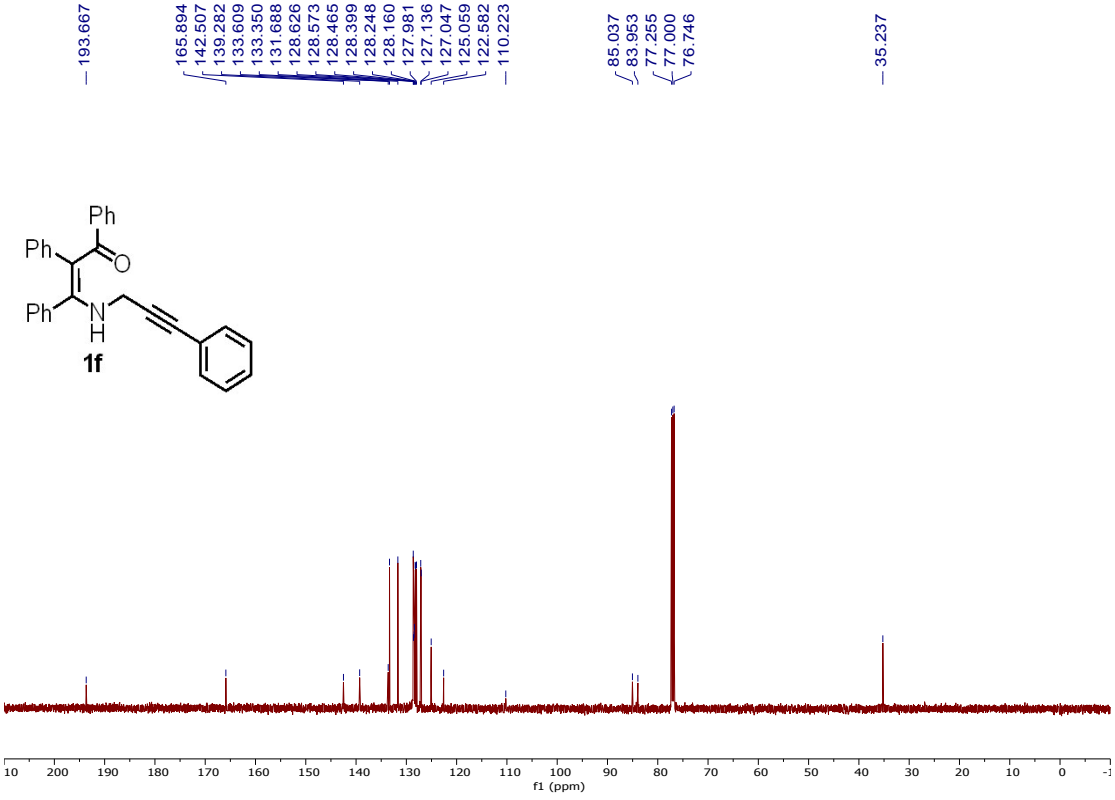

208.577
197.543
163.064
139.598
133.330
132.628
128.413
128.301
127.865
127.554
125.771
111.140
79.989
77.255
77.000
76.746
71.987
34.060
29.640


Me
Ph
O
Ph
N
H

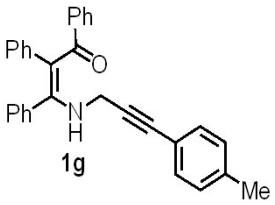
1ag

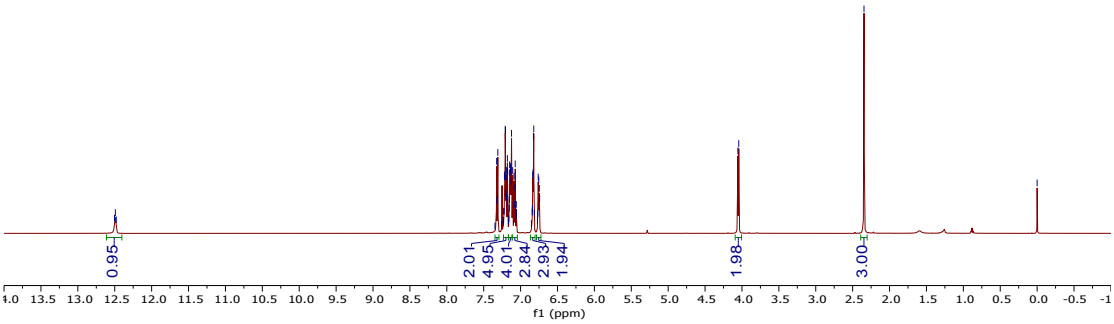
f1 (ppm)

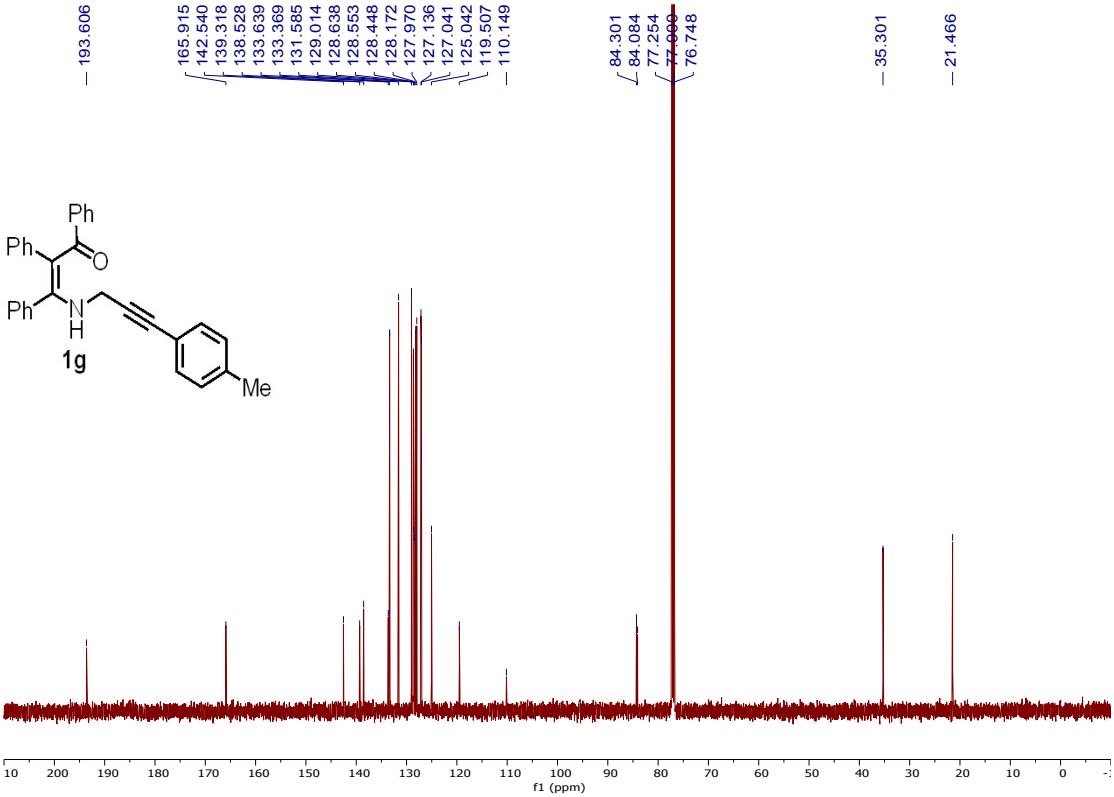

12.513
12.500
7.431
7.422
7.415
7.311
7.246
7.219
7.208
7.197
7.182
7.151
7.144
7.136
7.122
7.087
7.072
7.058
6.833
6.823
6.765
6.757
6.748
4.064
4.052
-0.000
Ph
Ph
O
Ph
N
H
1f
0.95
2.15
2.06
11.57
3.17
2.10
2.00
f1 (ppm)

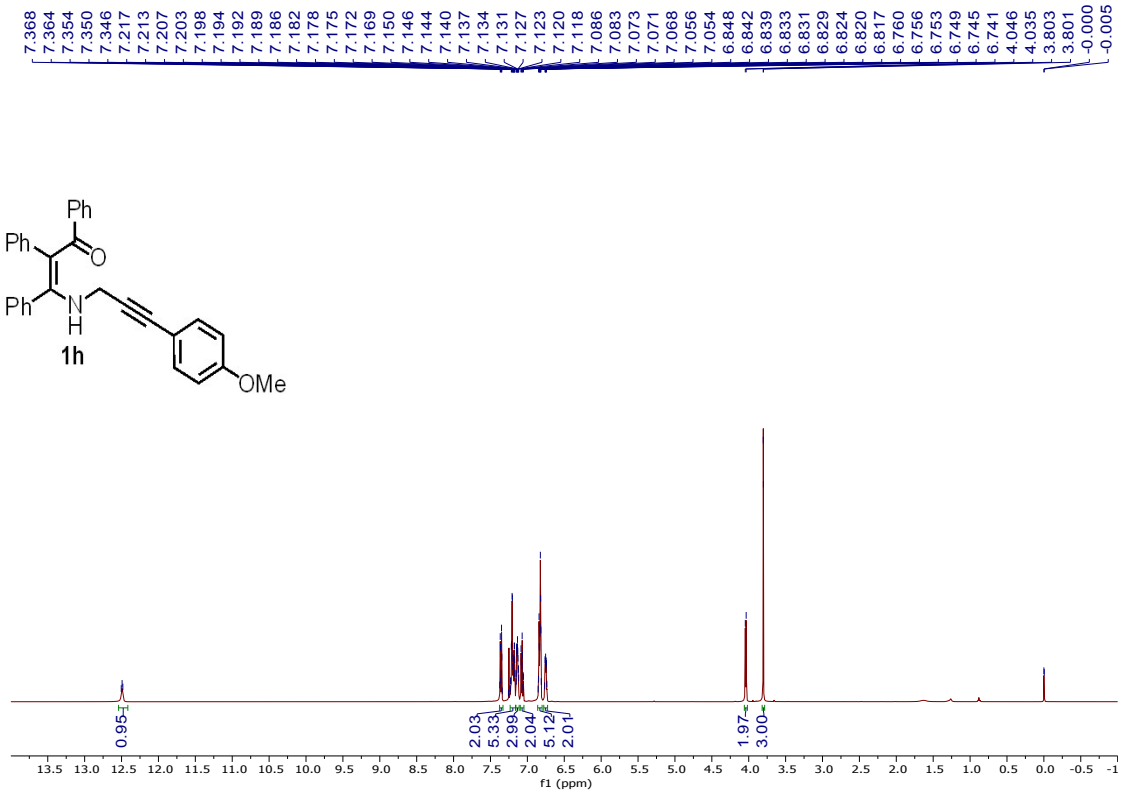

193.667
165.894
142.507
139.282
133.609
133.350
131.688
128.626
128.573
128.465
128.399
128.248
128.160
127.981
127.136
127.047
125.059
122.582
110.223
85.037
83.953
77.255
77.000
76.746
35.237
Ph
Ph
O
Ph
N
H
1f
f1 (ppm)

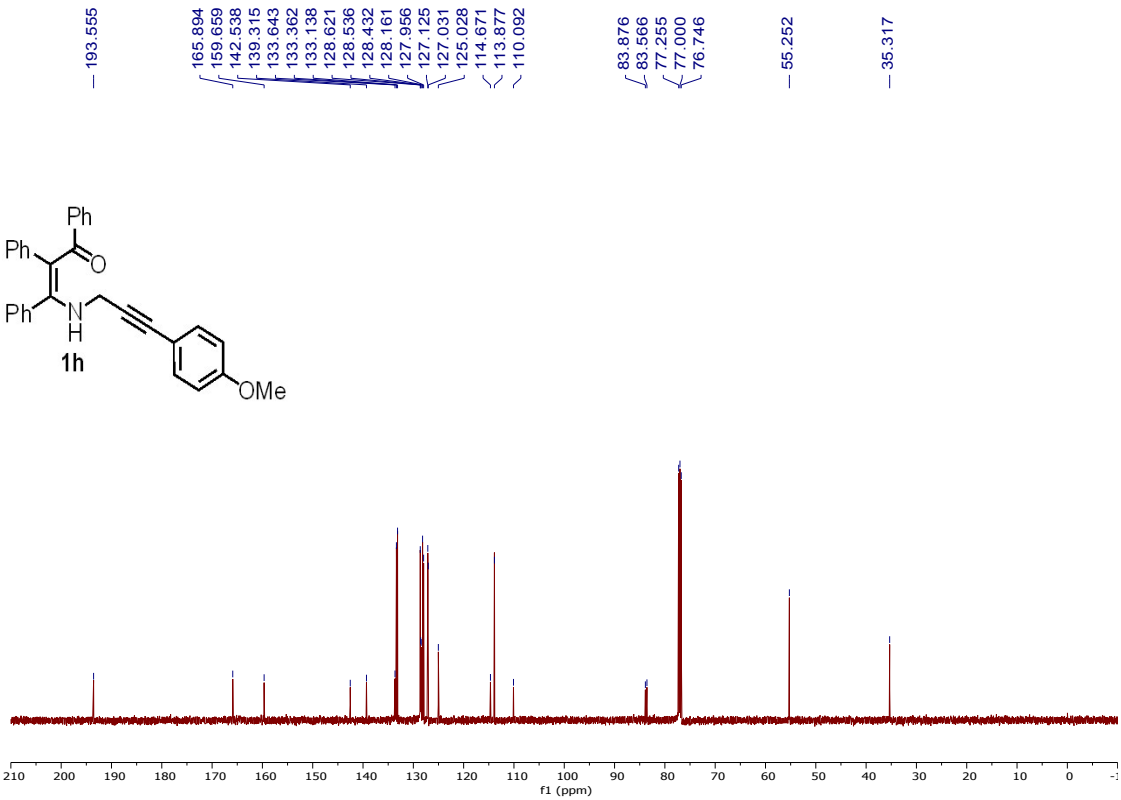

12.503
12.492
12.480
7.325
7.321
7.312
7.309
7.237
7.233
7.228
7.225
7.219
7.215
7.209
7.205
7.199
7.195
7.193
7.189
7.183
7.179
7.175
7.164
7.159
7.155
7.153
7.149
7.142
7.138
7.133
7.129
7.123
7.107
7.088
7.085
7.076
7.073
7.062
7.059
7.056
6.853
6.843
6.839
6.835
6.832
6.826
6.821
6.814
6.771
6.766
6.761
6.754
6.746
6.742
4.055
4.043
2.346
-0.000


Ph
Ph
O
Ph
N
H
1g
Me

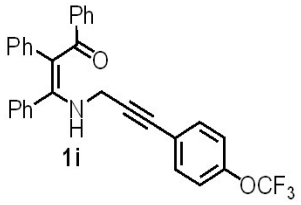

0.95
2.01
4.95
4.01
2.84
2.93
1.94
1.98
3.00
f1 (ppm)

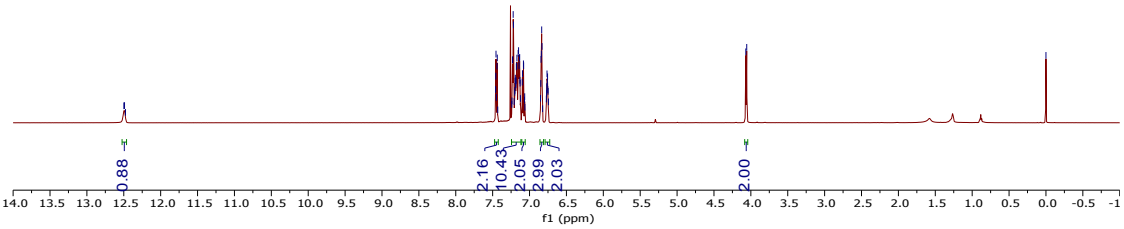

193.606
165.915
142.540
139.318
138.528
133.639
133.369
131.585
129.014
128.638
128.553
128.448
128.172
127.970
127.136
127.041
125.042
119.507
110.149
84.301
84.084
77.254
77.000
76.748
35.301
21.466
Ph
Ph
O
Ph
N
H
1g
Me
f1 (ppm)


7.368
7.364
7.354
7.350
7.346
7.217
7.213
7.207
7.203
7.198
7.194
7.192
7.189
7.186
7.182
7.178
7.175
7.172
7.169
7.150
7.146
7.144
7.140
7.137
7.134
7.131
7.127
7.123
7.120
7.118
7.086
7.083
7.073
7.071
7.068
7.056
7.054
6.848
6.842
6.839
6.833
6.831
6.829
6.824
6.820
6.817
6.760
6.756
6.753
6.749
6.745
6.741
4.046
4.035
3.803
3.801
-0.000
-0.005
Ph
Ph
O
Ph
N
H
1h
OMe
0.95
2.03
5.33
2.99
2.04
5.12
2.01
1.97
3.00
f1 (ppm)

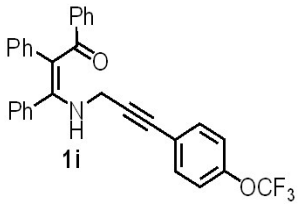

193.555
165.894
159.659
142.538
139.315
133.643
133.362
133.138
128.621
128.536
128.432
128.161
127.956
127.125
127.031
125.028
114.671
113.877
110.092
83.876
83.566
77.255
77.000
76.746
55.252
35.317
Ph
Ph
O
Ph
N
H
1h
OMe
f1 (ppm)

