Supporting Information

Synthesis of 4-ethenyl Quinazolines *via* Rhodium(Ⅲ)-Catalyzed [5+1] Aunulation Reaction of *N*-arylamidines with Cyclopropenones

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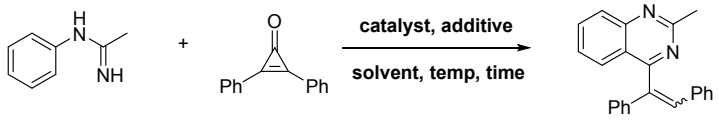
Ⅰ. General Information

Unless otherwise noted, materials were purchased from commercial suppliers and used without further purification. Except for the specially mentioned dry solvent, all the solvents were treated according to general methods. All the reactions were monitored by thin-layer chromatography (TLC) and were visualized using UV light. The product purification was done using silica gel column chromatography. Thin-layer chromatography (TLC) characterization was performed with precoated silica gel GF254 (0.2 mm), while column chromatography characterization was performed with silica gel (100-200 mesh). ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra were recorded with tetramethylsilane (TMS, δ = 0.00 ppm) as the internal standard. ^{1}H NMR spectra were recorded at 400 or 600 MHz (Varian), ^{13}C NMR spectra were recorded at 100 or 150 MHz (Varian) and ^{19}F NMR spectra were recorded at 376 MHz (Varian). Chemical shifts are reported in ppm downfield from $CDCl_3$ (δ = 7.26 ppm) or DMSO-d_6 (δ = 2.50 ppm; H_2O signal was found at δ = 3.34 ppm) for ^{1}H NMR and chemical shifts for ^{13}C NMR spectra are reported in ppm relative to the central $CDCl_3$ (δ = 77.0 ppm) or DMSO-d_6 (δ = 39.6 ppm). Coupling constants were given in Hz. The following notations were used: br-broad, s-singlet, d-doublet, t-triplet, q-quartet, m-multiplet, dd-doublet of doublet, dt-doublet of triplet, td-triplet of doublet, ddd-doublet of doublet of doublet. Melting points were measured with YRT-3 melting point apparatus (Shantou Keyi Instrument &Equipment Co., Ltd., Shantou, China).

Ⅱ. Experimental Information

(a) Optimization of the reaction conditions

Table SI_1. Optimization of the Reaction Conditions[a]

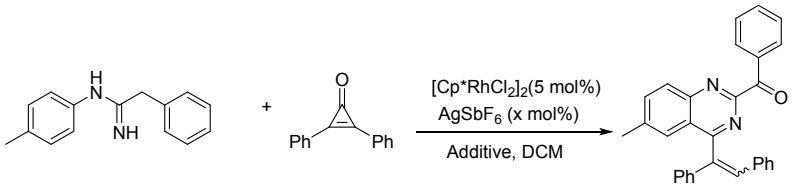


1a 2a 3aa

Entry	Catalyst System (mol%)	Additive	Solvent	Yield[b] (%)
1	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	HOAc	DCM	10
2	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	NaOAc	DCM	＜5
3	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	$Cu(OAc)_2$	DCM	＜5
4	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	/	DCE	75
5	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	/	HFIP	56
6	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	/	DME	24
7	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	/	PhCl:PhMe = 1:1	65

[a] Reactions conditions: **1a** (1.2 mmol), **2a** (1.0 mmol), $[Cp^*RhCl_2]_2$ (5 mol%), $AgSbF_6$ (50 mol%), additive (1.0 mmol), solvent (1.0 ml), 100 °C, 36 h, sealed tube under O_2.[b] Total isolated yield of the mixture after chromatography.

Table SI_2.Optimization of the Reaction Conditions[a]



1u 2a 4aa

Entry	Catalyst System (mol%)	Additive	Solvent	Yield [b] (%)
1	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (50)	/	DCM	30
2	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	/	DCM	45
3	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (100)	/	DCM	40
4[c]	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	/	DCM	44
5[d]	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	/	DCM	47
6	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	NaOAc	DCM	33
7	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	t-BuOK	DCM	11
8	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	DBU	DCM	＜5
9	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	HOAc	DCM	34
10	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	AdCOOH	DCM	＜5
11	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	*m*-CPBA[e]	DCM	35
12	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	TBHP[f]	DCM	N.R.[g]
13	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	DMSO	DCM	＜5
14	$[Cp^*RhCl_2]_2$ (5) /$AgSbF_6$ (70)	$K_2S_2O_8$	DCM	10

[a] Reactions conditions: **1u** (1.2 mmol), **2a** (1.0 mmol), $[Cp^*RhCl_2]_2$ (5 mol%), $AgSbF_6$ (x mol%), additive (1.0 mmol), DCM (1.0 ml), sealed tube under O_2. [b] Total isolated yield of the mixture after chromatography. [c] Temp. = 120 °C. [d] Stirred for 40 h. [e] *m*-CPBA = 3-Chloroperbenzoic acid. [f] TBHP = tert-Butylhydroperoxide. [g] N.R. = No Reaction

(b) General procedure for the synthesis of imidamides 1 (1a as an example)[1]

A mixture of aniline (1.0 equiv.), $AlCl_3$ (1.2 equiv.) and carbonitrile (2.0 equiv.) was stirred at 120 °C in a sealed reaction tube overnight. After completion of the reaction, a concentrated NaOH solution in a mixture of water and ice was added into the residual crude product and stirred for about 15 minutes. Then the mixture was extracted with DCM (25 mL × 3). The combined organic layers were washed with brine (30 mL × 3), dried over anhydrous Na_2SO_4 and evaporated under vacuum. The residue was purified by column chromatography on silica gel.

(c) General procedure for the synthesis of cyclopropenone 2 (2a as an example)[2]

Substrate **2a** was synthesized according to the reported procedure.

(d) General procedure for the synthesis of products 3 (3aa as an example).

N-phenylethanimidamide **1a** (0.12 mmol), cyclopropenone **2a** (0.10 mmol), $[Cp^*RhCl_2]_2$ (0.05 mmol), and $AgSbF_6$ (0.5 mmol) were charged into a pressure tube,

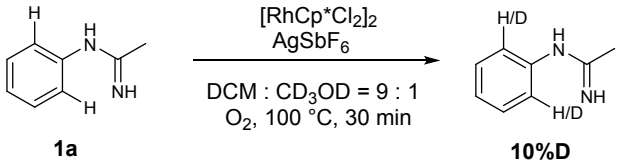
to which was added DCM (1.0 mL) under O_2 atmosphere. The reaction mixture was stirred at 100 °C for 36 h. After cooled to rt, the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using PE/EA to afford compound **3aa** as a yellow solid.

(e) General procedure for the synthesis of products 4 (4aa as an example).

N-arylamidine **1u** (0.12 mmol), cyclopropenone **2a** (0.10 mmol), $[Cp^*RhCl_2]_2$ (0.05 mmol), and $AgSbF_6$ (0.7 mmol) were charged into a pressure tube, to which was added DCM (1.0 mL) under O_2 atmosphere. The reaction mixture was stirred at 100 °C for 40 h. After cooled to rt, the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using PE/EA to afford compound **4aa** as a yellow solid.

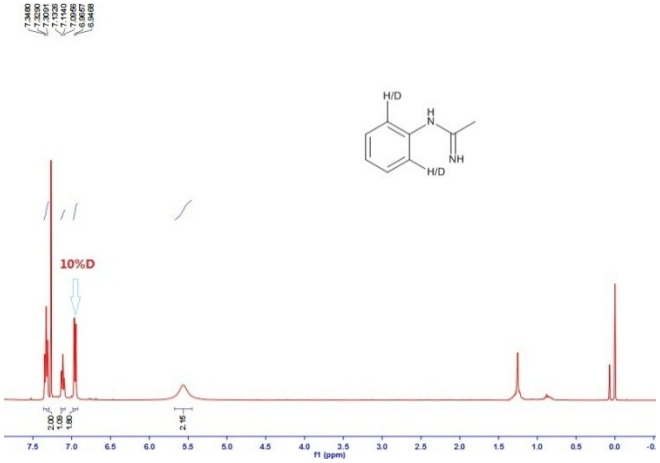
Ⅲ.Mechanistic Studies

(a) Ortho deuteration experiment

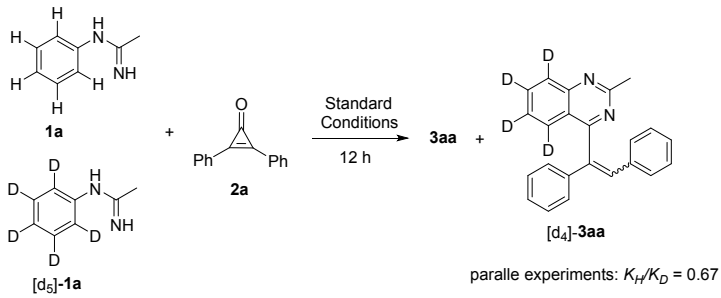


N-phenylethanimidamide **1a** (0.10 mmol) was dissolved in DCE (0.9 ml) / CD_3OD (0.1 mL) in the presence of $[Cp^*RhCl_2]_2$ (5 mol%), $AgSbF_6$ (50 mol%) under O_2 atmosphere, and was stirred at 100 °C for 30 min. After cooling down, the volatiles were removed and the mixture was purified by flash chromatography of silica gel .The deuterium incorporation was estimated to be 10% at *ortho*-position by ^{1}H NMR analysis.