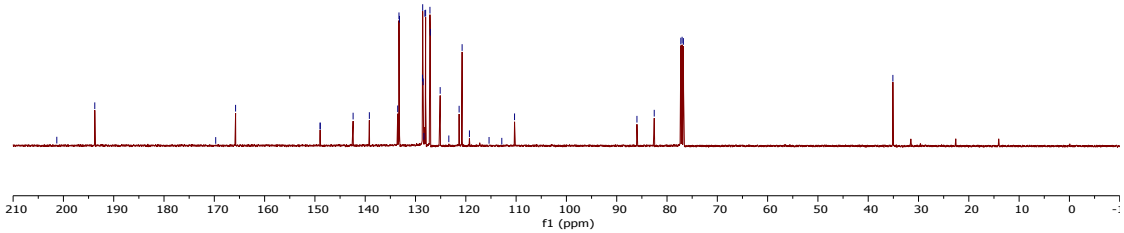

12.499
12.490
7.460
7.457
7.455
7.450
7.441
7.437
7.240
7.239
7.231
7.228
7.222
7.217
7.208
7.202
7.199
7.195
7.193
7.189
7.186
7.183
7.179
7.176
7.171
7.154
7.149
7.143
7.136
7.134
7.131
7.128
7.123
7.098
7.096
7.083
7.080
7.069
7.066
7.063
6.851
6.847
6.844
6.839
6.835
6.831
6.772
6.769
6.767
6.763
6.759
6.756
6.753
6.749
6.744
4.069
4.056
-0.000


Ph
Ph
O
Ph
N
H
1i
OCF3

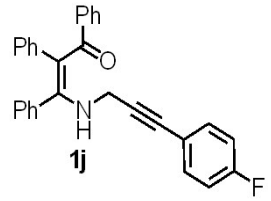

0.88
2.16
10.43
2.05
2.99
2.03
2.00
14.0 13.5 13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

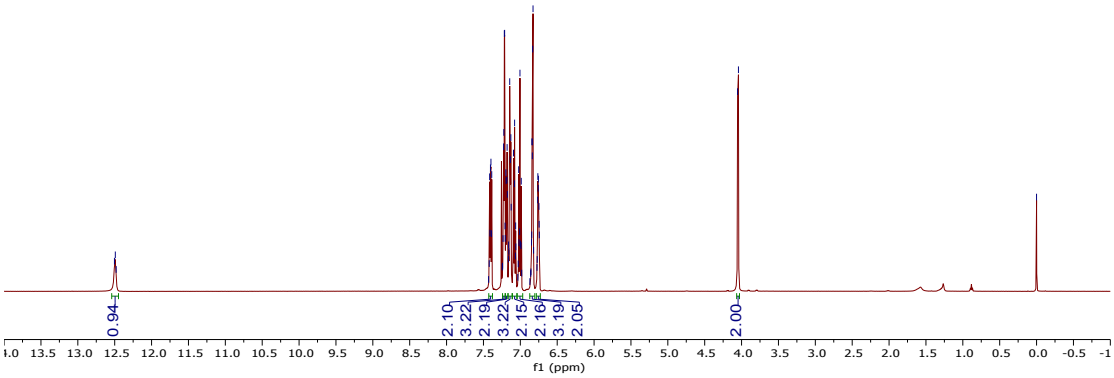

201.315
193.765
169.724
165.771
148.963
148.947
142.409
139.178
133.544
133.289
133.197
128.619
128.573
128.488
128.334
128.139
127.991
127.131
127.055
125.098
123.380
121.332
120.737
119.283
115.382
112.847
110.312
85.979
82.542
77.254
77.000
76.746
35.097

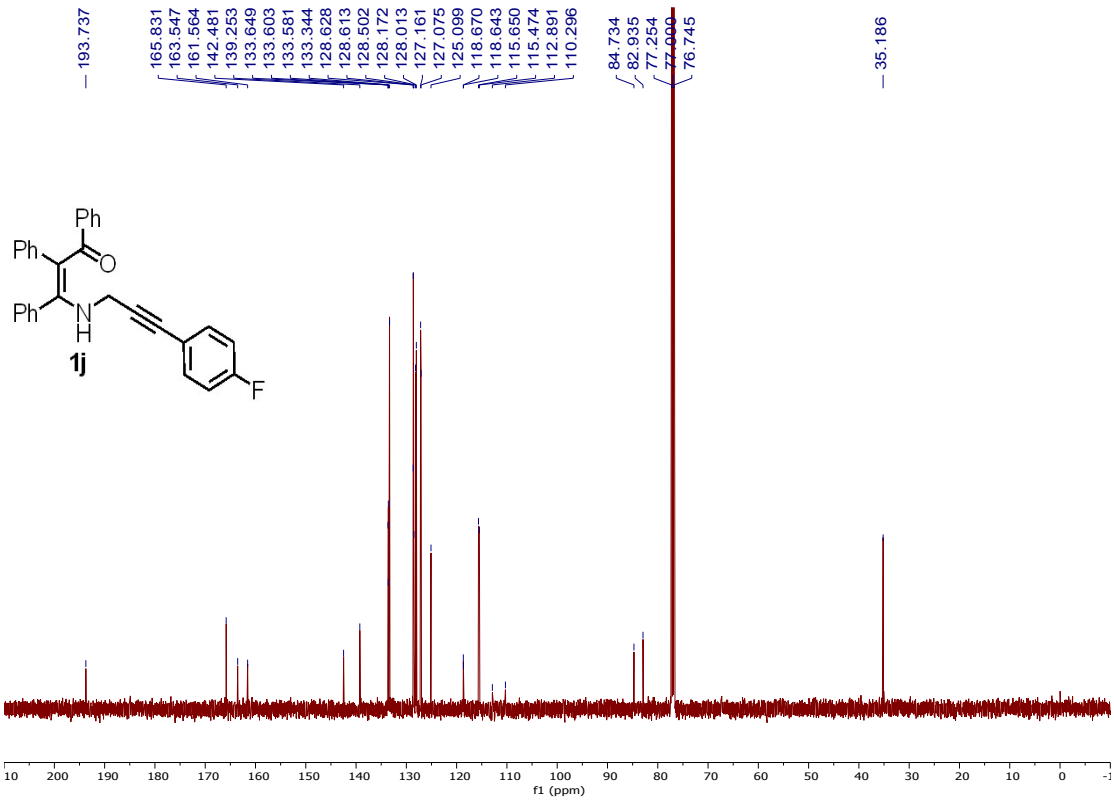

Ph
Ph
O
Ph
N
H
1i
OCF3


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

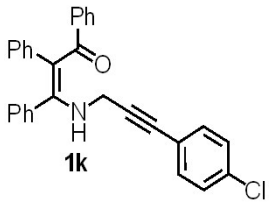

12.492
7.416
7.412
7.405
7.398
7.392
7.388
7.235
7.227
7.223
7.217
7.213
7.207
7.204
7.196
7.193
7.182
7.179
7.176
7.162
7.159
7.156
7.144
7.135
7.128
7.124
7.093
7.080
7.077
7.066
7.063
7.061
7.022
7.018
7.009
7.005
7.000
6.992
6.988
6.848
6.845
6.841
6.839
6.837
6.833
6.828
6.820
6.771
6.765
6.762
6.757
6.755
6.748
6.745
6.743
4.054
4.042
0.000

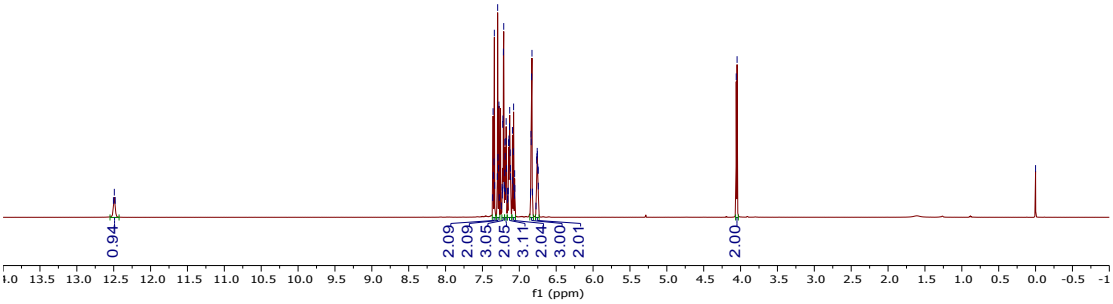

Ph
Ph
O
Ph
N
H
1j
F

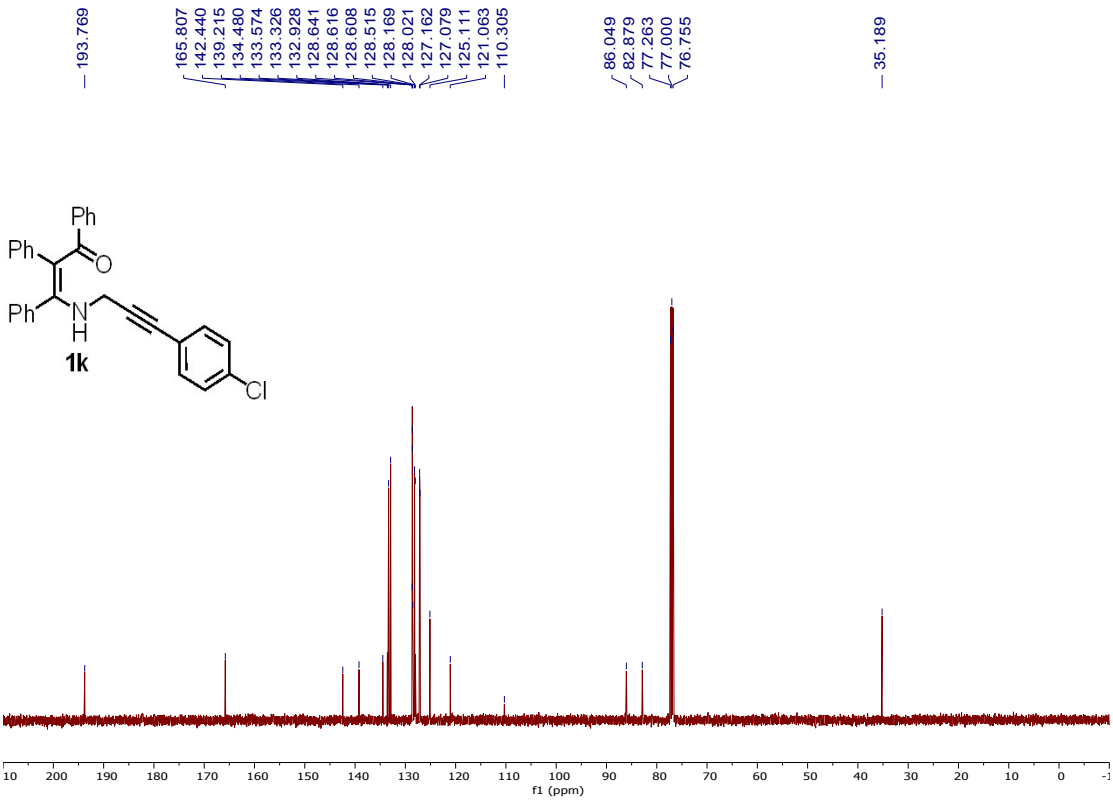

0.94
2.10
3.22
2.19
3.22
2.15
2.16
3.19
2.05
2.00
f1 (ppm)


193.737
165.831
163.547
161.564
142.481
139.253
133.649
133.603
133.581
133.344
128.628
128.613
128.502
128.172
128.013
127.161
127.075
125.099
118.670
118.643
115.650
115.474
112.891
110.296
84.734
82.935
77.254
77.000
76.745
35.186
Ph
Ph
O
Ph
N
H
1j
F
f1 (ppm)

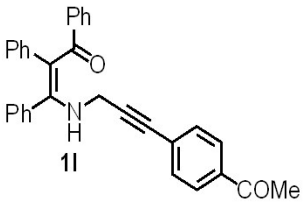

7.356
7.352
7.343
7.339
7.334
7.298
7.294
7.290
7.281
7.277
7.233
7.228
7.225
7.222
7.216
7.211
7.206
7.203
7.198
7.195
7.192
7.186
7.182
7.179
7.175
7.160
7.150
7.145
7.140
7.138
7.133
7.130
7.124
7.121
7.119
7.093
7.090
7.080
7.078
7.074
7.063
7.061
6.842
6.839
6.833
6.828
6.821
6.765
6.762
6.757
6.754
6.750
6.747
6.745
6.742
4.059
4.047
0.000

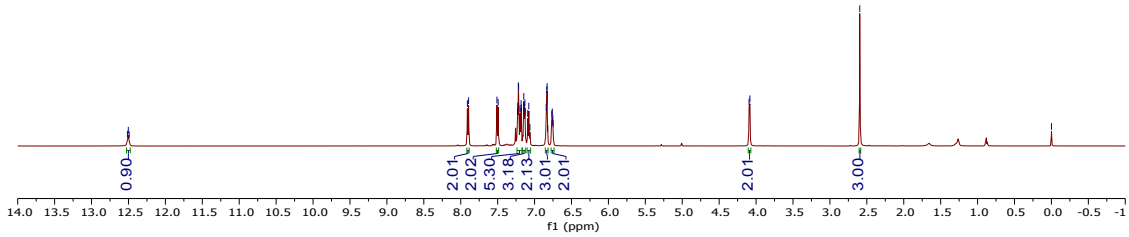

Ph
Ph
O
Ph
N
H
1k
Cl


0.94
2.09
2.09
3.05
2.05
3.11
2.04
3.00
2.01
2.00
f1 (ppm)

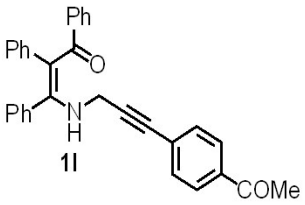

193.769
165.807
142.440
139.215
134.480
133.574
133.326
132.928
128.641
128.616
128.608
128.515
128.169
128.021
127.162
127.079
125.111
121.063
110.305
86.049
82.879
77.263
77.000
76.755
35.189
Ph
Ph
O
Ph
N
H
1k
Cl
f1 (ppm)

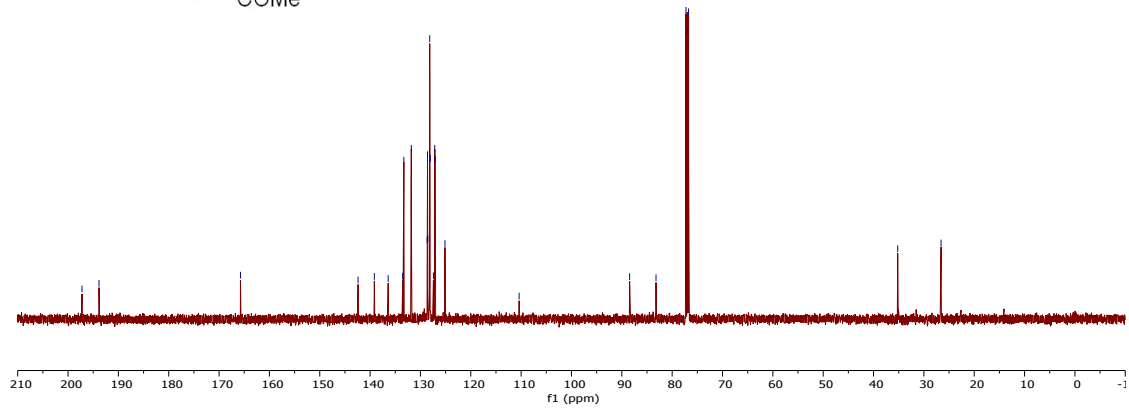

12.514
12.502
12.490
7.910
7.894
7.510
7.494
7.231
7.227
7.220
7.216
7.197
7.182
7.179
7.146
7.139
7.131
7.127
7.093
7.078
7.063
6.842
6.835
6.830
6.823
6.767
6.760
6.753
6.748
4.095
4.083
2.596
-0.001


Ph
Ph
O
Ph
N
H
1l
COMe

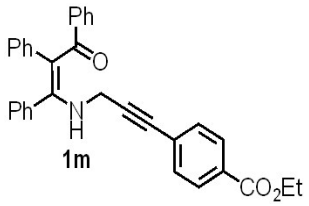

0.90
2.01
2.02
5.30
3.18
2.13
3.01
2.01
2.01
3.00
14.0 13.5 13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

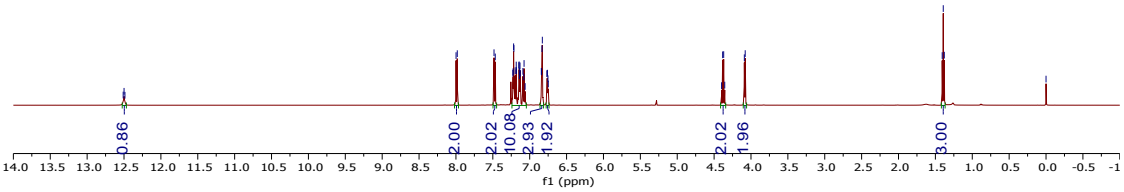

197.224
193.851
165.753
142.392
139.159
136.412
133.529
133.297
131.820
128.665
128.597
128.540
128.157
128.042
127.425
127.158
127.082
125.133
110.401
88.449
83.209
77.253
77.003
76.745
35.196
26.590