Figure S1: The ^{1}H NMR (400MHz, Chloroform-*d*) of the mixture

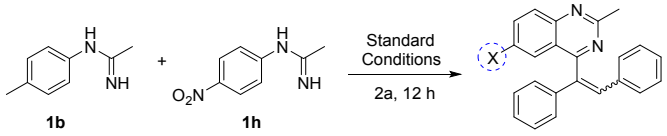


(b) Kinetic isotope effect experiment (KIE)



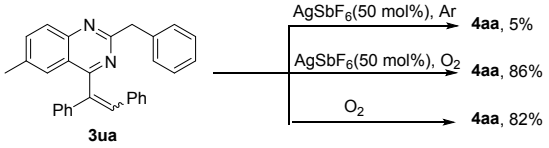
Two Schlenk tubes each was charged with N-arylamidine **1a** (0.12 mmol) or d_5-**1a** (0.12 mmol). Cyclopropenone **2a** (0.10 mmol), $[Cp^*RhCl_2]_2$ (0.05 mmol), $AgSbF_6$ (0.5 mmol), DCM (1.0 mL) were added to each tube under O_2 atmosphere, and the two reactions were stirred side-by-side at 100 °C for 10 h. After rapidly evaporating the two mixtures separately, the residues were purified by flash column chromatography on silica gel using PE/EA. The KIE value was determined to be $k_H/k_D = 0.67$ on the yield ratio of **3aa** and d_4-**3aa**, which indicated that the cleavage of the C-H bond is likely not involved in the rate-limiting step.

(c) Competition experiments



A mixture of N-arylamidine **1b** (0.12 mmol), **1h** (0.12 mmol), cyclopropenone **2a** (0.10 mmol), $[Cp^*RhCl_2]_2$ (0.05 mmol), $AgSbF_6$ (0.5 mmol) were dissolved in DCM (1.0 mL) in a pressure tube under O_2 atmosphere. The reaction mixture was stirred at 100 °C for 10 h. After that, the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using PE/EA to afford **3ba** and **3ha** in a ratio 2.3:1.

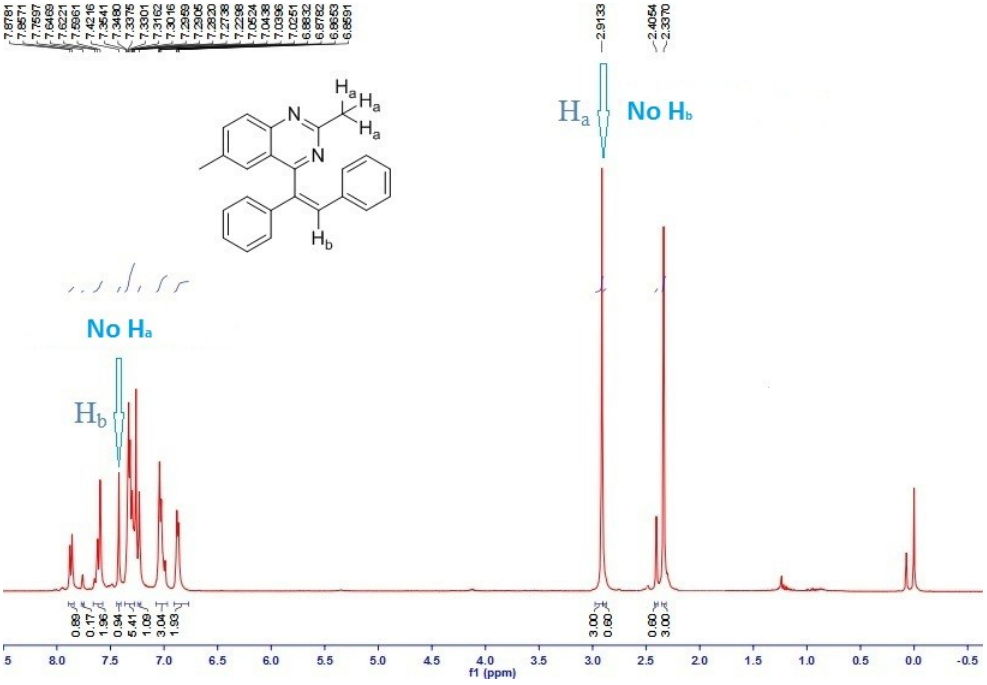
(d) Oxidation control experiments

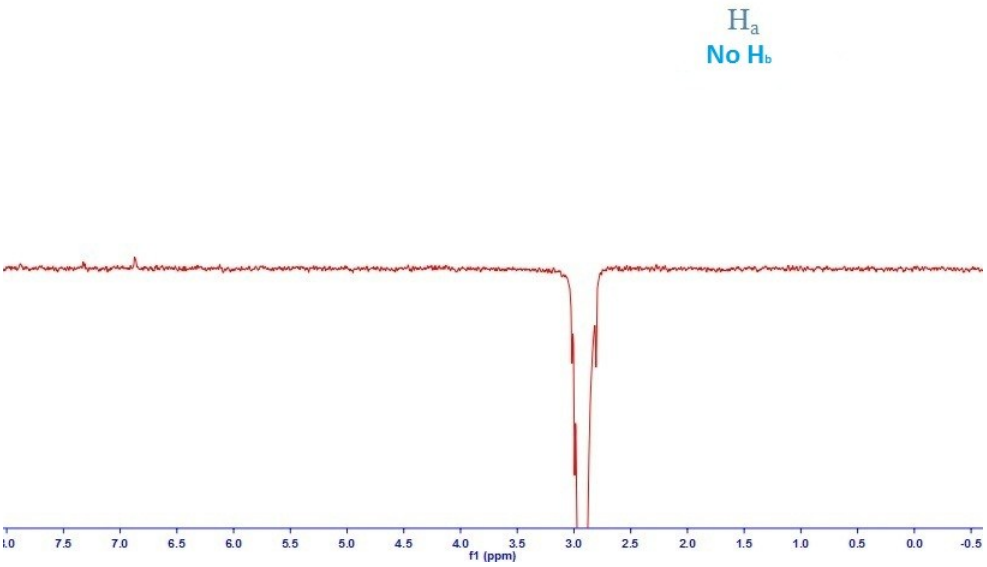


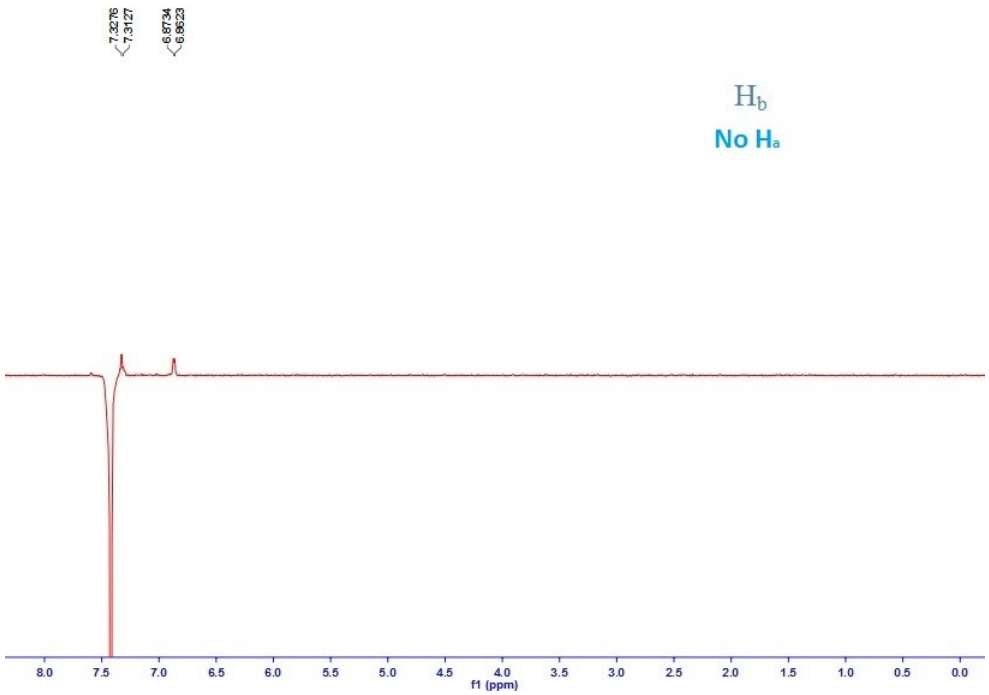
Three Schlenk tubes each was charged with the product **3ua** (0.10 mmol). The first one was added $AgSbF_6$ (0.5 mmol) under Ar atmosphere, the second one was added $AgSbF_6$ (0.5 mmol) under O_2 atmosphere, the last one was just under O_2 atmosphere without any additive. All of the reaction mixtures were dissolved in DCM (1.0 mL) and stirred at 100 °C for 24 h. After that, the solvents were removed under reduced pressure and the residues were purified by silica gel chromatography using PE/EA.

Ⅳ. Z/E Configuration

Take 3ba as an example



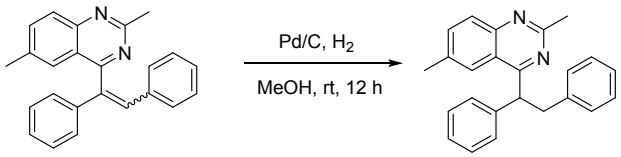




The characteristic of NOE signal of the product **3ba** showed that the Z-configuration product is favorable one.

Ⅴ. Product Transformations

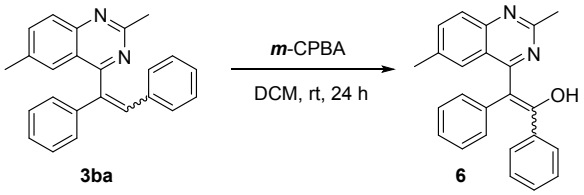
4-(1,2-Diphenylethyl)-2,6-dimethylquinazoline (5)



3ba **5**

A vial equipped with a stir bar was charged with **3ba** (33.6 mg, 0.1 mmol, *Z/E* = 5:1), Pd/C (10 mg), and MeOH (2.0 mL) under a balloon of H_2 (1 atm), the reaction mixture was stirred for 12 h at room temperature. After the indicated time, the reaction mixture was filtered, the organic layers were combined and concentrated.[3] Purification by chromatography on silica gel afforded the title product **5** as a white solid (30.4 mg, 90%), mp: 98-100 °C. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.82-7.76 (m, 2H), 7.55 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.36-7.31 (m, 2H), 7.24-7.20 (m, 2H), 7.19-7.12 (m, 3H), 7.11-7.05 (m, 3H), 5.05 (t, *J* = 7.2 Hz, 1H), 3.87-3.80 (m, 1H), 3.44-3.37 (m, 1H), 2.95 (s, 3H), 2.44 (s, 3H). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 170.0, 162.6, 148.8, 142.1, 140.4, 136.5, 135.4, 129.3, 128.5, 128.2, 128.0, 127.8, 126.8, 125.9, 123.1, 121.7, 50.5, 41.5, 26.5, 21.9. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{22}N_2$: 339.1856, found: 339.1857.

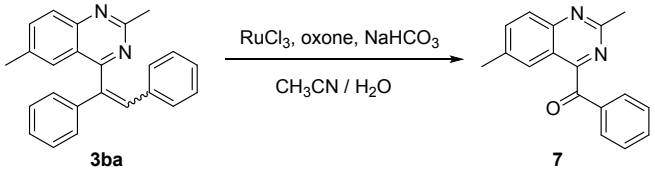
2-(2,6-Dimethylquinazolin-4-yl)-1,2-diphenylethen-1-ol (6)



3ba 6

An oven-dried vial equipped with a stir bar was charged with **3ba** (33.6 mg, 0.1 mmol, *Z/E* = 5:1), *m*-chloroperbenzoic acid (34.5 mg, 0.2 mmol), and DCM (2.0 mL) under Ar. The reaction mixture was stirred for 24 h at room temperature. After the indicated time, the reaction mixture was quenched with $NaHCO_3$ (5 mL), and extracted with diethyl ether (10 × 3 mL). The organic layers were combined, washed with NaOH (1 N, 5 mL), and brine (5 mL), dried over anhydrous Na_2SO_4 and concentrated.[4] Purification by chromatography on silica gel afforded the title product **6** as a yellow oil in a ratio 5:1 (25.3 mg, 72%). R_f = 0.3 (PE/EA 2:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.58 (d, *J* = 8.8 Hz, 1H), 7.67 (dd, *J* = 8.8, 1.6 Hz, 1H), 7.58 (s, 1H), 7.44 (s, 1H), 7.35-7.28 (m, 6H), 7.22 (s, 1H), 7.08-7.02 (m, 3H), 6.93-6.88 (m, 2H), 2.94 (s, 3H, Z/E-$CH_3C_4N_2$), 2.35 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 155.1, 153.0, 142.1, 140.5, 139.3, 136.6, 136.5, 135.7, 132.4, 129.8, 129.7, 128.8, 128.8, 128.7, 128.3, 128.2, 128.0, 127.8, 126.6, 125.7, 124.1, 118.7, 21.5, 20.3. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{20}N_2O$: 353.1648, found: 353.1647.

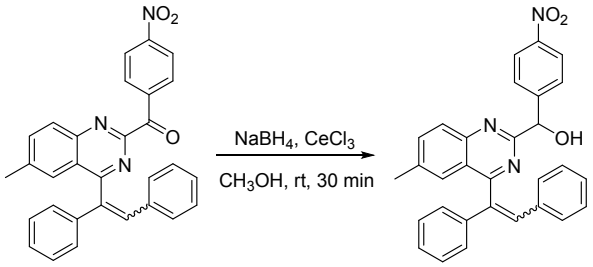
(2,6-Dimethylquinazolin-4-yl)(phenyl)methanone (7)



3ba 7

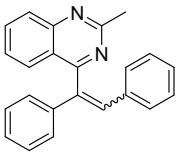
To a 10 mL vial was added $RuCl_3$ (0.82 mg, 4.0 mol%), Oxone (104.5 mg, 0.17 mmol), sodium bicarbonate (45.3 mg, 0.54 mmol), acetonitrile (1.5 mL), and water (1.0 mL) and **3ba** (33.6 mg, 0.1 mmol, *Z/E* = 5:1). The reaction was stirred at room temperature for 1 h. After the indicated time, the reaction mixture was poured into a separatory funnel along with EtOAc (30 mL) and water (10 mL). the organic layer was separated and washed with water (10 mL) and brine (10 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated.[5] Purification by chromatography on silica gel afforded the title product **7** as a yellow solid[1b] (23.3 mg, 89%), mp: 140-141 °C. R_f = 0.6 (PE/EA 5:1).

(4-(1,2-Diphenylvinyl)-6-methylquinazolin-2-yl)(4-nitrophenyl)methanol (8)



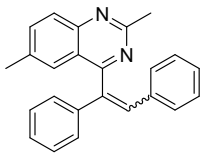
To a solution of **4ad** (47.1 mg, 0.1 mmol, *Z/E* = 1:1) and $CeCl_3$ (32.0 mg, 0.13 mmol) in MeOH (2 mL) was added $NaBH_4$ (4.5 mg, 0.12 mmol), and the mixture was stirred for 30 min at room temperature. After the indicated time, the mixture was quenched with water and extracted with EtOAc (20 × 3). The organic phase was dried with Na_2SO_4, filtered and concentrated under reduced pressure.[6] The residue was purified by silica gel chromatography using PE/EA to afford compound **8** as a yellow oil (41.2 mg, 87%), *Z/E* = 4:1. R_f = 0.3 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.02 (d, *J* = 8.8 Hz, 2H), 7.95 (d, *J* = 8.8 Hz, 1H), 7.78-7.72 (m, 1H), 7.68-7.63 (m, 2H), 7.59 (s, 1H), 7.42 (s, 1H), 7.34-7.27 (m, 4H), 7.25-7.21 (m, 3H), 7.01-6.94 (m, 1H), 6.87 (t, *J* = 7.6 Hz, 2H), 6.69 (d, *J* = 7.6 Hz, 2H), 6.13 (s, 1H), 2.36 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.8, 168.8, 163.5, 156.7, 149.9, 149.4, 149.3, 148.3, 147.2, 140.9, 140.5, 140.1, 139.9, 138.6, 137.7, 137.4, 137.2, 137.1, 136.1, 135.6, 132.8, 132.3, 132.0, 129.9, 129.7, 129.6, 128.9, 128.8, 128.7, 128.6, 128.5, 128.2, 128.1, 127.9, 127.8, 127.6, 127.4, 126.6, 126.4, 125.4, 125.3, 123.3, 123.1, 74.4, 21.8. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{30}H_{23}N_3O_3$: 474.1812, found: 474.1810.

Ⅵ. Characterization Date of Products



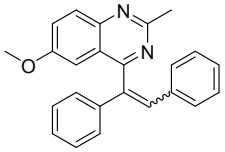
4-(1,2-Diphenylvinyl)-2-methylquinazoline (3aa)

Yellow solid (26.7 mg, 83%), mp: 147-150 °C, Z/E = 3:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.99 (d, *J*= 8.0 Hz, 2H), 7.85 (d, *J* = 8.0 Hz, 1H), 7.79 (t, *J* = 8.0 Hz, 2H), 7.43 (s, 1H), 7.40-7.27 (m, 7H), 7.23-7.17 (m, 2H), 7.07-6.97 (m, 3H), 6.87 (d, *J* = 6.0 Hz, 2H), 2.94 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.8, 163.5, 149.9, 139.4, 137.5, 137.4, 136.1, 134.9, 134.8, 133.1, 132.7, 130.7, 128.8, 128.6, 127.9, 127.7, 127.6, 127.2, 127.1, 127.0, 126.9, 126.6, 126.1, 125.8, 125.6, 125.4, 120.9, 120.4, 25.6. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{18}N_2$: 323.1543, found: 323.1540.



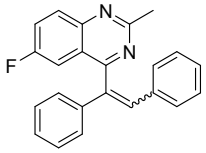
4-(1,2-Diphenylvinyl)-2,6-dimethylquinazoline (3ba)

Yellow solid (27.6 mg, 82%), mp: 112-115 °C, Z/E = 5:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.87 (d, *J* = 8.4 Hz, 1H), 7.65-7.57 (m, 2H), 7.42 (s, 1H), 7.36-7.27 (m, 6H), 7.24-7.19 (m, 1H), 7.07-6.98 (m, 3H), 6.87 (dd, *J* = 7.4, 2.2 Hz, 2H), 2.91 (s, 3H, Z/E-$CH_3C_4N_2$), 2.34 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.8, 163.7, 149.5, 140.4, 137.2, 137.1, 136.4, 135.9, 131.4, 128.9, 128.6, 128.2, 128.0, 127.6, 127.6, 126.6, 125.0, 121.9, 26.7,21.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{20}N_2$: 337.1699, found: 337.1695.



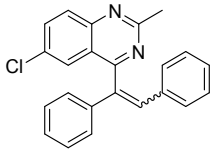
4-(1,2-Diphenylvinyl)-6-methoxy-2-methylquinazoline (3ca)

Yellow solid (29.8 mg, 85%), mp: 121-123 °C, Z/E = 3.8:1. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.87 (d, *J* = 9.2 Hz, 1H), 7.44-7.38 (m, 2H), 7.35-7.27 (m, 6H), 7.23-7.17 (m, 2H), 7.09-6.98 (m, 4H), 6.92-6.87 (m, 2H), 3.63 (s, 3H, Z/E-OCH_3), 2.89 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 162.4, 157.9, 140.6, 137.3, 136.0, 131.6, 130.0, 129.8, 129.4, 128.8, 128.7, 128.2, 128.0, 127.8, 127.1, 126.8, 122.6, 103.3, 55.5, 26.3. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{20}N_2O$: 353.1648, found: 353.1650.



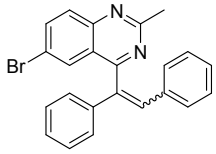
4-(1,2-Diphenylvinyl)-6-fluoro-2-methylquinazoline (3da)

Yellow oil (18.4 mg, 54%), Z/E = 2.3:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.98 (dd, *J* = 9.2, 5.2 Hz, 1H), 7.58-7.51 (m, 2H), 7.44 (s, 1H), 7.38-7.27 (m, 8H), 7.23 (s, 3H), 7.07-7.03 (m, 3H), 6.90-6.85 (m, 2H), 2.93 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.7 (d, *J* = 6.0 Hz), 169.2 (d, *J* = 6.0 Hz), 164.1 (d, *J* = 2.5 Hz), 163.4 (d, *J* = 2.5 Hz), 160.2 (d, *J* = 249.1 Hz), 159.7 (d, *J* = 249.1 Hz), 148.6, 148.2, 140.1, 138.3, 138.2, 136.8, 135.8, 135.7, 135.1, 131.9, 130.9, 130.8, 130.7, 130.6, 129.8, 129.6, 128.8, 128.7, 128.3, 128.2, 128.1, 128.1, 127.8, 126.6, 124.4 (d, *J* = 26.0 Hz), 123.8 (d, *J* = 26.0 Hz), 122.4 (d, *J* = 9.1 Hz), 121.9 (d, *J* = 9.1 Hz), 110.1 (d, *J* = 23.0 Hz), 109.6 (d, *J* = 23.0 Hz)., 26.5, 26.4. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -110.73, -111.05. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}FN_2$: 341.1449, found: 341.1499.