Ph
Ph
O
Ph
N
H
1l
COMe

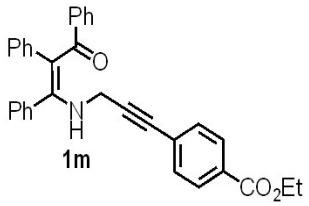

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


12.511
12.499
12.487
7.998
7.982
7.484
7.467
7.228
7.225
7.218
7.214
7.197
7.183
7.180
7.147
7.144
7.140
7.138
7.131
7.128
7.092
7.079
7.076
7.062
6.842
6.840
6.834
6.829
6.767
6.760
6.753
6.748
4.398
4.384
4.370
4.356
4.090
4.078
1.408
1.393
1.379
-0.000


Ph
Ph
O
Ph
N
H
1m
CO2Et

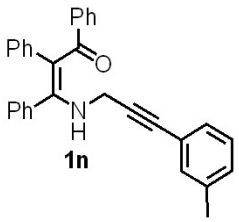

0.86
2.00
2.02
10.08
2.93
1.92
2.02
1.96
3.00
14.0 13.5 13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


193.836
165.953
165.768
142.421
139.191
133.553
133.315
131.575
130.095
129.383
128.649
128.614
128.531
128.163
128.036
127.155
127.122
127.079
125.123
110.394
88.008
83.294
77.254
77.000
76.746
61.125
35.193
14.282

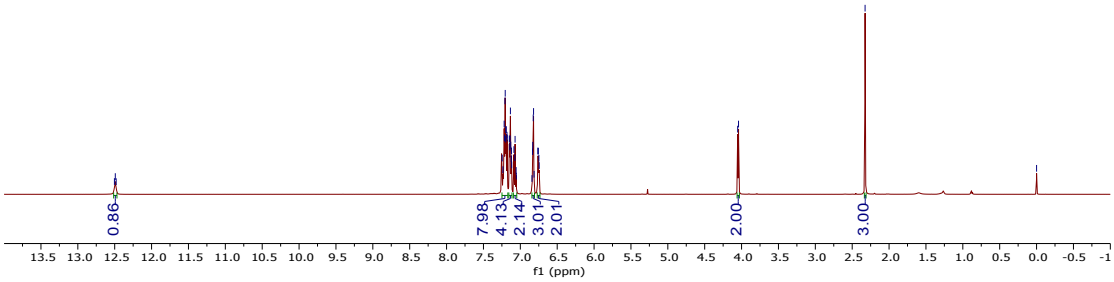

Ph
Ph
O
Ph
N
H
1m
CO2Et

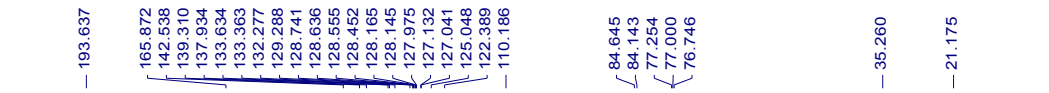
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

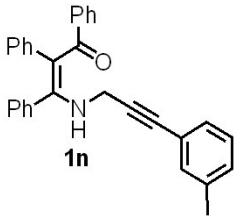

12.504
12.492
12.480
7.246
7.235
7.219
7.215
7.208
7.205
7.198
7.195
7.192
7.181
7.178
7.149
7.143
7.140
7.134
7.130
7.123
7.120
7.117
7.086
7.074
7.071
7.057
7.054
6.842
6.834
6.831
6.825
6.820
6.813
6.763
6.756
6.748
6.744
4.053
4.041
2.325
-0.000


Ph
Ph
O
Ph
N
H

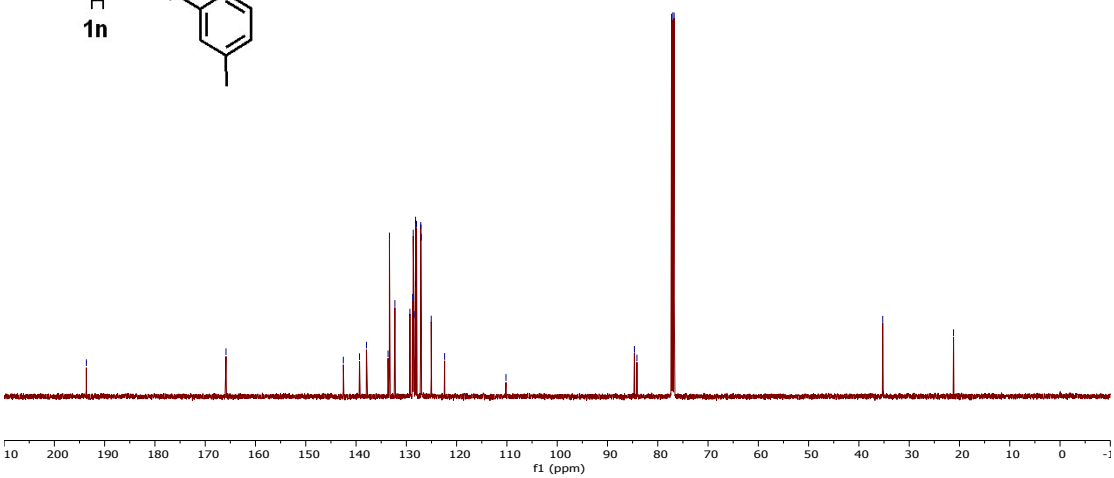
1n


0.86
7.98
4.13
2.14
3.01
2.01
2.00
3.00
f1 (ppm)

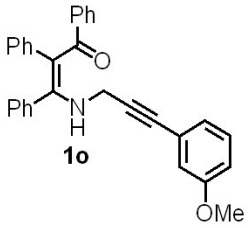

193.637
165.872
142.538
139.310
137.934
133.634
133.363
132.277
129.288
128.741
128.636
128.555
128.452
128.165
128.145
127.975
127.132
127.041
125.048
122.389
110.186
84.645
84.143
77.254
77.000
76.746
35.260
21.175

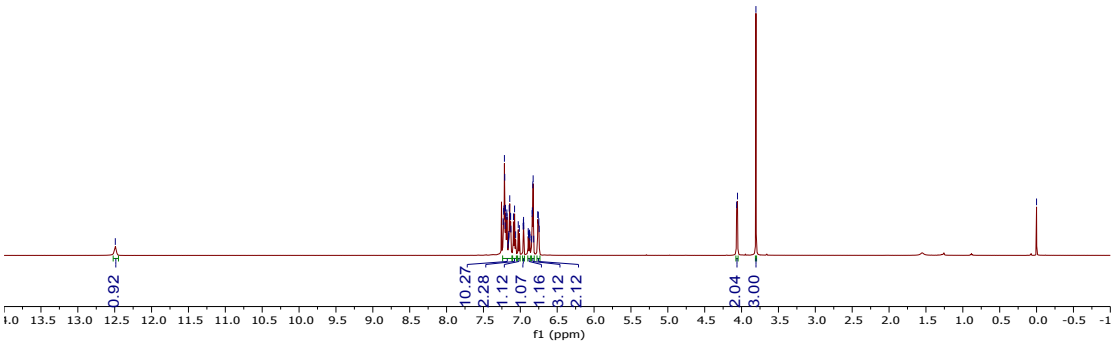

Ph
Ph
O
Ph
N
H

1n

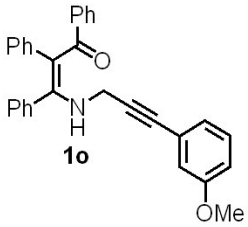

f1 (ppm)

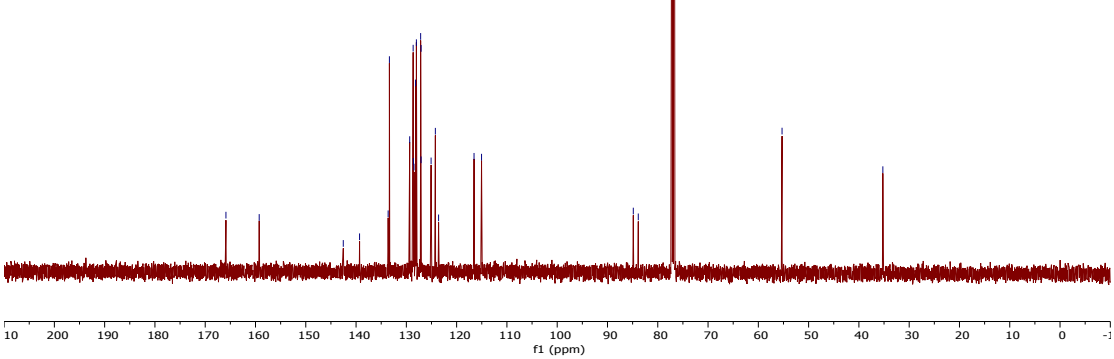

12.492
7.233
7.226
7.222
7.216
7.211
7.206
7.201
7.196
7.183
7.180
7.167
7.161
7.158
7.156
7.151
7.143
7.135
7.131
7.128
7.093
7.078
7.063
7.028
7.013
6.961
6.958
6.956
6.953
6.893
6.888
6.887
6.876
6.871
6.870
6.847
6.840
6.837
6.831
6.826
6.819
6.764
6.756
6.749
6.744
4.067
4.056
3.805
0.000


Ph
Ph
O
Ph
N
H
1o
OMe

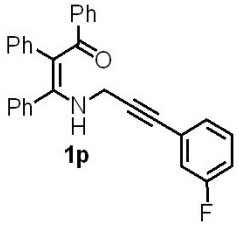

0.92
10.27
2.28
1.12
1.07
1.16
3.12
2.12
2.04
3.00
f1 (ppm)


165.879
159.264
142.544
139.304
133.621
133.370
129.334
128.648
128.597
128.484
128.170
128.002
127.156
127.073
127.065
125.080
124.232
123.588
116.538
115.045
84.867
83.876
77.254
77.000
76.745
55.284
35.236

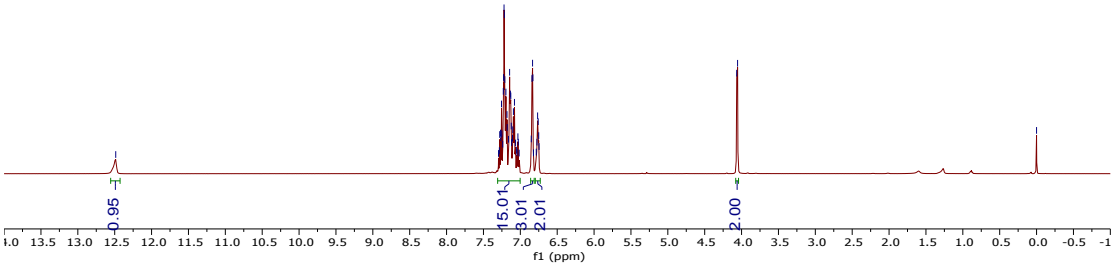

Ph
Ph
O
Ph
N
H
1o
OMe


f1 (ppm)

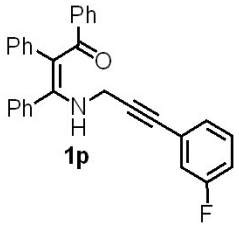

12.486
7.295
7.284
7.280
7.268
7.263
7.255
7.252
7.239
7.231
7.227
7.221
7.217
7.210
7.196
7.181
7.178
7.161
7.145
7.135
7.129
7.123
7.118
7.106
7.102
7.094
7.079
7.064
7.050
7.045
7.033
7.028
7.016
6.851
6.842
6.834
6.829
6.822
6.784
6.775
6.766
6.758
6.751
6.746
4.066
4.054
0.000


Ph
Ph
O
Ph
N
H
F

1p


0.95
15.01
3.01
2.01
2.00
f1 (ppm)

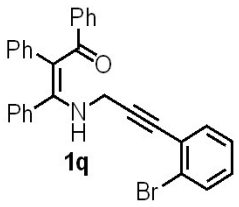

193.815
165.822
163.267
161.304
142.464
139.234
133.576
133.338
129.897
129.828
128.648
128.626
128.536
128.182
128.037
127.613
127.589
127.167
127.088
125.124
124.458
118.610
118.429
115.902
115.732
110.371
86.078
82.748
77.255
77.000
76.746
35.124

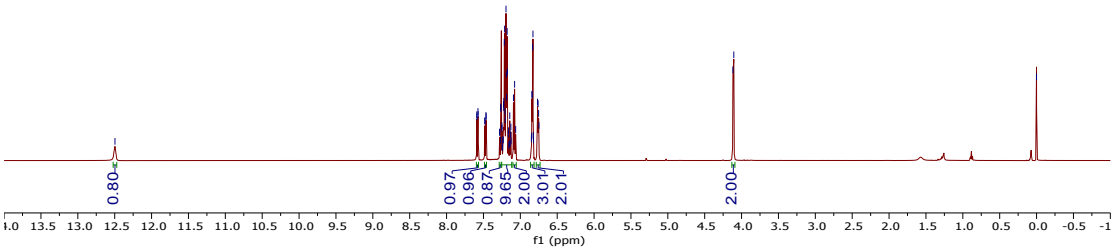

Ph
Ph
O
Ph
N
H
F

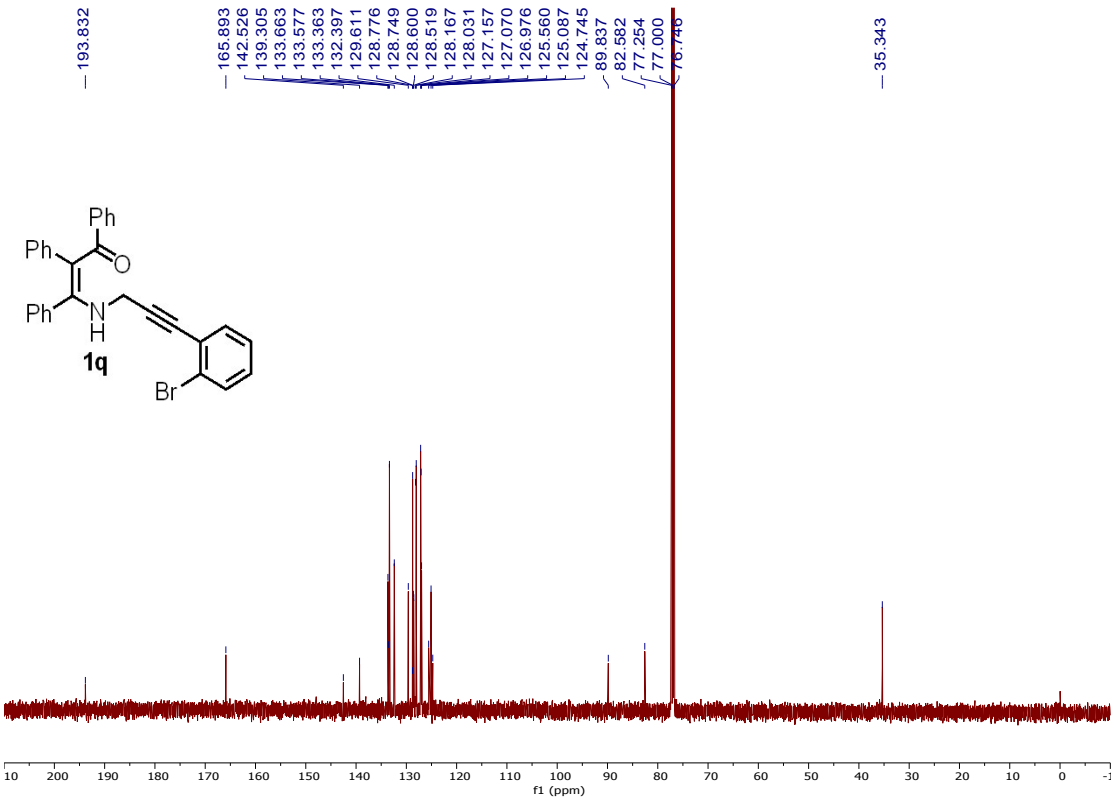
1p

f1 (ppm)

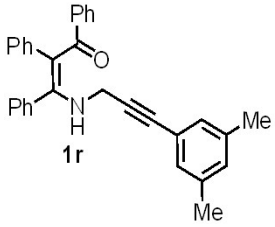

12.496
7.591
7.588
7.574
7.572
7.482
7.478
7.466
7.463
7.281
7.278
7.268
7.266
7.263
7.251
7.248
7.245
7.236
7.233
7.227
7.225
7.223
7.217
7.213
7.208
7.204
7.194
7.190
7.186
7.179
7.175
7.163
7.159
7.155
7.148
7.143
7.139
7.131
7.128
7.126
7.093
7.078
7.063
6.850
6.847
6.842
6.839
6.833
6.829
6.824
6.821
6.767
6.759
6.752
6.747
4.117
4.105
0.001