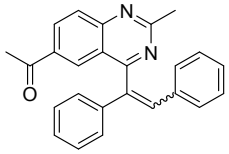
6-Chloro-4-(1,2-diphenylvinyl)-2-methylquinazoline (3ea)

Yellow solid (25.2 mg, 71%), mp: 110-113 °C, Z/E = 4:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.91 (d, *J* = 9.2 Hz, 1H), 7.80 (d, *J* = 2.4 Hz, 1H), 7.69 (dd, *J* = 9.2, 2.4 Hz, 1H), 7.45 (s, 1H), 7.35-7.31 (m, 7H), 7.23 (s, 2H), 7.08-7.02 (m, 3H), 6.89-6.85 (m, 2H), 2.93 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.2, 165.0, 149.5, 140.2, 136.8, 135.8, 135.2, 132.9, 132.2, 129.9, 129.0, 128.9, 128.4, 128.4, 128.0, 126.8, 125.3, 122.6, 26.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}ClN_2$: 357.1153, found: 357.1157.



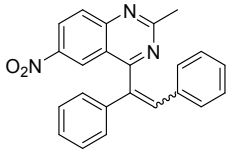
6-Bromo-4-(1,2-diphenylvinyl)-2-methylquinazoline (3fa)

Yellow solid (27.2 mg, 68%), mp: 111-113 °C, Z/E = 5.5:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.97 (s, 1H), 7.85-7.78 (m, 2H), 7.46 (s, 1H), 7.37-7.28 (m, 6H), 7.23 (s, 1H), 7.01-7.00 (m, 3H), 6.92-6.83 (m, 2H), 2.92 (s, 3H, Z/E-$CH_3C_4N_2$).**^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.9, 165.0, 149.7, 140.0, 137.6, 136.6, 135.7, 132.1, 129.9, 128.8, 128.7, 128.5, 128.3, 128.2, 127.9, 126.6, 122.9, 120.7, 26.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}BrN_2$: 401.0648, found: 401.0646.



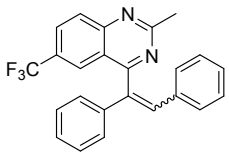
1-(4-(1,2-Diphenylvinyl)-2-methylquinazolin-6-yl)ethan-1-one (3ga)

Yellow solid (26.5 mg, 73%), mp: 127-129 °C, Z/E = 10:1. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.40 (d, *J* = 2.0 Hz, 1H), 8.30 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.99 (d, *J* = 8.8 Hz, 1H), 7.52 (s, 1H), 7.38-7.28 (m, 6H), 7.06-7.00 (m, 3H), 6.93-6.87 (m, 2H), 2.96 (s, 3H, Z/E-$CH_3C_4N_2$), 2.46 (s, 3H, Z/E-CH_3CO). **^{13}C NMR (150 MHz, Chloroform-*d*)** δ 192.4, 167.3, 162.8, 136.5, 132.7, 131.6, 131.0, 128.5, 128.0, 124.8, 124.7, 124.6, 124.5, 124.3, 124.3, 123.9, 122.8, 116.9, 22.8, 22.4. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{25}H_{20}N_2O$: 365.1648, found: 365.1650.



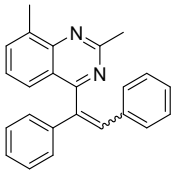
4-(1,2-Diphenylvinyl)-2-methyl-6-nitroquinazoline (3ha)

Yellow solid (17.2 mg, 47%), mp: 163-166 °C, Z/E = 3.6:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.74 (d, *J* = 2.0 Hz, 1H), 8.49 (dd, *J* = 8.8, 2.0 Hz, 1H), 8.05 (d, *J* = 8.8 Hz, 1H), 7.56 (s, 1H), 7.38-7.30 (m, 7H), 7.24 (s, 1H), 7.05-7.01 (m, 3H), 7.05-6.99 (m, 2H), 2.99 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 172.2, 168.1, 153.3, 145.5, 140.0, 136.4, 135.5, 133.1, 130.1, 128.9, 128.8, 128.5, 128.4, 128.1, 127.3, 126.8, 123.5, 120.7, 27.0. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}N_3O_2$: 368.1394, found: 368.1395.



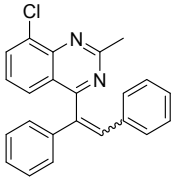
4-(1,2-Diphenylvinyl)-2-methyl-6-(trifluoromethyl)quinazoline (3ia)

Yellow solid (17.1 mg, 44%), mp: 87-90 °C, Z/E = 2.3:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.14-8.01 (m, 2H), 7.95-7.88 (m, 1H), 7.52 (s, 1H), 7.36-7.30 (m, 5H), 7.24 (s, 2H), 7.05-6.99 (m, 2H), 6.88-6.85 (m, 1H), 2.97 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (150 MHz, Chloroform-*d*)** δ 170.9, 170.9, 166.6, 165.9, 152.6, 152.1, 141.0, 140.1, 138.3, 138.1, 136.5, 136.0, 135.6, 135.5, 132.7, 130.8, 130.2, 129.9, 129.7, 129.6, 129.5, 129.5, 129.4, 129.3, 129.0, 129.0, 128.9, 128.7, 128.7, 128.7(q, *J* = 33.0 Hz), 128.3, 128.3, 128.2, 128.1, 127.8, 126.7, 124.8 (q, *J* = 4.4 Hz), 124.5 (q, *J* = 4.4 Hz), 123.3 (q, *J* = 271.9 Hz), 120.8, 120.4, 26.8, 26.7. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -62.77. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{17}F_3N_2$: 391.1417, found: 391.1418.



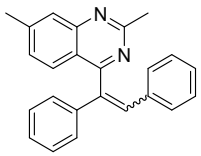
4-(1,2-Diphenylvinyl)-2,8-dimethylquinazoline (3ja)

Yellow oil (26.2 mg, 78%), Z/E = 6.8:1. R_f = 0.7 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.70 (d, *J* = 8.4 Hz, 1H), 7.61 (d, *J* = 7.2 Hz, 1H), 7.40 (s, 1H), 7.35-7.26 (m, 6H), 7.25-7.20 (m, 2H), 7.05-7.00 (m, 3H), 6.90-6.85 (m, 2H), 2.94 (s, 3H, Z/E-$CH_3C_4N_2$), 2.78 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.5, 163.5, 150.1, 140.5, 137.4, 136.3, 135.8, 133.9, 131.3, 128.9, 128.6, 128.2, 127.9, 127.5, 126.6, 124.1, 121.7, 26.8, 17.3. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{20}N_2$: 337.1699, found: 337.1697.



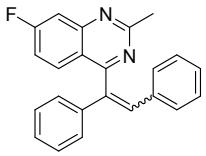
8-Chloro-4-(1,2-diphenylvinyl)-2-methylquinazoline (3ka)

Yellow solid (27.0 mg, 76%), mp: 59-61 °C, Z/E = 1.6:1. R_f = 0.7 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.90-7.84 (m, 2H), 7.79 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.44 (s, 1H), 7.32-7.26 (m, 9H), 7.24-7.18 (m, 4H), 7.08-7.00 (m, 4H), 6.87-6.84 (m, 2H), 3.00 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 170.7, 170.2, 165.6, 164.8, 148.1, 147.7, 140.2, 138.3, 138.2, 136.8, 135.7, 135.5, 135.2, 133.8, 133.3, 132.5, 132.4, 131.9, 129.8, 129.5, 128.9, 128.8, 128.7, 128.3, 128.2, 128.1, 128.1, 128.0, 127.8, 126.9, 126.6, 126.1, 125.8, 125.4, 123.1, 122.7, 27.0, 27.0. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}ClN_2$: 357.1153, found: 357.1153.



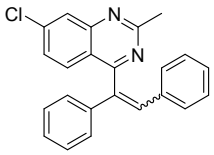
4-(1,2-Diphenylvinyl)-2,7-dimethylquinazoline (3la)

Yellow solid (29.2 mg, 87%), mp: 96-98 °C, Z/E = 2.7:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.76-7.69 (m, 2H), 7.41 (s, 1H), 7.35-7.26 (m, 6H), 7.24-7.20 (m, 3H), 7.18 (d, *J* = 8.4 Hz, 1H), 7.07-6.99 (m, 3H), 6.91-6.85 (m, 2H), 2.91 (s, 3H, Z/E-$CH_3C_4N_2$), 2.52 (s, 1H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.1, 164.6, 151.2, 145.2, 140.5, 138.7, 138.6, 137.2, 136.0, 135.8, 131.4, 129.8, 129.6, 129.5, 128.9, 128.7, 128.6, 128.2, 128.1, 128.0, 127.9, 127.6, 126.9, 126.6, 126.5, 126.1, 120.1, 119.6, 26.7, 22.2, 22.1. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{20}N_2$: 337.1699, found: 337.1670.