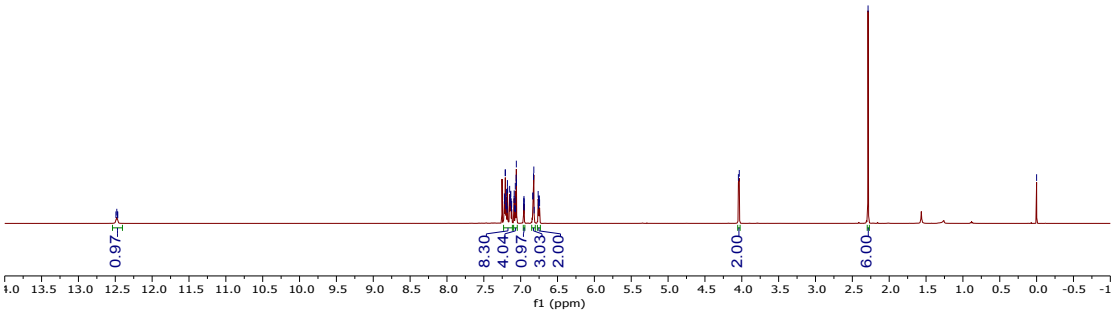

Ph
Ph
O
Ph
N
H
1q
Br

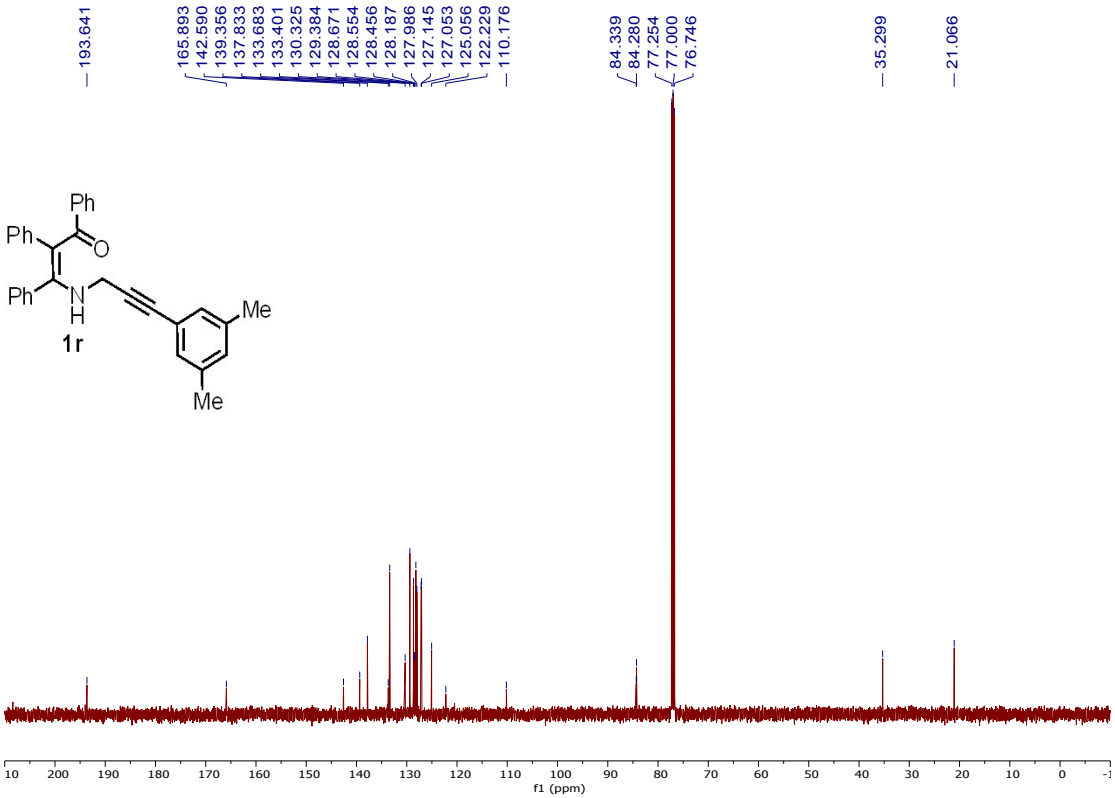

0.80
0.97
0.96
0.87
9.65
2.00
3.01
2.01
2.00
f1 (ppm)


193.832
165.893
142.526
139.305
133.663
133.577
133.363
132.397
129.611
128.776
128.749
128.600
128.519
128.167
128.031
127.157
127.070
126.976
125.560
125.087
124.745
89.837
82.582
77.254
77.000
76.746
35.343
Ph
Ph
O
Ph
N
H
1q
Br
f1 (ppm)

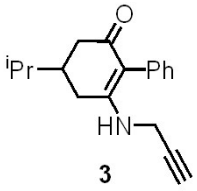

12.491
12.480
12.469
12.467
7.221
7.218
7.217
7.210
7.206
7.201
7.196
7.194
7.190
7.184
7.180
7.177
7.149
7.145
7.143
7.140
7.137
7.134
7.130
7.125
7.122
7.090
7.088
7.085
7.076
7.073
7.069
7.062
7.059
7.056
6.959
6.957
6.955
6.953
6.952
6.835
6.832
6.826
6.821
6.817
6.763
6.761
6.758
6.756
6.754
6.748
6.743
4.046
4.034
2.287
0.000


Ph
Ph
O
Ph
N
H
Me
Me
1r

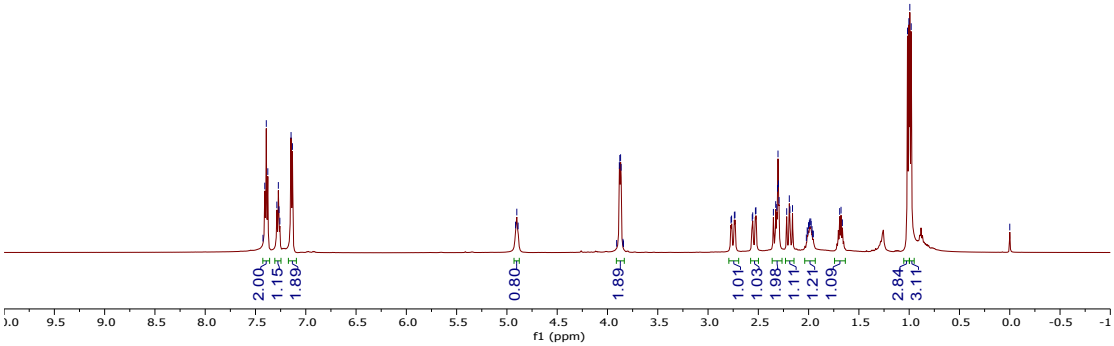

0.97
8.30
4.04
0.97
3.03
2.00
2.00
6.00
f1 (ppm)


193.641
165.893
142.590
139.356
137.833
133.683
133.401
130.325
129.384
128.671
128.554
128.456
128.187
127.986
127.145
127.053
125.056
122.229
110.176
84.339
84.280
77.254
77.000
76.746
35.299
21.066
Ph
Ph
O
Ph
N
H
Me
Me
1r
f1 (ppm)

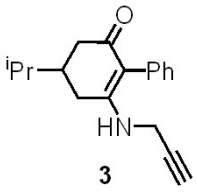

7.426
7.408
7.393
7.378
7.288
7.273
7.266
7.258
7.146
7.133
4.914
4.902
4.889
3.909
3.882
3.877
3.870
3.865
3.846
3.841
2.771
2.766
2.738
2.732
2.560
2.556
2.529
2.524
2.350
2.327
2.317
2.310
2.304
2.299
2.294
2.218
2.192
2.186
2.160
2.022
2.014
2.008
2.001
1.992
1.988
1.978
1.975
1.966
1.961
1.953
1.691
1.678
1.664
1.017
1.003
0.994
0.980
-0.000


O
iPr
Ph
HN

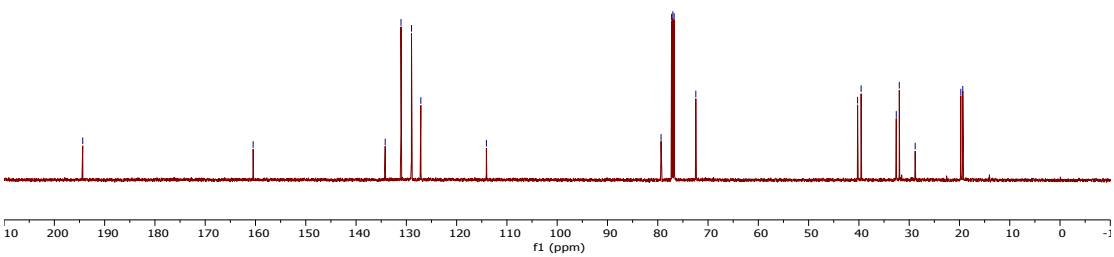
3


2.00
1.15
1.89
0.80
1.89
1.01
1.03
1.98
1.11
1.21
1.09
2.84
3.11
f1 (ppm)

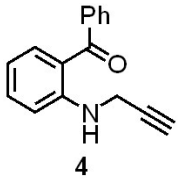

194.357
160.469
134.205
131.067
128.976
127.117
114.082
79.344
77.254
77.000
76.745
72.431
40.259
39.559
32.570
31.965
28.810
19.733
19.337


O
iPr
Ph
HN

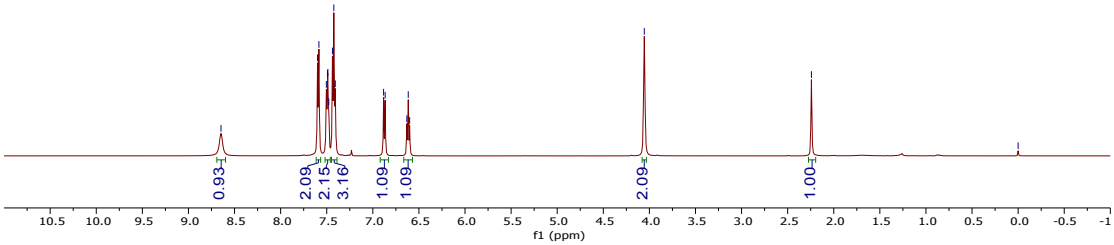
3


f1 (ppm)


8.647
7.600
7.585
7.504
7.492
7.487
7.478
7.438
7.423
7.407
6.883
6.866
6.631
6.616
6.601
4.055
2.242
0.000


Ph
O
N
H

4

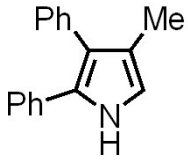

0.93
2.09
2.15
3.16
1.09
1.09
2.09
1.00
f1 (ppm)


Ph
O
N
H

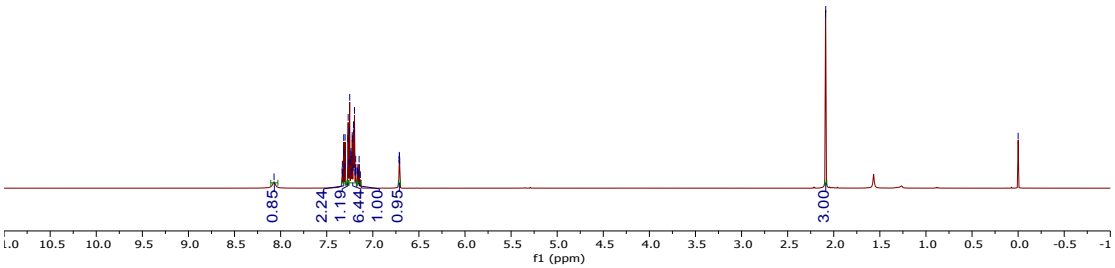
4

199.239
150.349
140.105
135.282
134.767
130.836
128.980
127.949
118.172
114.915
111.779
80.101
77.254
77.000
76.746
71.327
71.327
32.270
f1 (ppm)


8.072
7.333
7.330
7.327
7.316
7.313
7.305
7.301
7.271
7.267
7.257
7.254
7.251
7.241
7.238
7.236
7.232
7.226
7.224
7.222
7.214
7.210
7.203
7.199
7.194
7.189
7.186
7.182
7.166
7.163
7.159
7.153
7.149
7.135
6.716
6.713
6.710
6.708
2.089
2.087
-0.000


Ph
Me
Ph
N
H

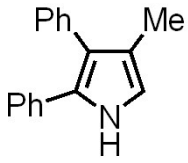
2a


0.85
2.24
1.19
6.44
1.00
0.95
3.00
f1 (ppm)

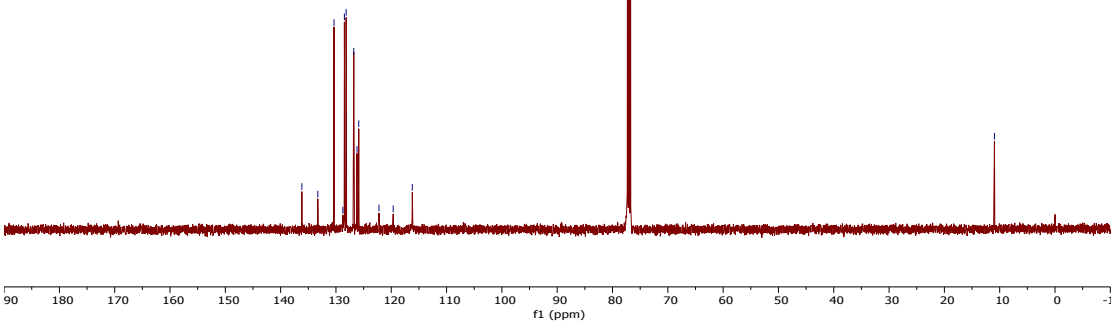

136.163
133.277
130.349
128.757
128.475
128.161
126.780
126.194
125.876
122.218
119.651
116.197


77.254
77.000
76.746

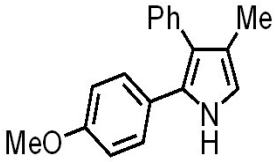

10.951


Ph
Me
Ph
N
H

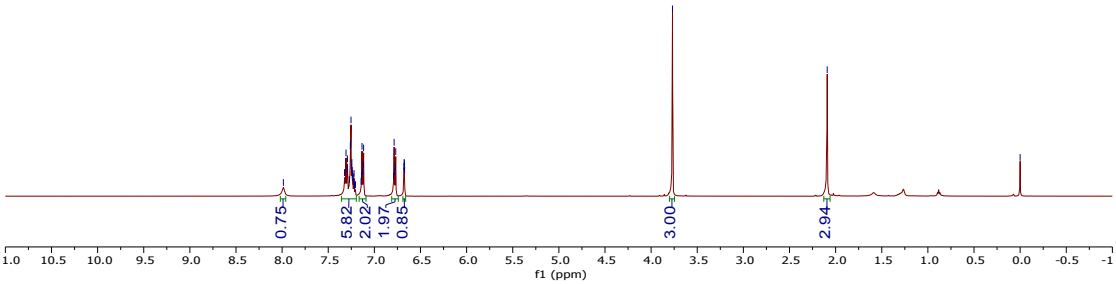
2a


f1 (ppm)

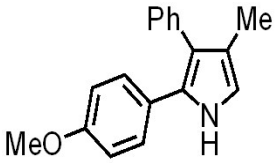

7.986
7.322
7.322
7.307
7.296
7.292
7.272
7.261
7.258
7.253
7.247
7.244
7.241
7.237
7.234
7.231
7.224
7.220
7.216
7.209
7.206
7.143
7.139
7.134
7.129
7.120
7.116
6.792
6.786
6.781
6.772
6.768
6.680
6.677
6.674
6.672
3.769
2.091
0.000


Ph
Me
N
H
MeO

2b


0.75
5.82
2.02
1.97
0.85
3.00
2.94
f1 (ppm)

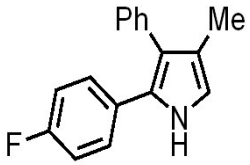

158.155
136.286
130.342
128.753
128.193
128.113
126.048
125.712
121.334
119.389
115.584
113.955
77.255
77.000
76.746
55.187
11.026


Ph
Me
N
H
MeO

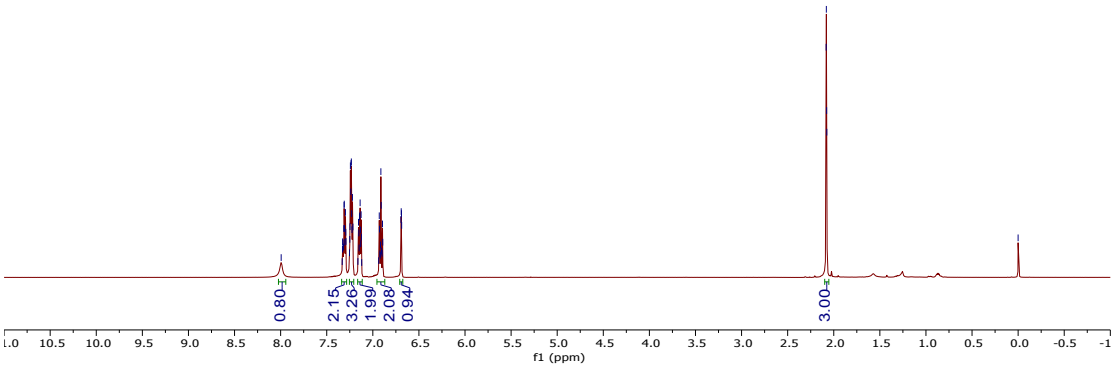
2b

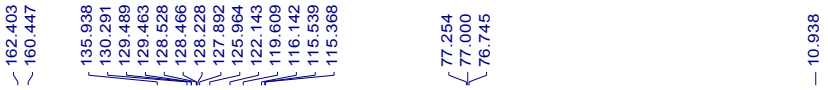
f1 (ppm)