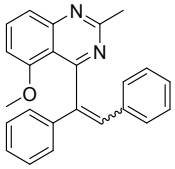
4-(1,2-Diphenylvinyl)-7-fluoro-2-methylquinazoline (3ma)

White solid (27.2 mg, 80%), mp: 162-165 °C, Z/E = 3.8:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.84-7.72 (m, 3H), 7.39-7.36 (m, 6H), 7.24-7.18 (m, 2H), 7.07-7.03 (m, 4H), 6.88-6.84 (m, 2H), 2.91 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 166.0 (d, *J* = 3.9 Hz), 165.1 (d, *J* = 1.7 Hz), 157.8 (d, *J* = 262.8 Hz), 152.3, 140.1 (d, *J* = 1.1 Hz), 139.9 (d, *J* = 2.2 Hz), 136.2, 136.0, 134.0 (d, *J* = 9.7 Hz), 133.8 (d, *J* = 10.1 Hz), 131.8 (d, *J* = 3.6 Hz), 130.1 (d, *J* = 3.6 Hz), 129.8, 129.6, 128.8, 128.5, 128.2, 128.1, 128.0, 127.8, 127.7, 127.6, 127.3, 126.6, 124.3 (d, *J* = 4.5 Hz), 113.8 (d, *J* = 12.3 Hz), 112.1 (d, *J* = 21.2 Hz), 26.5. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -104.58, -108.21. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}FN_2$: 341.1449, found: 341.1498.



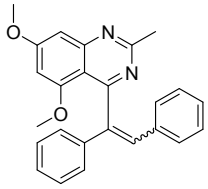
7-Chloro-4-(1,2-diphenylvinyl)-2-methylquinazoline (3na)

Yellow oil (22.4 mg, 63%), Z/E = 2.4:1. R_f = 0.7 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.96 (d, *J* = 2.0 Hz, 1H), 7.78 (d, *J* = 8.8 Hz, 1H), 7.43 (s, 1H), 7.35-7.27 (m, 8H), 7.24-7.15 (m, 2H), 7.08-7.01 (m, 3H), 6.89-6.84 (m, 2H), 2.92 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 170.3, 169.7, 165.7, 164.9, 151.5, 140.3, 140.2, 138.3, 138.2, 136.7, 135.7, 135.6, 131.9, 129.9, 129.6, 128.9, 128.7, 128.3, 128.3, 128.2, 128.1, 128.1, 127.9, 127.8, 127.7, 127.1, 126.6, 120.3, 119.8, 26.7, 26.6. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{17}ClN_2$: 357.1153, found: 357.1155.



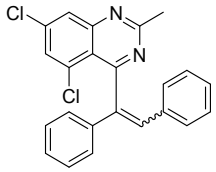
4-(1,2-Diphenylvinyl)-5-methoxy-2-methylquinazoline (3oa)

Yellow oil (24.9 mg, 71%), Z/E = 2.6:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.73 (t, *J* = 8.0 Hz, 1H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.29-7.26 (m, 3H), 7.25-7.21 (m, 2H), 7.21-7.16 (m, 2H), 7.10 (s, 1H), 7.07-7.01 (m, 3H), 6.90-6.82 (m, 2H), 6.74 (d, *J* = 8.0 Hz, 1H), 3.64 (s, 3H, Z/E-OCH_3), 2.83 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.7, 166.8, 164.5, 163.7, 156.4, 156.3, 153.0, 152.7, 142.4, 142.4, 140.8, 138.0, 136.8, 136.6, 134.4, 134.1, 129.7, 129.5, 129.4, 128.9, 128.2, 128.1, 128.0, 127.8, 127.3, 127.1, 126.9, 126.4, 120.0, 119.9, 115.5, 114.0, 106.1, 106.0, 55.6, 55.5, 26.5, 26.4. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{20}N_2O$: 353.1648, found: 353.1649.



4-(1,2-Diphenylvinyl)-5,7-dimethoxy-2-methylquinazoline (3pa)

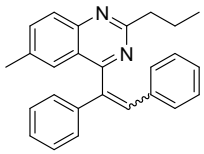
Yellow solid (31.7 mg, 83%), mp: 69-71 °C, Z/E = 1.2:1. R_f = 0.3 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.29-7.26 (m, 3H), 7.25-7.21 (m, 5H), 7.20-7.14 (m, 6H), 7.08-7.02 (m, 3H), 6.94-6.84 (m, 3H), 6.66 (s, 1H), 6.38 (d, *J* = 1.6 Hz, 1H), 6.33 (d, *J* = 1.6 Hz, 1H), 3.93 (s, 3H, Z/E-OCH_3), 3.93 (s, 3H, Z/E-OCH_3), 2.87 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 167.6, 165.7, 165.1, 164.8, 164.7, 164.3, 157.6, 157.5, 155.0, 154.7, 142.3, 141.0, 138.1, 136.9, 136.7, 129.7, 129.5, 129.4, 128.8, 128.2, 128.0, 127.9, 127.8, 127.8, 127.2, 127.1, 126.9, 126.4, 111.7, 110.2, 99.2, 99.1, 98.8, 98.6, 55.8, 55.6, 55.5, 26.4, 26.3. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{25}H_{22}N_2O_2$: 383.1754, found: 383.1754.



5,7-Dichloro-4-(1,2-diphenylvinyl)-2-methylquinazoline (3qa)

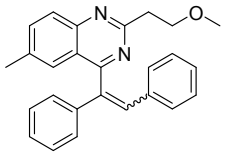
Yellow solid (31.2 mg, 80%), mp: 51-53 °C, Z/E = 1.9:1. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.93 (d, *J* = 2.0 Hz, 1H), 7.46 (d, *J* = 2.0 Hz, 1H), 7.37-7.33 (m, 1H), 7.32-7.26 (m, 5H), 7.24-7.19 (m, 5H), 7.09-7.03 (m, 3H), 6.87-6.81 (m, 2H), 6.56 (s, 1H), 2.87 (s, 3H, Z/E-$CH_3C_4N_2$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.6, 167.7, 165.5, 164.6, 153.6, 153.2, 140.0, 139.8, 139.2, 139.1, 138.9, 137.4, 136.3, 136.1, 133.4, 132.5, 132.2, 130.5, 130.2, 130.0, 129.9, 129.4, 128.8, 128.5, 128.2, 128.2, 127.9, 127.8, 127.7, 127.4, 127.0, 126.9, 126.7, 119.9, 118.6, 26.3, 26.2. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{23}H_{16}Cl_2N_2$: 391.0763,

found: 391.0761.



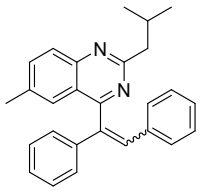
4-(1,2-Diphenylvinyl)-6-methyl-2-propylquinazoline (3ra)

Pale yellow solid (21.1 mg, 58%), mp: 80-82 °C, Z/E = 2.2:1. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.89 (d, *J* = 8.4 Hz, 1H), 7.76 (s, 1H), 7.66-7.55 (m, 2H), 7.37-7.27 (m, 6H), 7.24-7.20 (m, 6H), 7.08-6.95 (m, 3H), 6.90-6.85 (m, 1H), 3.10 (t, *J* = 7.6 Hz, 2H, Z/E-$CH_2CH_2CH_3$), 2.40 (s, 3H, Z/E-$CH_3C_6H_3$), 1.94 (m, 2H, Z/E-CH_2CH_3), 1.03 (t, *J* = 7.2 Hz, 3H, Z/E-CH_3CH_2). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.5, 168.6, 166.9, 166.2, 149.5, 140.2, 138.7, 138.5, 137.5, 137.1, 136.5, 136.2, 136.0, 135.9, 135.7, 134.3, 131.3, 129.8, 129.6, 128.9, 128.6, 128.1, 127.9, 127.8, 127.5, 126.5, 125.4, 124.9, 122.1, 121.5, 41.8, 41.8, 22.6, 22.4, 21.8, 21.7, 14.0, 13.8. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{26}H_{24}N_2$: 365.2012, found: 365.2014.



4-(1,2-Diphenylvinyl)-2-(2-methoxyethyl)-6-methylquinazoline (3sa)

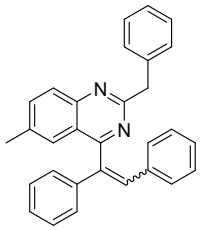
Yellow oil (22.8 mg, 60%), Z/E = 1.6:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.62-7.59 (m, 1H), 7.58 (s, 1H), 7.43 (s, 1H), 7.38-7.30 (m, 5H), 7.30-7.27 (m, 3H), 7.23 (m, 3H), 7.08-6.97 (m, 4H), 6.91-6.84 (m, 2H), 3.91 (t, *J* = 6.8 Hz, 2H, Z/E-CH_2OCH_3), 3.41 (t, *J* = 6.8, Hz, 2H, Z/E-$CH_2CH_2OCH_3$), 3.30 (s, 3H, Z/E-CH_3OCH_2), 2.34 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.5, 168.7, 164.2, 163.3, 149.6, 140.3, 138.6, 137.3, 137.3, 136.7, 136.2, 136.0, 136.0, 135.7, 134.5, 131.3, 129.8, 129.6, 128.9, 128.6, 128.6, 128.2, 128.1, 128.1, 127.9, 127.8, 127.8, 127.5, 126.5, 125.4, 124.9, 122.2, 121.7, 71.3, 71.1, 58.7, 40.1, 39.8, 21.8, 21.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{26}H_{24}N_2O$: 381.1961, found: 381.1961.



4-(1,2-Diphenylvinyl)-2-isobutyl-6-methylquinazoline (3ta)

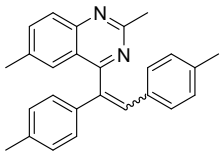
Yellow oil (31.0 mg, 82%), Z/E = 1.9:1. R_f = 0.7 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.90 (d, *J* = 8.4 Hz, 1H), 7.60 (m, 2H), 7.44 (s, 1H), 7.38-7.26 (m, 7H), 7.24-7.19 (m, 3H), 7.07-6.96 (m, 4H), 6.92-6.85 (m, 2H), 3.01 (d, *J* = 7.2 Hz, 2H, Z/E-$CH_2CH(CH_3)_2$), 2.34 (s, 3H, Z/E-$CH_3C_6H_3$), 2.29 (m, 1H, Z/E-$CH(CH_3)_2$), 0.92 (d, *J* = 6.8 Hz, 6H, Z/E-$(CH_3)_2CH$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.5, 168.6, 166.4, 165.6, 149.8, 149.4, 140.2, 138.8, 138.6, 137.6, 137.1, 136.5, 136.2, 136.0, 136.0, 135.7, 134.2, 131.3, 129.8, 129.6, 128.9, 128.6, 128.6, 128.1, 128.1,

128.0, 127.9, 127.8, 127.5, 126.5, 125.4, 124.9, 122.1, 121.5, 48.8, 48.6, 29.0, 28.7, 22.5, 22.4, 21.8, 21.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{27}H_{26}N_2$: 379.2169, found: 379.2172.



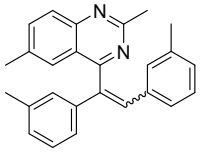
2-Benzyl-4-(1,2-diphenylvinyl)-6-methylquinazoline (3ua)

Yellow solid (30.9 mg, 75%), mp: 116-118 °C, Z/E = 6:1. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.88 (d, *J* = 8.4 Hz, 1H), 7.61-7.52 (m, 2H), 7.42 (s, 1H), 7.38-7.26 (m, 8H), 7.23-7.10 (m, 5H), 7.04-6.99 (m, 1H), 6.94 (t, *J* = 7.6 Hz, 2H), 6.84 (d, *J* = 7.6 Hz, 2H), 4.48 (s, 2H, Z/E-$CH_2C_6H_5$), 2.32 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (150 MHz, Chloroform-*d*)** δ 164.9, 161.1, 145.7, 136.1, 134.8, 133.3, 133.3, 132.2, 131.9, 127.2, 125.0, 124.8, 124.6, 124.3, 124.1, 123.9, 123.5, 122.5, 122.1, 120.8, 118.0, 42.1, 17.6. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{30}H_{24}N_2$: 413.2012, found: 413.2010.



4-(1,2-Di-*p*-tolylvinyl)-2,6-dimethylquinazoline (3bb)

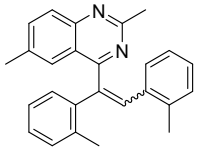
Yellow solid (30.9 mg, 85%), mp: 126-128 °C, Z/E = 6:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.90-7.83 (m, 1H), 7.64-7.55 (m, 2H), 7.35 (s, 1H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 6.83 (d, *J* = 8.0 Hz, 2H), 6.73 (d, *J* = 8.0 Hz, 2H), 2.91 (s, 3H, Z/E-$CH_3C_4N_2$), 2.33 (s, 3H, Z/E-$CH_3C_6H_4$), 2.32 (s, 3H, Z/E-$CH_3C_6H_4$), 2.17 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.3, 163.7, 149.5, 137.7, 137.4, 137.1, 136.4, 136.0, 130.4, 129.3, 128.9, 128.8, 127.6, 126.4, 125.1, 122.0, 26.6, 21.7, 21.2, 21.1. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{26}H_{24}N_2$: 365.2012, found: 365.2010.



4-(1,2-Di-*m*-tolylvinyl)-2,6-dimethylquinazoline (3bc)

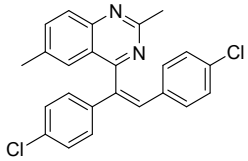
Yellow oil (29.1 mg, 80%), Z/E = 2:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.91-7.78 (m, 2H), 7.68-7.56 (m, 2H), 7.37 (s, 1H), 7.23-7.13 (m, 3H), 7.13-6.98 (m, 4H), 6.92-6.81 (m, 2H), 6.78 (s, 1H), 6.59-6.51 (m, 1H), 2.92 (s, 3H, Z/E-$CH_3C_4N_2$), 2.34 (s, 3H, Z/E-$CH_3C_6H_4$), 2.31 (s, 3H, Z/E-$CH_3C_6H_4$), 2.10 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.9, 168.0, 162.6, 162.1, 148.9, 148.5, 139.4, 137.4, 137.3, 137.2, 137.2, 136.6, 136.1, 136.0, 135.5, 135.3, 134.9, 134.8, 134.8, 133.2, 130.3, 129.6, 129.1, 129.0, 127.7, 127.6, 127.5, 127.5, 127.4, 127.3, 127.0, 126.9, 126.6, 126.5, 126.1, 125.7, 125.6, 124.6, 124.0,

122.8, 120.9, 120.4, 25.5, 20.8, 20.7, 20.5, 20.3, 20.3, 20.2. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{26}H_{24}N_2$: 365.2012, found: 365.2011.



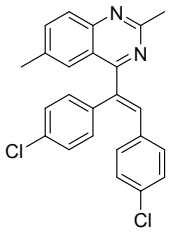
4-(1,2-Di-*o*-tolylvinyl)-2,6-dimethylquinazoline (3bd)

Yellow oil (16.3 mg, 45%), Z/E = 1:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.87 (d, *J* = 8.4 Hz, 1H), 7.77 (s, 1H), 7.72 (d, *J* = 8.4 Hz, 1H), 7.63 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.57 (s, 1H), 7.47 (dd, *J*= 8.4, 2.0 Hz, 1H), 7.38 (d, *J* = 7.2 Hz, 1H), 7.33 (s, 1H), 7.25-7.21 (m, 4H), 7.19-7.16 (m, 3H), 7.14-7.11 (m, 2H), 7.10-7.05 (m, 2H), 6.93-6.85 (m, 3H), 6.63-6.56 (m, 2H), 2.80 (s, 3H, Z/E-$CH_3C_4N_2$), 2.45 (s, 3H, Z/E-$CH_3C_6H_3$), 2.35 (s, 3H, Z/E-$CH_3C_6H_4$), 2.27 (s, 3H, Z/E-$CH_3C_6H_4$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.3, 168.9, 163.4, 163.1, 150.3, 149.5, 141.9, 139.1, 138.8, 138.7, 137.1, 136.6, 136.4, 136.3, 136.3, 136.0, 135.9, 135.8, 135.7, 135.7, 134.9, 131.0, 130.9, 130.81, 130.2, 130.1, 129.8, 129.3, 129.0, 128.0, 127.9, 127.9, 127.8, 127.6, 126.0, 125.9, 125.5, 125.3, 125.2, 121.4, 121.2, 26.6, 26.5, 21.9, 21.6, 21.3, 20.3, 20.3, 20.3. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{26}H_{24}N_2$: 365.2012, found: 365.2010.



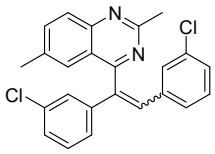
(Z)-4-(1,2-Bis(4-chlorophenyl)vinyl)-2,6-dimethylquinazoline (3be)

Yellow solid (14.9 mg, 37%), mp: 140-142 °C. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.89 (d, *J* = 8.8 Hz, 1H), 7.64 (dd, *J* = 8.8, 1.6 Hz, 1H), 7.51 (s, 1H), 7.33 (s, 1H), 7.30-7.26 (m, 2H), 7.25-7.22 (m, 2H), 7.00 (d, *J* = 8.4 Hz, 2H), 6.78 (d, *J* = 8.4 Hz, 2H), 2.91 (s, 3H), 2.36 (s, 3H). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 167.9, 163.7, 149.6, 138.5, 137.6, 136.7, 136.6, 134.1, 134.0, 133.6, 130.3, 130.0, 128.9, 128.5, 127.9, 127.8, 124.4, 121.6, 26.5, 21.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{18}Cl_2N_2$: 405.0920, found: 405.0920.



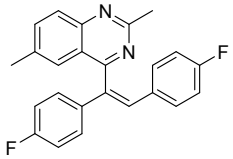
(E)-4-(1,2-Bis(4-chlorophenyl)vinyl)-2,6-dimethylquinazoline (3be')

Yellow solid (17.8 mg, 44%), mp: 131-134 °C. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.88 (d, *J* = 8.4 Hz, 1H), 7.68-7.62 (m, 2H), 7.26-7.21 (m, 6H), 7.17-7.13(m, 2H), 6.95 (s, 1H), 2.90 (s, 3H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.8, 162.9, 150.0, 138.0, 136.9, 136.6, 136.1, 134.1, 133.9, 133.6, 131.0, 130.8, 129.1, 128.5, 127.8, 125.0, 121.1, 26.4, 21.9. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{18}Cl_2N_2$: 405.0920, found: 405.0922.



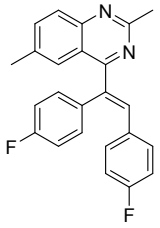
4-(1,2-Bis(3-chlorophenyl)vinyl)-2,6-dimethylquinazoline (3bf)

Yellow oil (28.7 mg, 71%), Z/E = 1.7:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.89 (d, *J* = 8.4 Hz, 1H), 7.64 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.51 (s, 1H), 7.36 (t, *J* = 1.6 Hz, 1H), 7.34 (s, 1H), 7.28-7.27 (m, 2H), 7.22-7.22 (m, 1H), 7.18-7.17 (m, 1H), 7.00 (t, *J* = 1.6 Hz, 1H), 6.93 (s, 1H), 6.63 (d, *J* = 8.0 Hz,1H), 2.92 (s, 3H, Z/E-$CH_3C_4N_2$), 2.45 (s, 2H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 167.4, 163.6, 162.9, 149.6, 141.7, 139.6, 138.4, 137.6, 137.4, 137.3, 137.2, 137.1, 136.7, 136.2, 134.7, 134.6, 134.2, 134.1, 133.7, 130.8, 130.0, 129.9, 129.7, 129.5, 129.4, 129.3, 129.3, 128.4, 128.4, 128.2, 127.9, 127.8, 127.8, 127.7, 126.6, 126.5, 124.9, 124.4, 121.5, 121.1, 26.5, 26.4, 21.9, 21.7. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{18}Cl_2N_2$: 405.0920, found: 405.0921.



(Z)-4-(1,2-Bis(4-fluorophenyl)vinyl)-2,6-dimethylquinazoline (3bg)

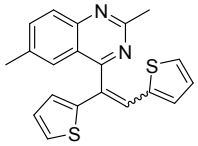
Yellow solid (17.1 mg, 46%), mp: 119-120 °C. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.88 (d, *J* = 8.8 Hz, 1H), 7.64 (dd, *J* = 8.8, 1.6 Hz, 1H), 7.54 (s, 1H), 7.32-7.27 (m, 3H), 7.01 (t, *J* = 8.8 Hz, 2H), 6.86-6.81(m, 2H), 6.72 (t, *J* = 8.8 Hz, 2H), 2.91 (s, 3H), 2.36 (s, 3H). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 168.3, 163.8, 162.6 (d, *J* = 248.4 Hz), 161.9 (d, *J* = 248.7 Hz), 149.6, 137.5, 136.6, 136.4 (d, *J* = 3.3 Hz), 136.0 (d, *J* = 1.4 Hz), 131.9 (d, *J* = 3.5 Hz), 130.5 (d, *J* = 8.1 Hz), 130.0, 128.3 (d, *J* = 8.1 Hz), 127.8, 124.6, 121.6, 115.6 (d, *J* = 21.7 Hz), 115.3 (d, *J* = 21.6 Hz)., 26.5, 21.7. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -113.06, -113.62. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{18}F_2N_2$: 373.1511, found: 373.1512.