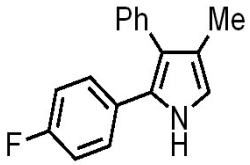

7.994
7.332
7.329
7.328
7.324
7.318
7.315
7.312
7.310
7.307
7.304
7.297
7.293
7.291
7.253
7.250
7.247
7.243
7.239
7.237
7.233
7.229
7.226
7.221
7.216
7.162
7.155
7.152
7.148
7.145
7.142
7.138
7.135
7.132
7.127
7.124
7.121
6.936
6.930
6.927
6.923
6.919
6.917
6.913
6.910
6.906
6.900
6.895
6.892
6.694
6.692
6.689
6.687
2.082
2.080
2.077
2.075
0.000


Ph
Me
F
N
H

2c


0.80
2.15
3.26
1.99
2.08
0.94
3.00
f1 (ppm)

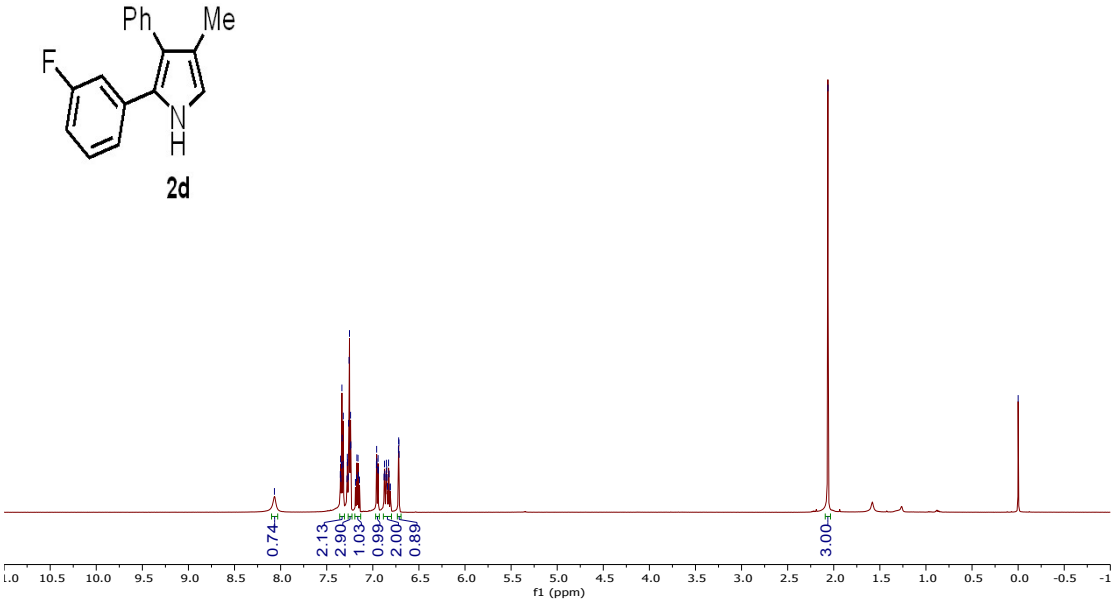

162.403
160.447
135.938
130.291
129.489
129.463
128.528
128.466
128.228
127.892
125.964
122.143
119.609
116.142
115.539
115.368
77.254
77.000
76.745
10.938

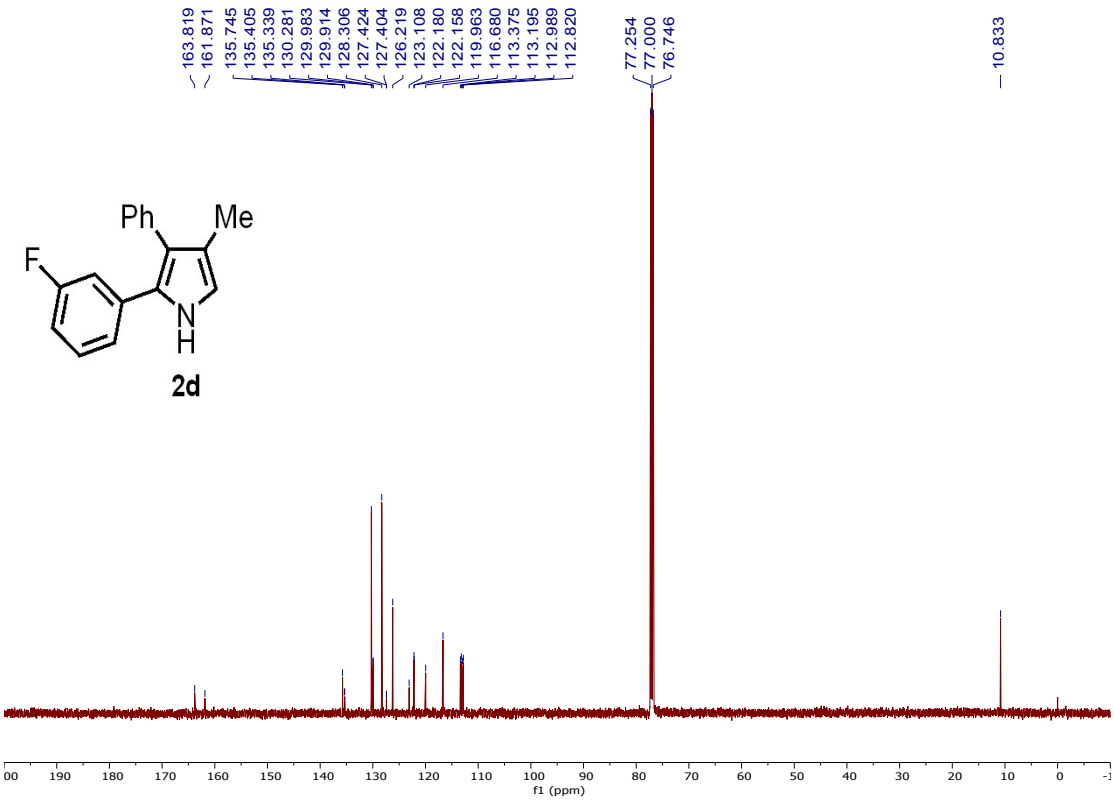

Ph
Me
F
N
H

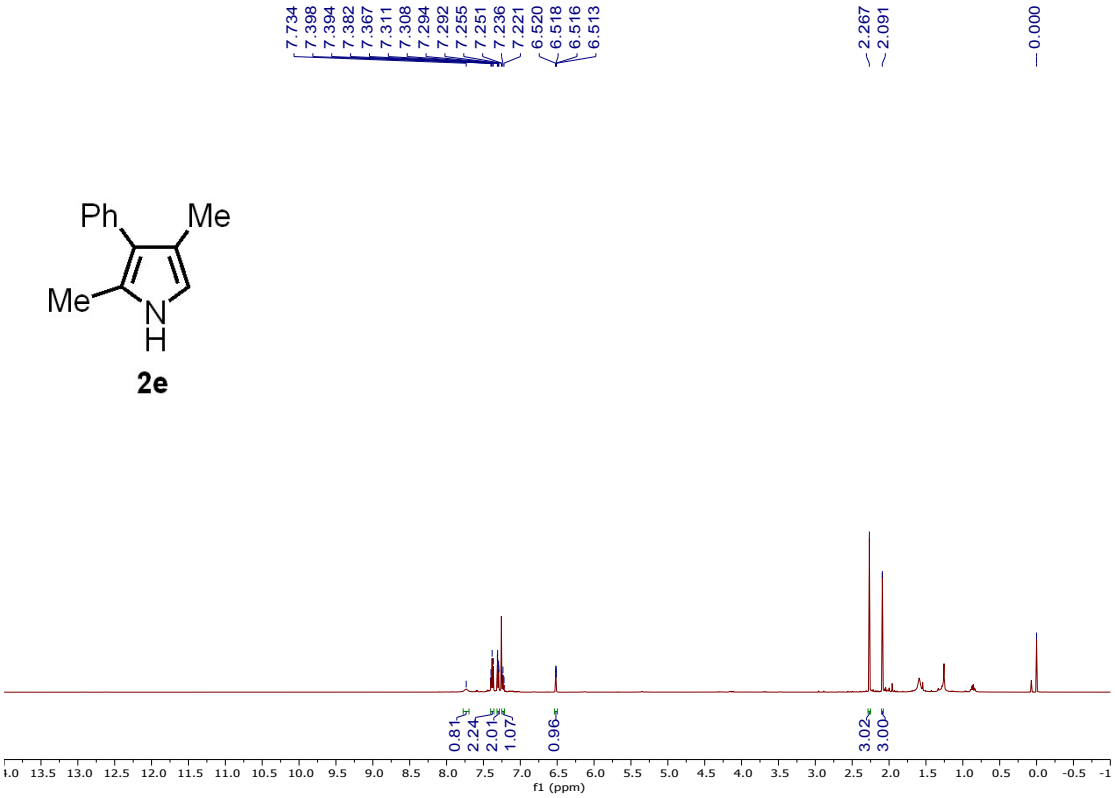
2c

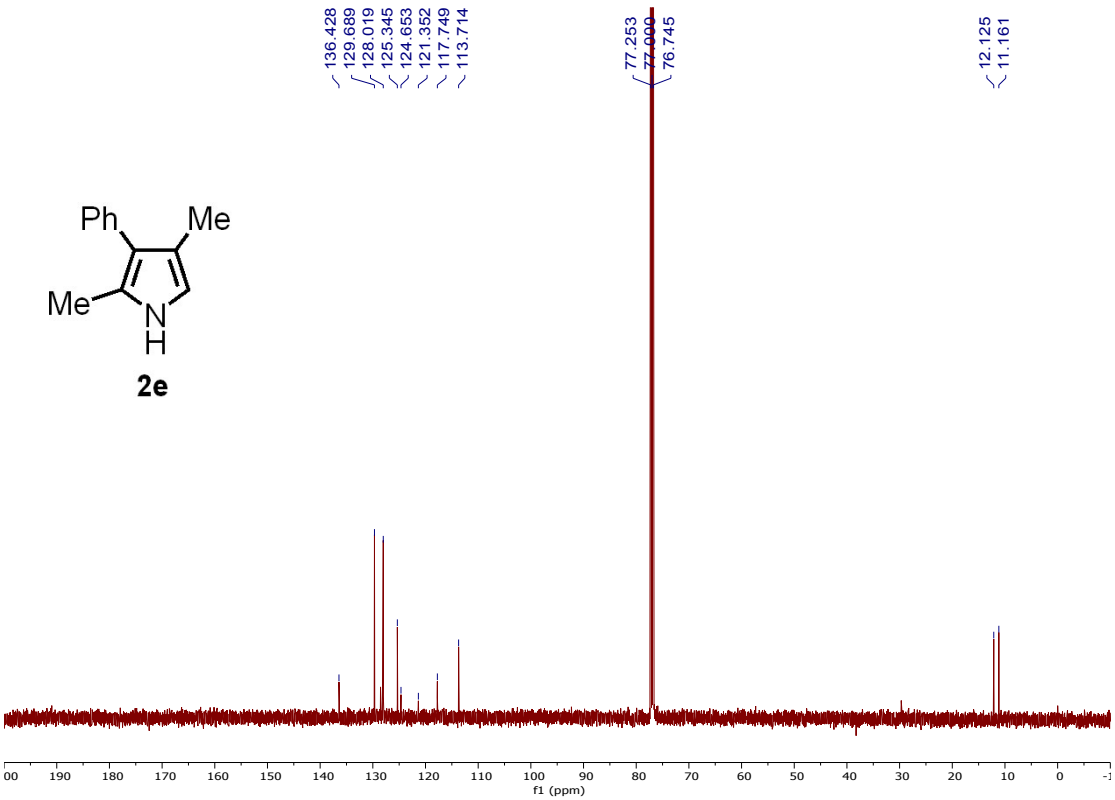
f1 (ppm)

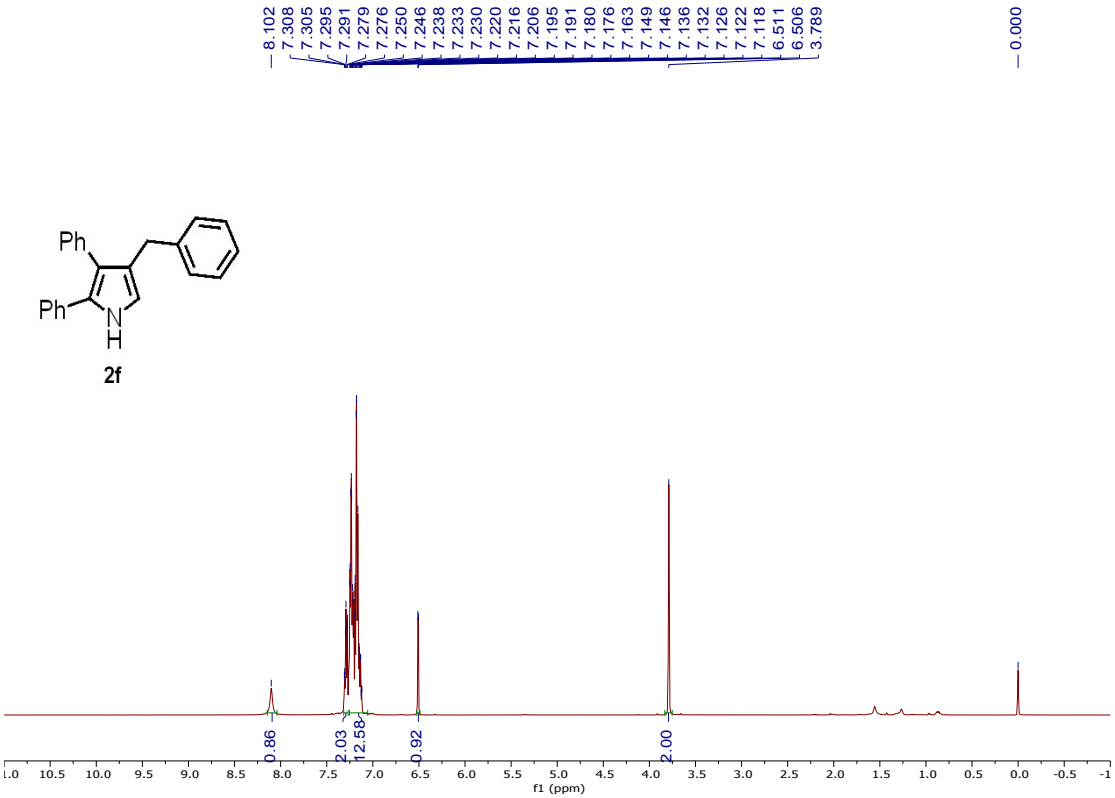

8.067
7.352
7.350
7.346
7.339
7.335
7.333
7.324
7.320
7.280
7.277
7.274
7.267
7.262
7.258
7.253
7.244
7.241
7.239
7.189
7.177
7.173
7.161
7.157
7.144
6.961
6.959
6.956
6.945
6.943
6.940
6.878
6.874
6.870
6.858
6.853
6.849
6.846
6.840
6.829
6.824
6.813
6.811
6.722
6.720
6.717
6.715
2.063
-0.000

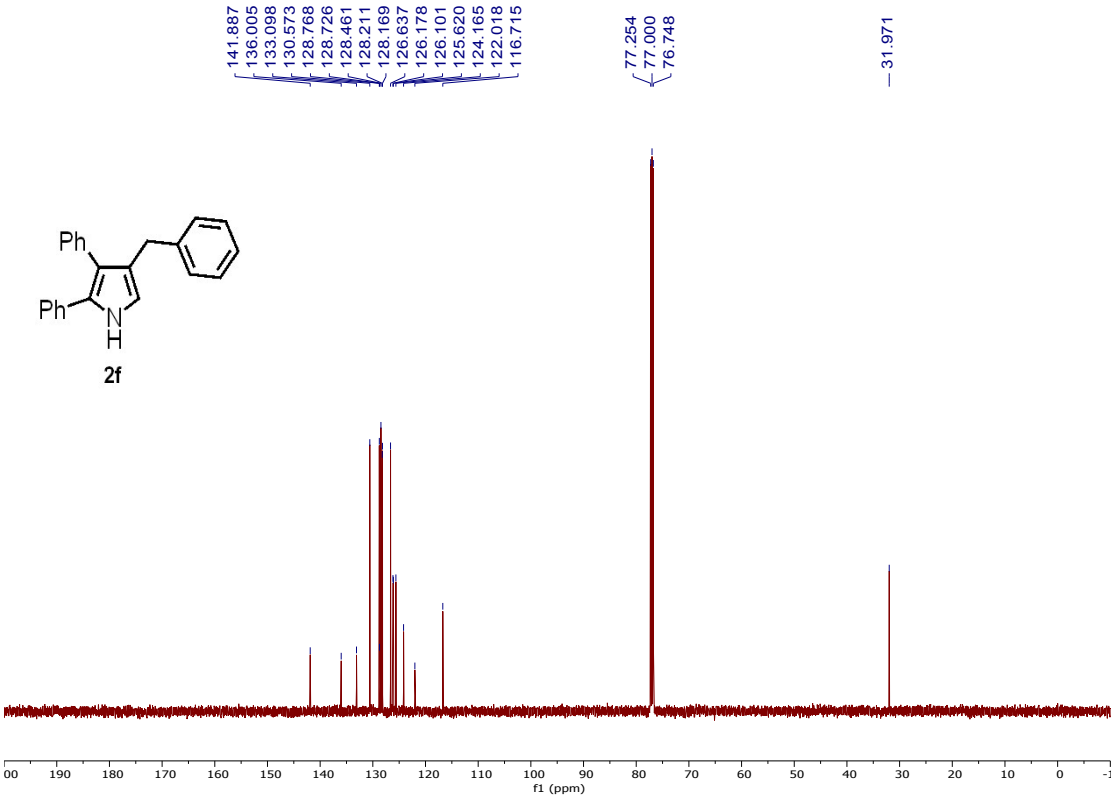

Ph
Me
F
N
H
2d
0.74
2.13
2.90
1.03
0.99
2.00
0.89
3.00
f1 (ppm)

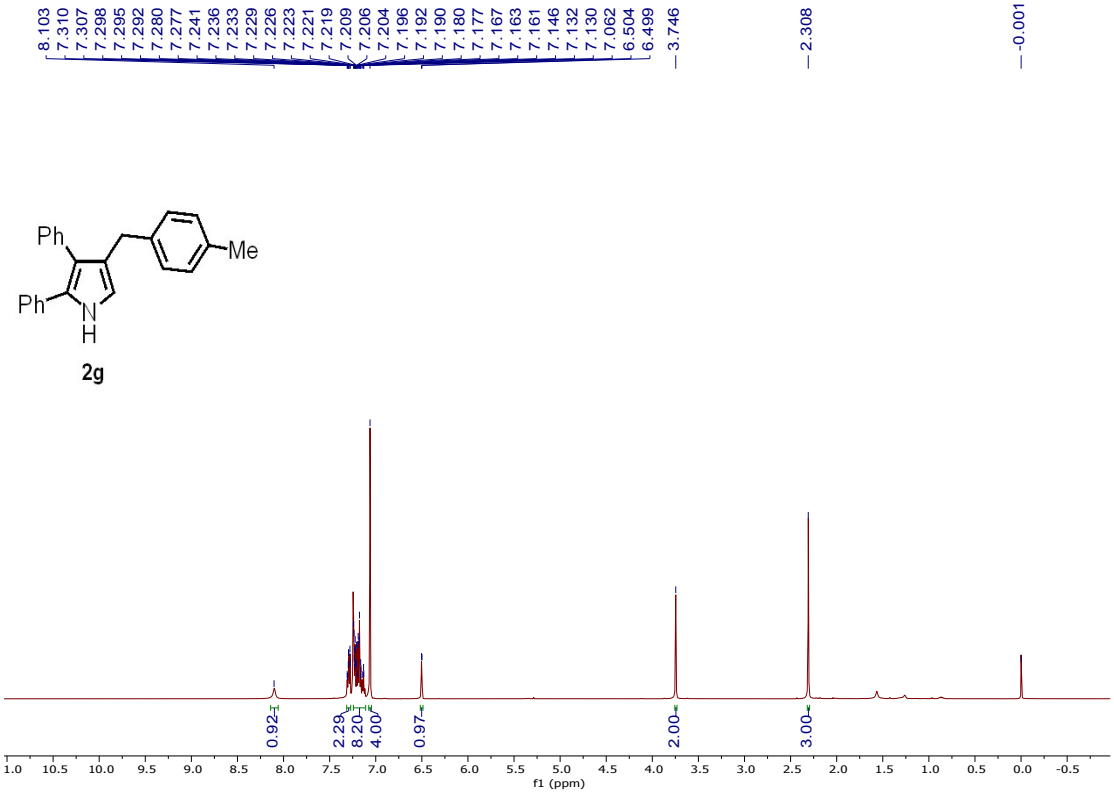

163.819
161.871
135.745
135.405
135.339
130.281
129.983
129.914
128.306
127.424
127.404
126.219
123.108
122.180
122.158
119.963
116.680
113.375
113.195
112.989
112.820
77.254
77.000
76.746
10.833
Ph
Me
F
N
H
2d
f1 (ppm)


7.734
7.398
7.394
7.382
7.367
7.311
7.308
7.294
7.292
7.255
7.251
7.236
7.221
6.520
6.518
6.516
6.513
2.267
2.091
0.000
Ph
Me
Me
N
H
2e
0.81
2.24
2.01
1.07
0.96
3.02
3.00
f1 (ppm)

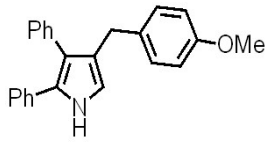

136.428
129.689
128.019
125.345
124.653
121.352
117.749
113.714
77.253
77.000
76.745
12.125
11.161
Ph
Me
Me
N
H
2e
f1 (ppm)


8.102
7.308
7.305
7.295
7.291
7.279
7.276
7.250
7.246
7.238
7.233
7.230
7.220
7.216
7.206
7.195
7.191
7.180
7.176
7.163
7.149
7.146
7.136
7.132
7.126
7.122
7.118
6.511
6.506
3.789
0.000
Ph
Ph
N
H
2f
0.86
2.03
12.58
0.92
2.00
f1 (ppm)

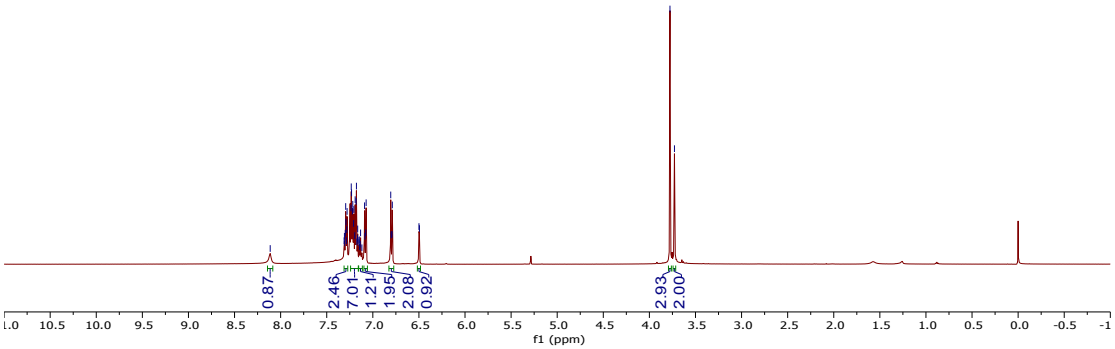

141.887
136.005
133.098
130.573
128.768
128.726
128.461
128.211
128.169
126.637
126.178
126.101
125.620
124.165
122.018
116.715
77.254
77.000
76.748
31.971
Ph
Ph
N
H
2f
f1 (ppm)


8.103
7.310
7.307
7.298
7.295
7.292
7.280
7.277
7.241
7.236
7.233
7.229
7.226
7.223
7.221
7.219
7.209
7.206
7.204
7.196
7.192
7.190
7.180
7.177
7.167
7.163
7.161
7.146
7.132
7.130
7.062
6.504
6.499
3.746
2.308
-0.001
Ph
Me
Ph
N
H
2g
0.92
2.29
8.20
4.00
0.97
2.00
3.00
f1 (ppm)
138.806
136.046
135.014
133.147
130.587
128.880
128.692
128.634
128.455
128.204
126.655
126.154
126.070
124.453
121.976
116.664
77.254
77.000
76.746
31.504
21.010
Ph
Me
Ph
N
H
2g
f1 (ppm)

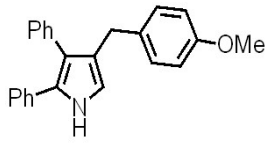

8.113
7.311
7.308
7.305
7.299
7.294
7.292
7.287
7.283
7.279
7.237
7.234
7.231
7.221
7.217
7.209
7.206
7.197
7.192
7.181
7.178
7.173
7.167
7.164
7.161
7.150
7.146
7.143
7.137
7.133
7.119
7.090
7.085
7.077
7.073
6.806
6.801
6.793
6.789
6.499
6.494
3.777
3.728


Ph
OMe
Ph
N
H

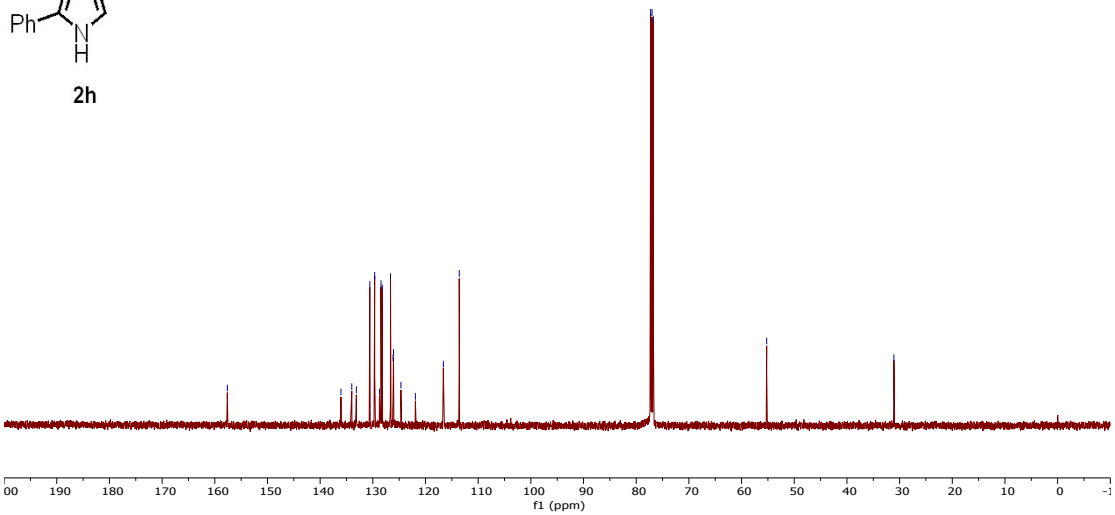
2h


0.87
2.46
7.01
1.21
1.95
2.08
0.92
2.93
2.00
f1 (ppm)

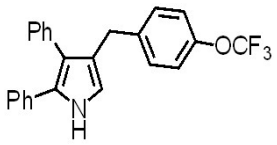

157.624
136.049
133.993
133.125
130.568
129.648
128.744
128.454
128.197
126.643
126.161
126.073
124.670
121.921
116.619
113.597
77.254
77.000
76.746
55.233
31.079


Ph
OMe
Ph
N
H

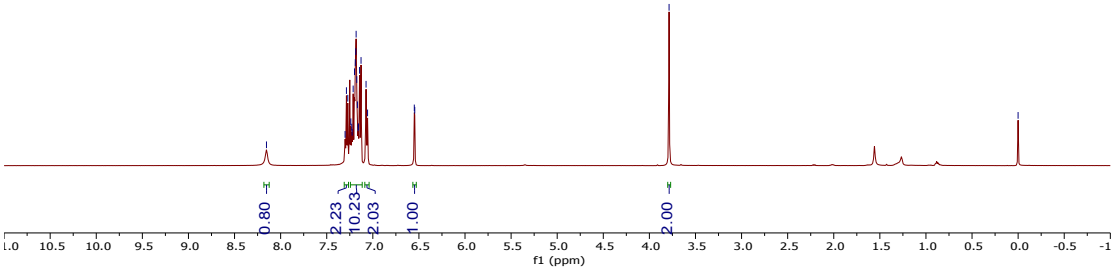
2h

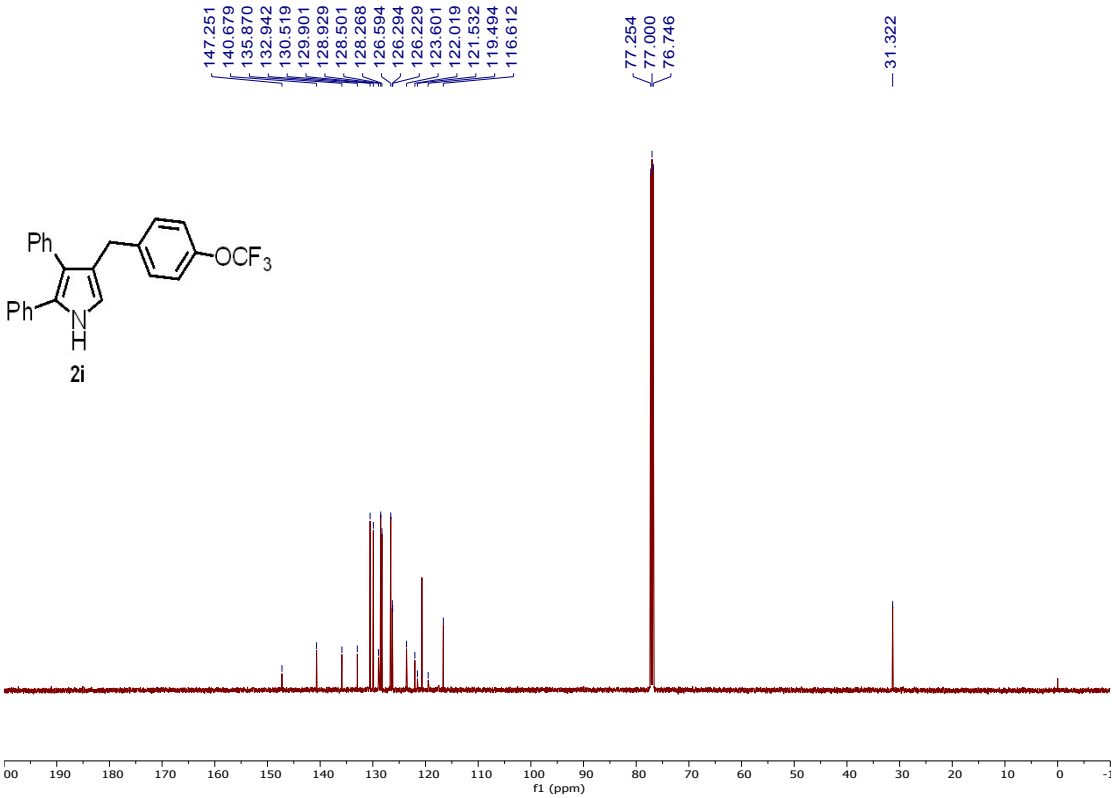

f1 (ppm)


8.154
7.301
7.286
7.272
7.239
7.228
7.225
7.213
7.199
7.190
7.185
7.181
7.175
7.167
7.159
7.156
7.144
7.128
7.073
7.057
6.550
6.545
3.786
0.000


Ph
OCF3
Ph
N
H

2i

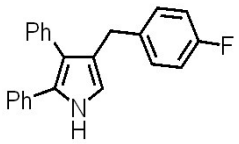

0.80
2.23
10.23
2.03
1.00
2.00
f1 (ppm)


147.251
140.679
135.870
132.942
130.519
129.901
128.929
128.501
128.268
126.594
126.294
126.229
123.601
122.019
121.532
119.494
116.612
77.254
77.000
76.746
31.322
f1 (ppm)

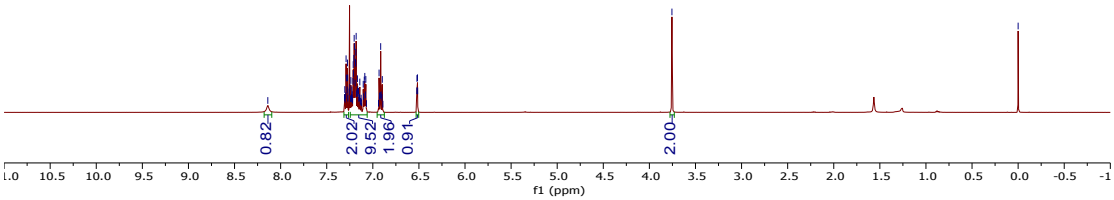
Ph
OCF3
Ph
N
H

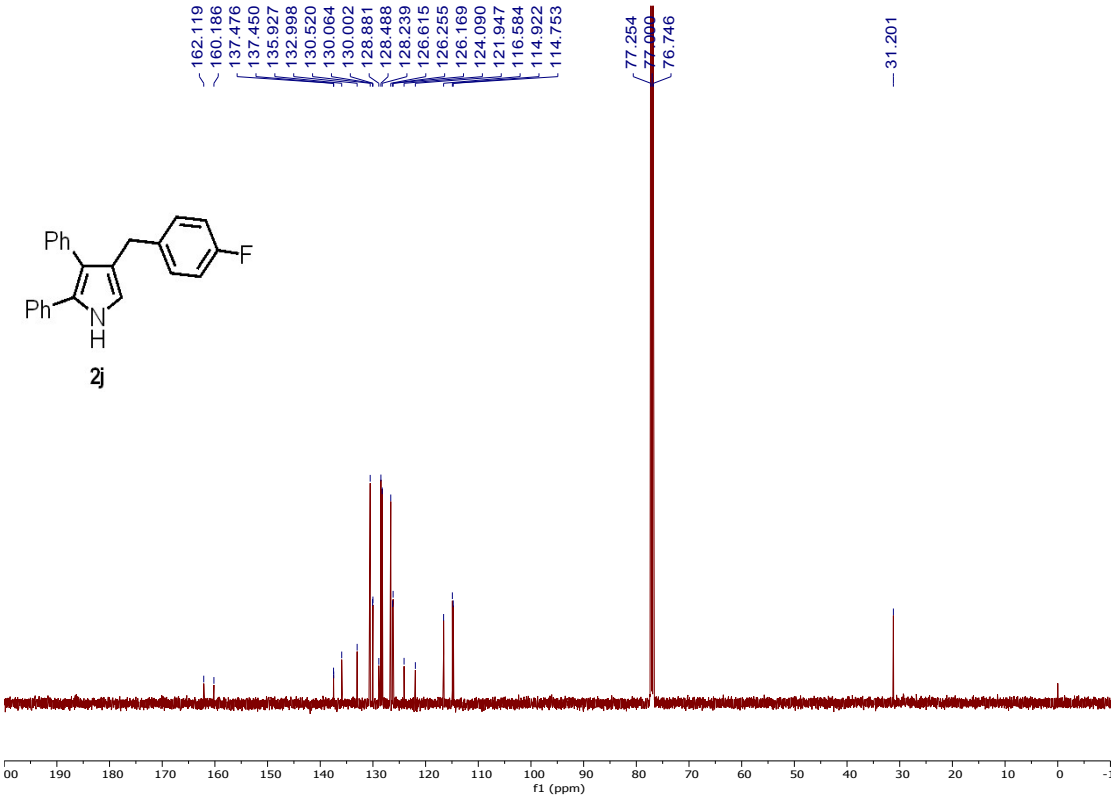
2i


7.307
7.304
7.301
7.294
7.290
7.287
7.278
7.275
7.274
7.271
7.256
7.249
7.243
7.238
7.232
7.230
7.227
7.224
7.215
7.213
7.211
7.206
7.202
7.198
7.192
7.189
7.186
7.184
7.181
7.176
7.170
7.167
7.164
7.158
7.155
7.152
7.145
7.141
7.127
7.104
7.100
7.093
7.087
7.080
7.076
6.932
6.928
6.920
6.915
6.910
6.902
6.897
6.523
6.521
6.516
6.514
3.755
-0.000