(E)-4-(1,2-Bis(4-fluorophenyl)vinyl)-2,6-dimethylquinazoline (3bg')

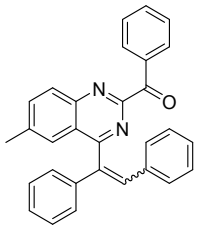
Yellow oil (14.1 mg, 38%), R_f = 0.3 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.88 (d, *J* = 8.4 Hz, 1H), 7.69 (s, 1H), 7.65 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.32-7.28 (m, 2H), 7.22-7.16 (m, 2H), 7.01-6.92 (m, 5H), 2.90 (s, 3H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 169.1, 162.6, 162.3 (d, *J* = 248.4 Hz), 162.2 (d, *J* = 248.8 Hz), 150.0 (d, *J* = 2.3Hz), 137.5, 137.4, 136.7, 135.9, 134.2 (d, *J* = 3.6 Hz), 131.8 (d, *J* = 3.4 Hz), 131.5 (d, *J* = 8.0 Hz), 131.4 (d, *J* = 8.0 Hz), 127.8, 125.2, 121.2, 115.9 (d, *J* = 21.5 Hz), 115.3 (d, *J* = 21.5 Hz). 26.5, 21.8. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -112.73, -113.10. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{24}H_{18}F_2N_2$:

373.1511, found: 373.1511.



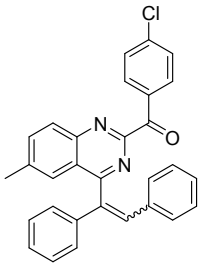
4-(1,2-Di(thiophen-2-yl)vinyl)-2,6-dimethylquinazoline (3bh)

Yellow oil (18.0 mg, 52%), Z/E = 15:1. R_f = 0.6 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.32 (s, 1H), 7.66 (d, *J* = 5.2 Hz, 1H), 7.40-7.30 (m, 3H), 7.28-7.27 (m, 1H), 7.14 (d, *J* = 3.2 Hz, 1H), 7.10 (d, *J* = 8.0 Hz, 2H), 7.01-6.96 (m, 1H), 2.30 (s, 3H), 1.26 (s, 3H). **^{13}C NMR (150 MHz, Chloroform-*d*)** δ 164.2, 138.9, 135.5, 135.5, 135.0, 134.4, 134.2, 131.4, 130.5, 130.0, 129.9, 129.7, 129.0, 127.1, 123.8, 120.3, 30.0, 21.2. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{20}H_{16}N_2S$: 349.0828, found: 349.0823.



(4-(1,2-Diphenylvinyl)-6-methylquinazolin-2-yl)(phenyl)methanone (4aa)

Yellow solid (20.0 mg, 47%), mp: 85-87 °C, Z/E = 3.3:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.14 (d, *J* = 8.4 Hz, 1H), 7.84-7.79 (m, 1H), 7.79-7.71 (m, 2H), 7.53-7.48 (m, 2H), 7.47 (s, 1H), 7.44-7.38 (m, 1H), 7.37-7.27 (m, 8H), 7.23 (s, 2H), 7.15-7.06 (m, 3H), 6.93 (d, *J* = 6.8 Hz, 2H), 2.43 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 191.9, 191.7, 169.7, 168.6, 158.5, 157.4, 149.7, 149.3, 140.1, 140.0, 139.4, 138.6, 138.0, 137.7, 137.6, 137.0, 136.5, 136.1, 135.7, 135.3, 134.6, 133.2, 133.2, 132.4, 131.2, 131.1, 131.0, 130.8, 130.5, 129.8, 129.7, 129.6, 129.5, 129.4, 129.2, 128.9, 128.8, 128.7, 128.4, 128.2, 128.2, 128.1, 128.1, 127.9, 127.7, 126.7, 125.5, 125.2, 124.1, 22.1, 22.0. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{30}H_{22}N_2O$: 427.1805, found: 427.1806.



(4-Chlorophenyl)(4-(1,2-diphenylvinyl)-6-methylquinazolin-2-yl)methanone(4ab)

Yellow solid (25.7 mg, 56%), mp: 60-62 °C, Z/E = 2.4:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.15 (d, *J* = 8.8 Hz, 1H), 8.04 (d, *J* = 8.8 Hz, 1H), 7.77-7.71 (m, 4H), 7.48 (s, 1H), 7.35-7.31 (m, 7H), 7.25-7.21 (m, 4H), 7.14-7.08 (m, 3H), 6.91 (d, *J* = 7.2 Hz, 2H), 2.44 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)**δ 190.5, 190.3, 169.8, 168.6, 157.9, 156.8, 149.8, 149.3, 140.3, 140.1, 139.7, 139.7, 139.6, 138.7, 137.9, 137.7, 137.2, 136.6, 136.1, 136.0, 135.6, 134.1,

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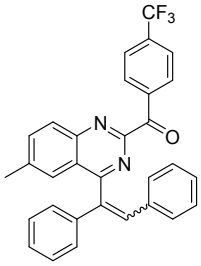
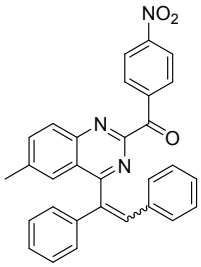


(4-(1,2-Diphenylvinyl)-6-methylquinazolin-2-yl)(4-(trifluoromethyl)phenyl)methanone (4ac)

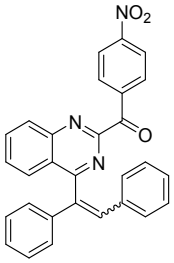
Yellow solid (38.0 mg, 77%), mp: 55-57 °C, Z/E = 3:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.20-8.15 (m, 2H), 7.93-7.89 (m, 2H), 7.77 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.74-7.71 (m, 1H), 7.68-7.62 (m, 2H), 7.52 (d, *J* = 8.8 Hz, 3H), 7.49-7.45 (m, 1H), 7.34-7.31 (m, 6H), 7.23 (s, 1H), 7.14-7.11 (m, 3H), 6.94-6.90 (m, 2H), 2.44 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 190.7, 190.6, 171.3, 171.1, 169.9, 168.8, 158.8, 157.3, 156.2, 149.8, 149.3, 140.6, 140.1, 140.0, 138.7, 138.7, 138.4, 138.4, 137.9, 137.7, 137.3, 136.7, 136.2, 136.1, 135.6, 134.1 (q, *J* = 32.6 Hz), 132.7, 131.5, 131.3, 130.5, 129.9, 129.8, 129.7, 129.4, 129.2, 129.07, 128.9, 128.8, 128.7, 128.6, 128.4,128.3, 128.3, 128.2, 128.2, 128.0, 127.8, 126.6, 126.1 (q, *J* = 3.9 Hz),125.9, 125.5, 125.3, 125.0 (q, *J* = 3.9 Hz), 124.9, 124.4, 123.6 (q, *J* =271.0 Hz), 116.3, 22.2, 22.0. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -63.21. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{31}H_{21}F_3N_2O$: 495.1679, found: 495.1677.



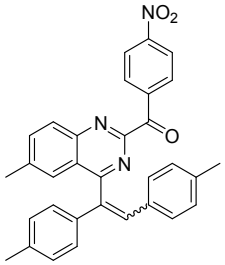
(4-(1,2-Diphenylvinyl)-6-methylquinazolin-2-yl)(4-nitrophenyl)methanone (4ad)

Yellow solid (40.0 mg, 85%), mp: 63-65 °C, Z/E = 1:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.24-8.20 (m, 3H), 8.17 (t, *J* = 8.0 Hz, 2H), 8.11-8.04 (m, 3H), 7.96-7.90 (m, 2H), 7.83 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.80 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.74 (s, 1H), 7.49 (s, 1H), 7.39-7.28 (m, 11H), 7.25-7.21 (m, 5H), 7.20-7.12 (m, 4H), 6.94-6.89 (m, 2H), 2.46 (s, 3H, Z/E-$CH_3C_6H_3$). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 190.1, 189.9, 170.0, 168.8, 156.8, 155.7, 150.0, 149.9, 149.3, 140.9, 140.8, 140.5, 140.4, 140.1, 138.8, 137.8, 137.7, 137.4, 136.9, 136.48, 136.14, 135.50, 132.84, 132.20, 132.00, 129.91, 129.84, 129.78, 128.93, 128.9, 128.8, 128.5, 128.3, 128.3, 128.2, 128.1, 127.9, 126.6, 125.5, 125.3, 124.5, 123.5, 123.4, 123.1, 123.0, 22.2, 22.1. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{30}H_{21}N_3O_3$: 472.1656, found:

472.1657.



(4-(1,2-Diphenylvinyl)quinazolin-2-yl)(4-nitrophenyl)methanone (4ae)
Yellow solid (33.3 mg, 73%), mp: 60-64 °C, Z/E = 1.3:1. R_f = 0.4 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.30-8.27 (m, 2H), 8.11-8.07 (m, 2H), 8.12-8.08 (m, 2H), 8.03-7.96 (m, 3H), 7.95-7.91 (m, 2H), 7.70 (dd, *J* = 8.4, 6.8, Hz, 1H), 7.62 (dd, *J* = 8.4, 6.8, Hz, 1H)., 7.50 (s, 1H), 7.38-7.31 (m, 7H), 7.30-7.27 (m, 3H), 7.24-7.22 (m, 3H), 7.19-7.12 (m, 4H), 6.91 (d, *J* = 7.2 Hz, 2H). **^{13}C NMR (100 MHz, Chloroform-*d*)** δ 190.0, 189.9, 171.0, 169.9, 157.5, 156.4, 151.3, 150.7, 150.1, 150.0, 140.7, 140.3, 140.1, 138.7, 137.7, 137.6, 136.9, 136.0, 135.4, 135.0, 134.6, 133.1, 132.2, 131.9, 130.1, 130.1, 129.9, 129.8, 129.6, 128.9, 128.8, 128.5, 128.5, 128.4, 128.3, 128.2, 127.9, 126.9, 126.8, 126.7, 124.5, 123.4, 123.2, 123.1. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{29}H_{19}N_3O_3$: 458.1499, found: 458.1497.