Ph
F
Ph
N
H

2j

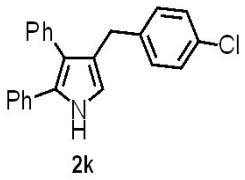

0.82
2.02
9.52
1.96
0.91
2.00
f1 (ppm)


162.119
160.186
137.476
137.450
135.927
132.998
130.520
130.064
130.002
128.881
128.488
128.239
126.615
126.255
126.169
124.090
121.947
116.584
114.922
114.753
77.254
77.000
76.746
31.201
f1 (ppm)

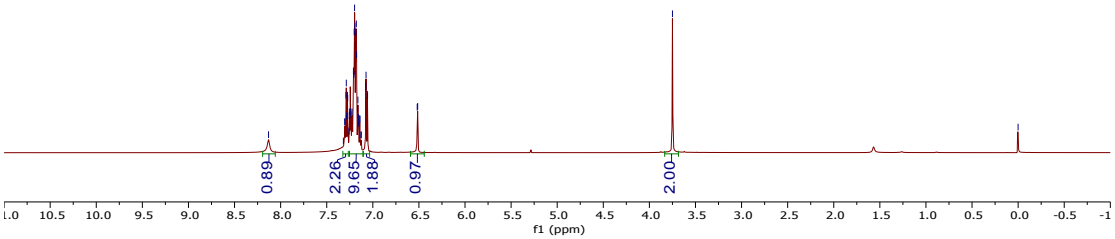
Ph
F
Ph
N
H

2j

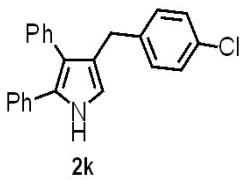

8.131
7.319
7.305
7.301
7.291
7.288
7.284
7.276
7.273
7.258
7.255
7.251
7.240
7.237
7.225
7.210
7.205
7.202
7.198
7.195
7.189
7.185
7.179
7.176
7.165
7.162
7.157
7.153
7.142
7.139
7.129
7.125
7.076
7.074
7.060
7.057
6.518
6.513
3.750
0.000


Ph
Cl
Ph
N
H

2k


0.89
2.26
9.65
1.88
0.97
2.00
f1 (ppm)

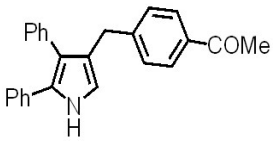

140.366
135.865
132.952
131.308
130.504
130.065
128.890
128.492
128.281
128.263
128.227
126.610
126.277
126.203
123.629
121.969
116.619
77.254
77.000
76.746
31.358


Ph
Cl
Ph
N
H

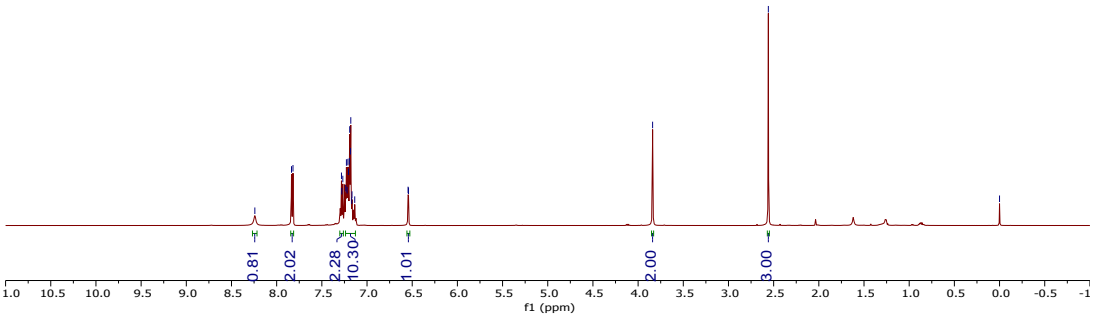
2k

f1 (ppm)

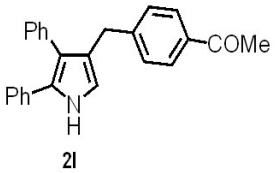

8.241
7.836
7.819
7.283
7.280
7.268
7.235
7.228
7.221
7.212
7.205
7.196
7.192
7.183
7.180
7.170
7.166
7.136
6.546
6.541
3.840
2.559
0.000


Ph
COMe
Ph
N
H

2l


0.81
2.02
2.28
10.30
1.01
2.00
3.00
f1 (ppm)

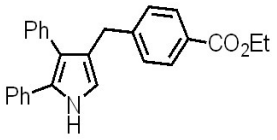

197.986
147.847
135.843
134.893
132.925
130.508
128.933
128.885
128.480
128.378
128.278
126.601
126.280
126.235
122.981
122.027
116.693
77.254
77.000
76.746
32.033
26.535


Ph
COMe
Ph
N
H

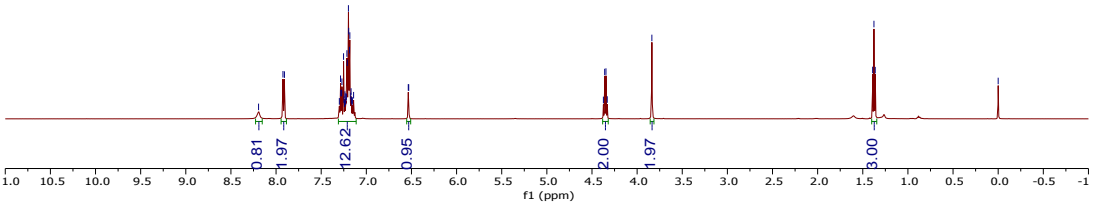
2l

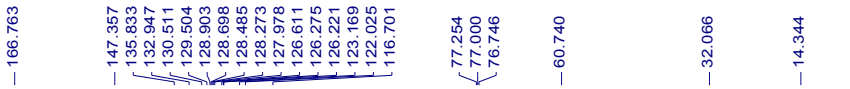
f1 (ppm)

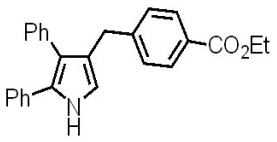

8.194
7.923
7.907
7.299
7.286
7.282
7.274
7.270
7.252
7.248
7.241
7.237
7.229
7.226
7.223
7.215
7.211
7.198
7.196
7.186
7.183
7.172
7.169
7.166
7.158
7.155
7.141
6.535
6.530
4.374
4.359
4.345
4.331
3.837
1.391
1.376
1.362
0.000


Ph
CO2Et
Ph
N
H

2m


0.81
1.97
12.62
0.95
2.00
1.97
3.00
f1 (ppm)

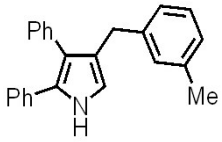

166.763
147.357
135.833
132.947
130.511
129.504
128.903
128.698
128.485
128.273
127.978
126.611
126.275
126.221
123.169
122.025
116.701
77.254
77.000
76.746
60.740
32.066
14.344


Ph
CO2Et
Ph
N
H

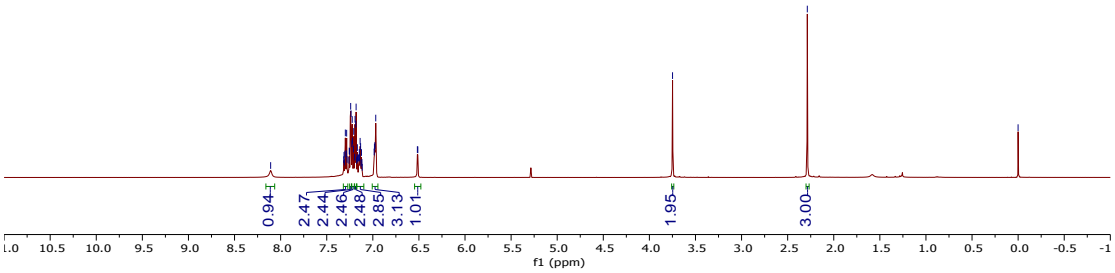
2m

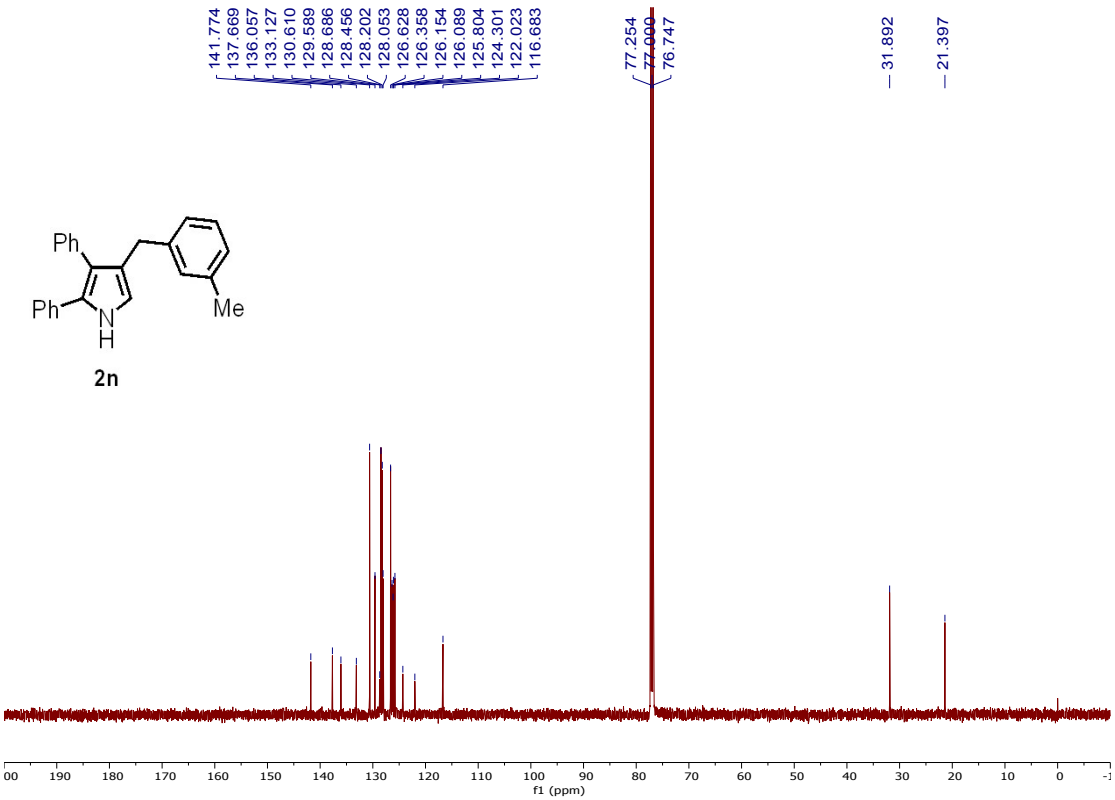
f1 (ppm)


8.108
7.315
7.312
7.309
7.303
7.298
7.287
7.284
7.280
7.259
7.256
7.253
7.240
7.236
7.227
7.224
7.221
7.210
7.207
7.198
7.193
7.185
7.181
7.176
7.171
7.168
7.164
7.154
7.150
7.146
7.142
7.138
7.133
7.128
7.123
7.119
6.986
6.982
6.977
6.968
6.517
6.512
3.749
2.287


Ph
Ph
N
H
Me

2n

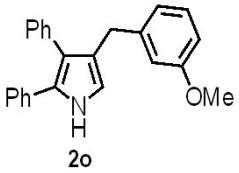

0.94
2.47
2.44
2.46
2.48
2.85
3.13
1.01
1.95
3.00
f1 (ppm)


141.774
137.669
136.057
133.127
130.610
129.589
128.686
128.456
128.202
128.053
126.628
126.358
126.154
126.089
125.804
124.301
122.023
116.683
77.254
77.000
76.747
31.892
21.397
f1 (ppm)

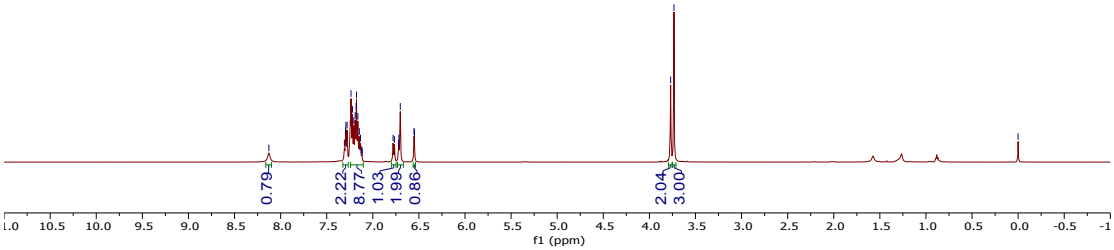
Ph
Ph
N
H
Me

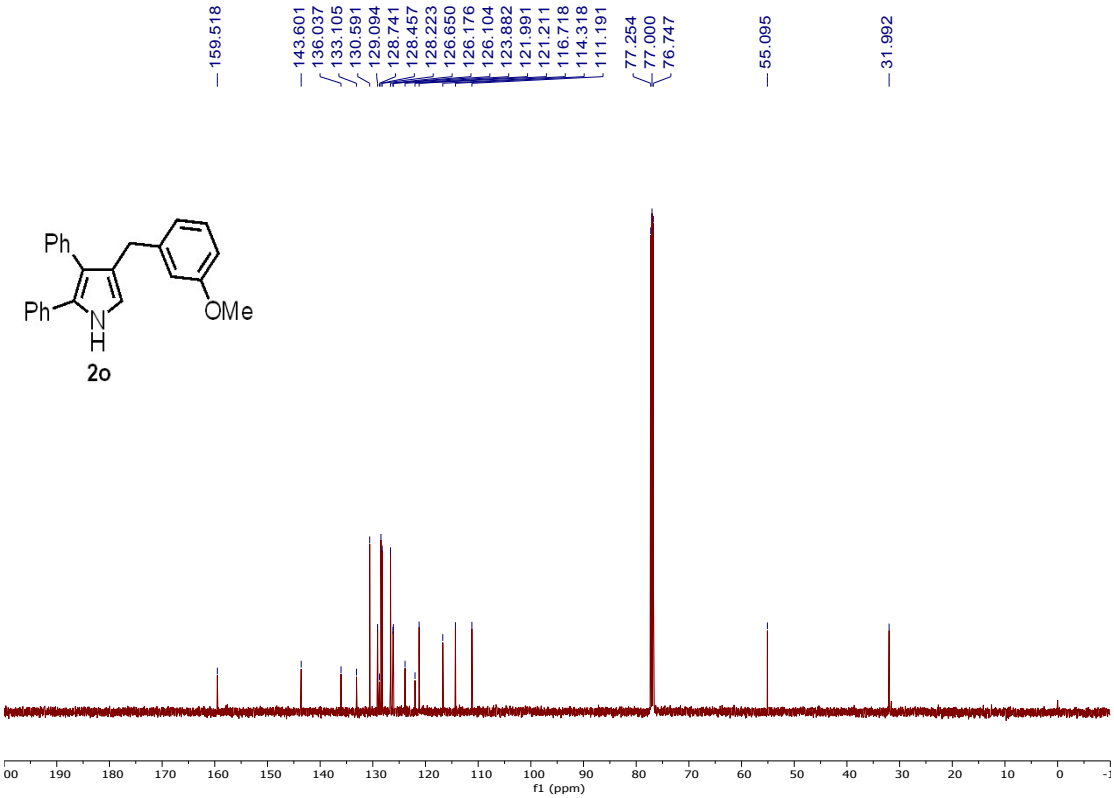
2n


8.128
7.308
7.297
7.293
7.279
7.237
7.221
7.206
7.191
7.180
7.177
7.162
7.146
7.133
7.122
7.119
7.115
6.781
6.765
6.722
6.717
6.702
6.554
6.548
3.769
3.733
0.000


Ph
Ph
N
H
OMe

2o

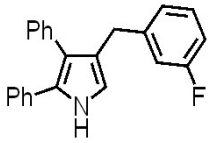

0.79
2.22
8.77
1.03
1.99
0.86
2.04
3.00
f1 (ppm)


159.518
143.601
136.037
133.105
130.591
129.094
128.741
128.457
128.223
126.650
126.176
126.104
123.882
121.991
121.211
116.718
114.318
111.191
77.254
77.000
76.747
55.095
31.992
f1 (ppm)

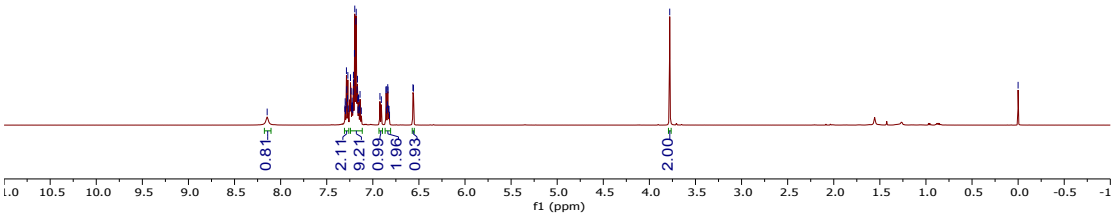
Ph
Ph
N
H
OMe

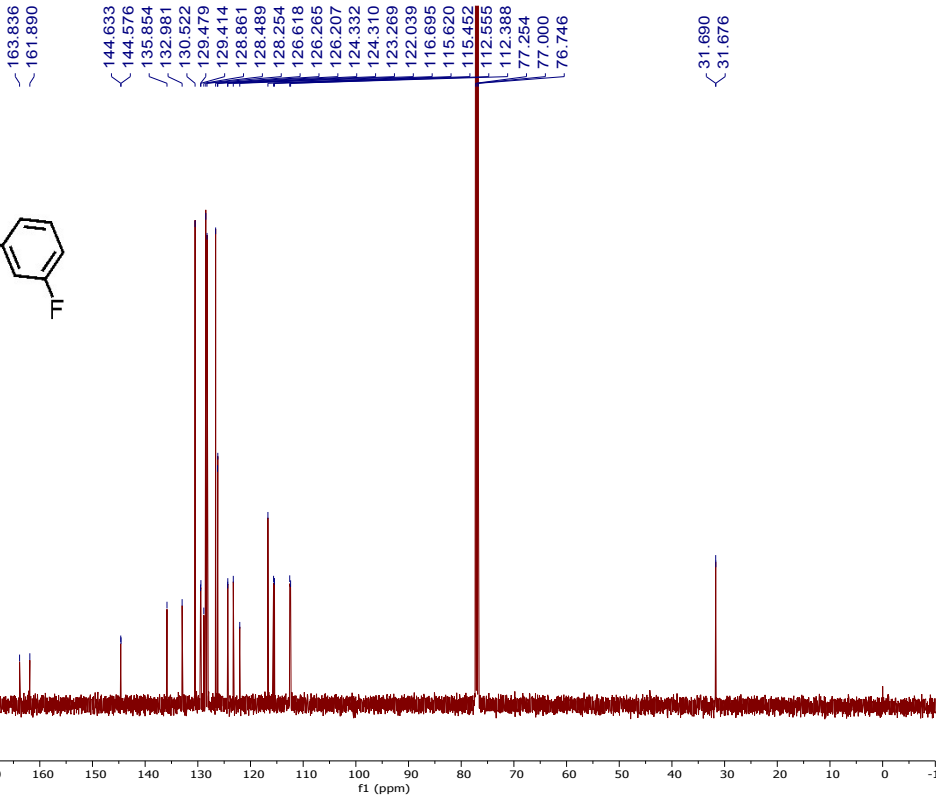
2o

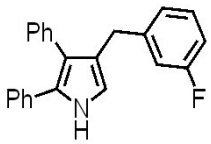

8.146
7.303
7.300
7.296
7.290
7.286
7.283
7.274
7.271
7.267
7.242
7.235
7.229
7.227
7.225
7.221
7.218
7.213
7.210
7.208
7.200
7.196
7.183
7.180
7.170
7.167
7.163
7.160
7.156
7.153
7.149
7.143
7.139
7.125
6.923
6.908
6.857
6.854
6.851
6.843
6.838
6.836
6.831
6.824
6.819
6.565
6.559
3.779
0.000


Ph
Ph
N
H
F

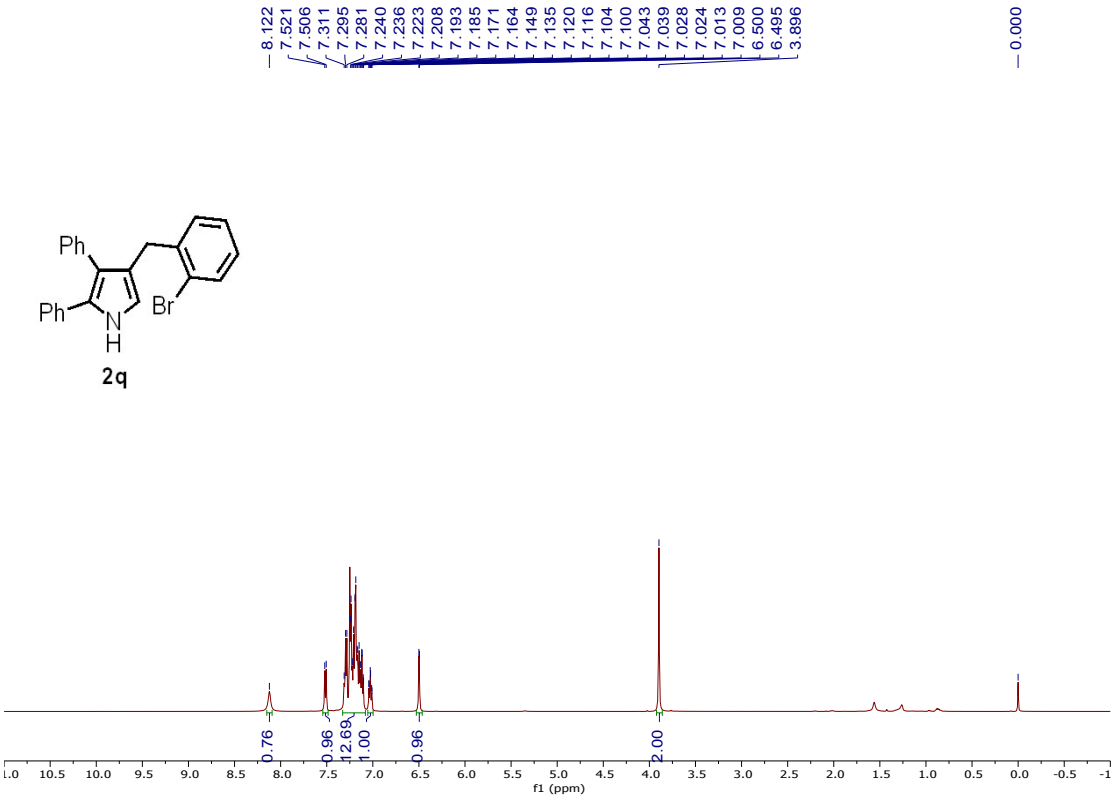
2p

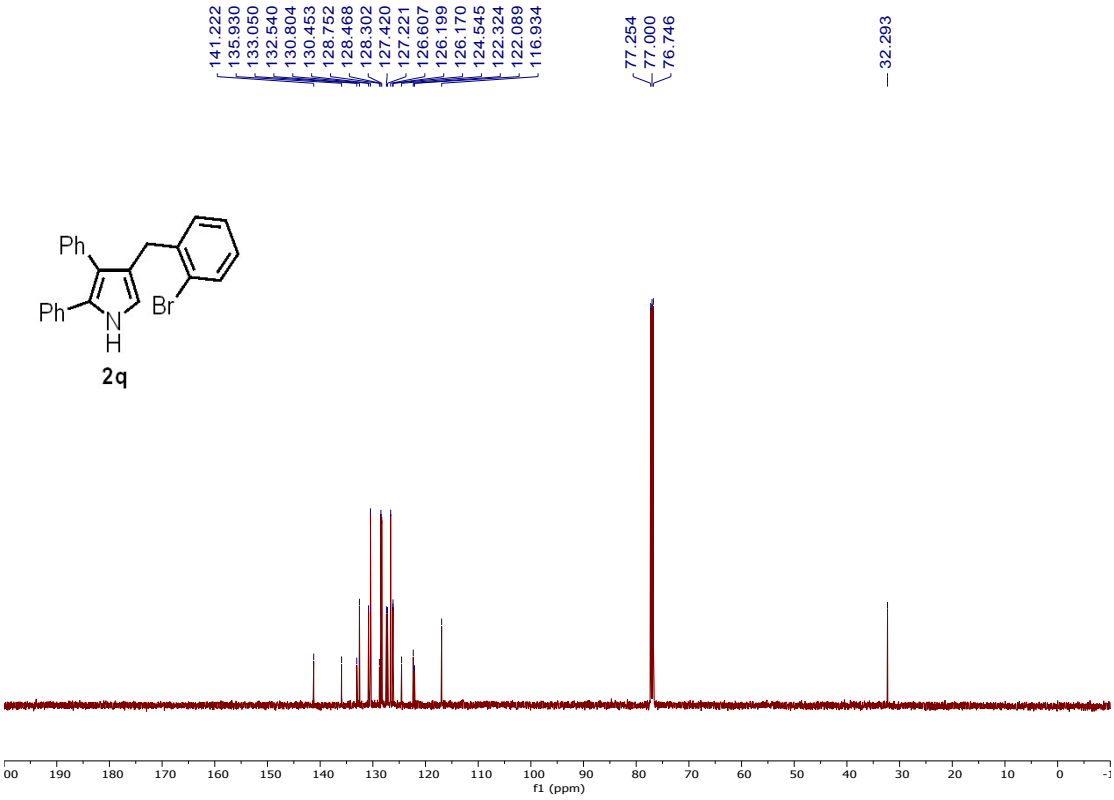

0.81
2.11
9.21
0.99
1.96
0.93
2.00
f1 (ppm)

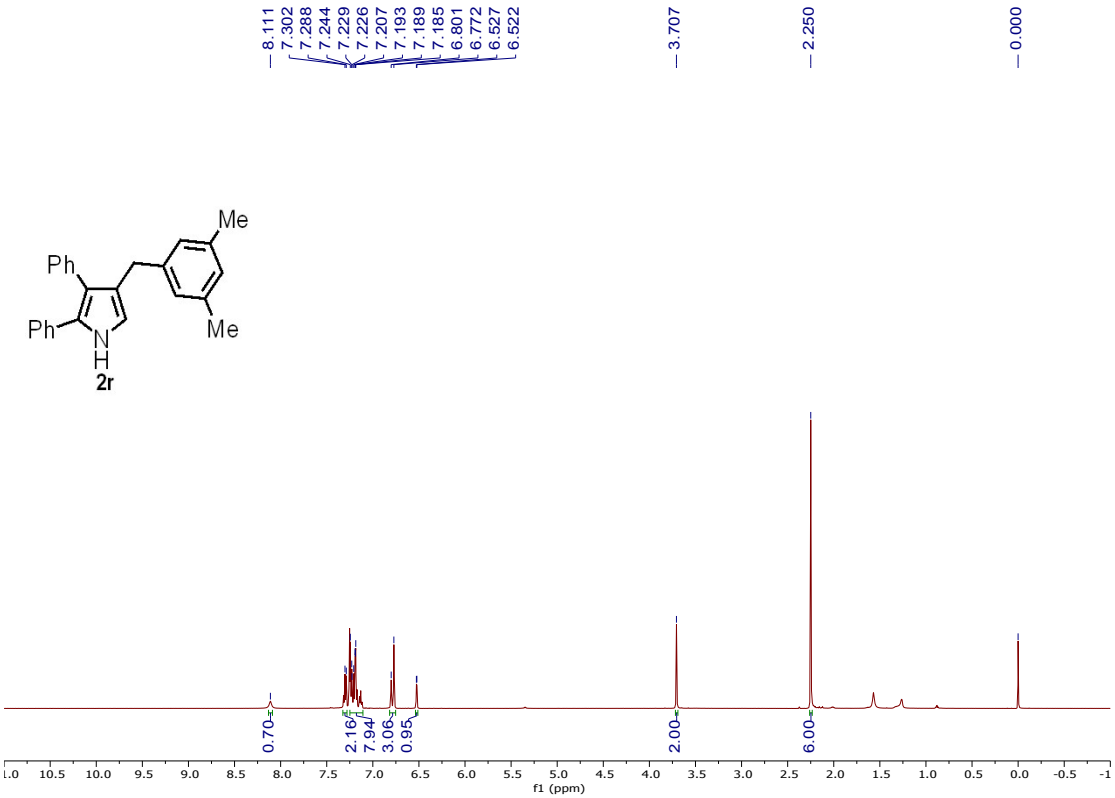

163.836
161.890
144.633
144.576
135.854
132.981
130.522
129.479
129.414
128.861
128.489
128.254
126.618
126.265
126.207
124.332
124.310
123.269
122.039
116.695
115.620
115.452
112.555
112.388
77.254
77.000
76.746
31.690
31.676
f1 (ppm)

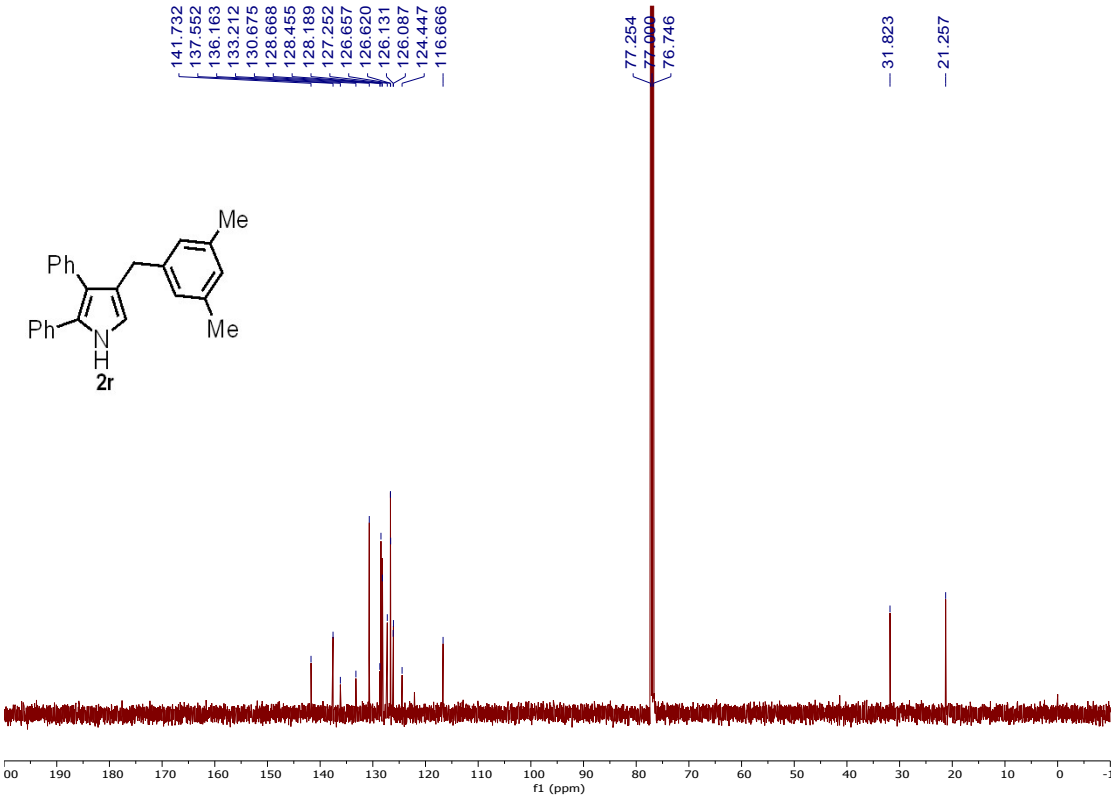

Ph
Ph
N
H
F

2p


8.122
7.521
7.506
7.311
7.295
7.281
7.240
7.236
7.223
7.208
7.193
7.185
7.171
7.164
7.149
7.135
7.120
7.116
7.104
7.100
7.043
7.039
7.028
7.024
7.013
7.009
6.500
6.495
3.896
0.000
Ph
Ph
N
H
Br
2q
0.76
0.96
12.69
1.00
0.96
2.00
f1 (ppm)


141.222
135.930
133.050
132.540
130.804
130.453
128.752
128.468
128.302
127.420
127.221
126.607
126.199
126.170
124.545
122.324
122.089
116.934
77.254
77.000
76.746
32.293
Ph
Ph
N
H
Br
2q
f1 (ppm)


8.111
7.302
7.288
7.244
7.229
7.226
7.207
7.193
7.189
7.185
6.801
6.772
6.527
6.522
3.707
2.250
0.000
Me
Ph
Ph
Me
N
H
2r
0.70
2.16
7.94
3.06
0.95
2.00
6.00
f1 (ppm)


141.732
137.552
136.163
133.212
130.675
128.668
128.455
128.189
127.252
126.657
126.620
126.131
126.087
124.447
116.666
77.254
77.000
76.746
31.823
21.257
Me
Ph
Ph
Me
N
H
2r
f1 (ppm)