(4-(1,2-Di-*p*-tolylvinyl)-6-methylquinazolin-2-yl)(4-nitrophenyl)methanone (4af)
Yellow oil (40.4 mg, 81%), Z/E = 4.4:1. R_f = 0.5 (PE/EA 5:1). **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.21-8.15 (m, 2H), 8.08 (d, *J* = 8.8 Hz, 2H), 7.94 (d, *J* = 8.8 Hz, 2H), 7.79 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.74 (s, 1H), 7.41 (s, 1H), 7.17-7.10 (m, 6H), 6.94 (d, *J* = 8.0 Hz, 2H), 6.78 (d, *J* = 8.0 Hz, 2H), 2.45 (s, 3H, Z/E-$CH_3C_6H_3$), 2.34 (s, 3H, Z/E-$CH_3C_6H_4$), 2.27 (s, 3H, Z/E-$CH_3C_6H_4$). **^{13}C NMR (150 MHz, Chloroform-*d*)** δ 190.5, 169.6, 157.2, 150.3, 149.6, 141.1, 140.8, 138.5, 138.1, 137.8, 137.6, 137.0, 136.6, 133.7, 132.5, 132.4, 132.2, 130.2, 130.0, 130.0, 129.9, 129.8, 129.5, 129.3, 129.2, 126.7, 125.8, 124.9, 123.4, 123.3, 22.4, 21.5, 21.5. **HRMS (ESI):** $[M+H]^+$ calculated for $C_{32}H_{25}N_3O_3$: 500.1969, found: 500.1968.

Ⅶ. References

[1]. (a) B. F. Sabrina, S. C. Marilia, B. Nubia, J. S. B. Romulo, S. G. Marcelo, M. C. Marilene, B. K. Warner and F. F. Vitor, *Eur. J. Med. Chem.* 2007, ***42*** (11-12), 1388-1395; (b) L. Ruizhi, W. Xiaohua, L. Songyang, Z. Chen, H. Maoyao, C. Yuncan, W. Qiantao, H. Li and W. Yong, *Chem. Commun. (Camb)* 2019, ***55*** (28), 4039-4042.
[2]. (a) C. Shuting, Z. Jing, L. Yongxin and L. Xuewei, *RSC Advances* 2014, ***4*** (14),

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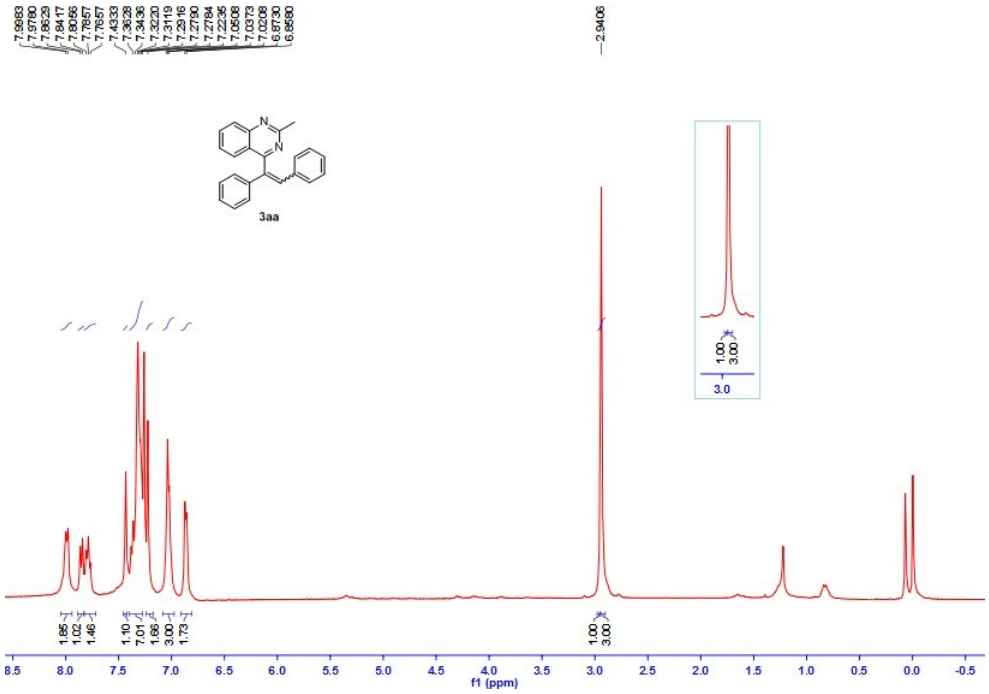
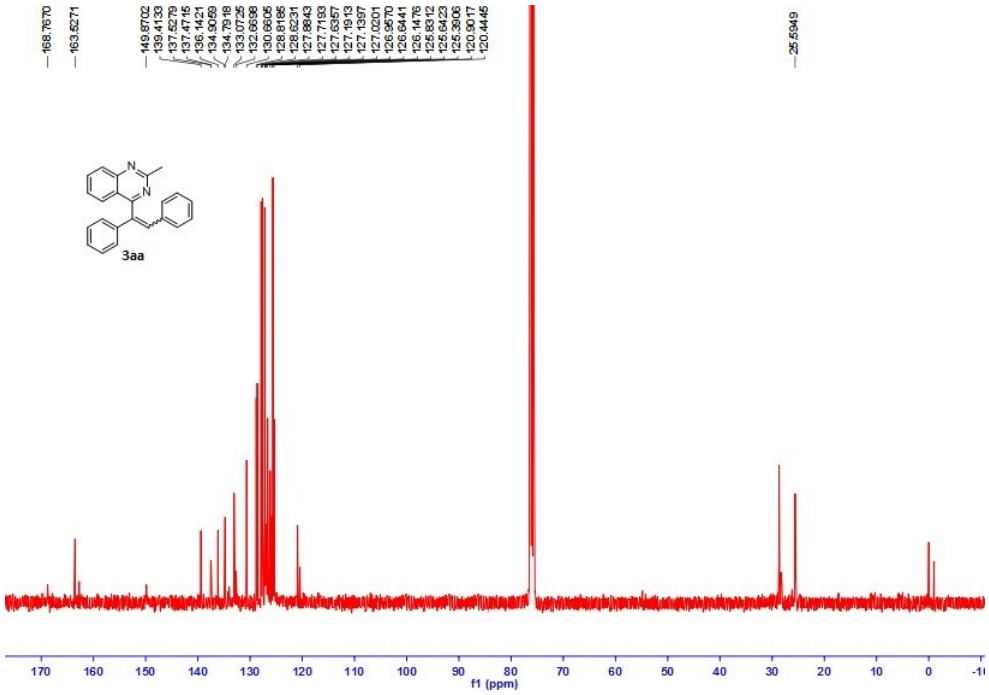
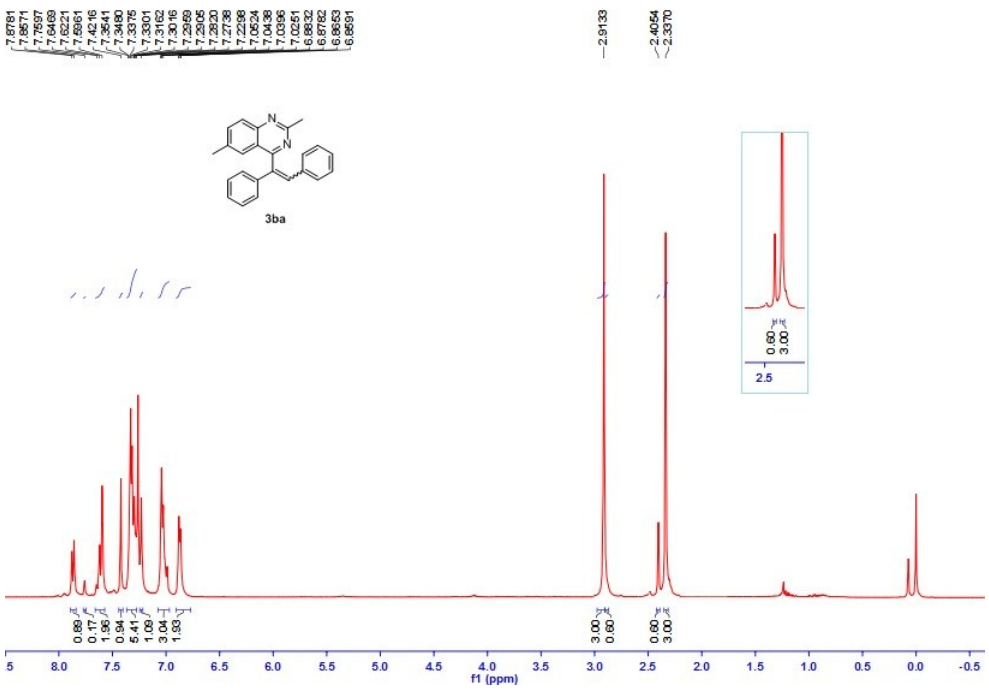
[4]. (a) R. K. Alan, A. A. A. Ashraf and G. A. Rena, *ARKIVOC* 2005, (vi), 329-338. (b) R. C. Peter, K. J. Wit and H. P. Rolf, *Aust. J. Chem.* 1989, ***42***, 549-559.
[5]. D. K. Gregory and L. H. Kami, *ACS Catal.* 2017, ***7***, 6220-6224.
[6]. K. Lingheng, Z. Xukai, X. Youwei and L. Xingwei, *Org. Lett.* 2017, ***19*** (13), 3644-3647.

Ⅷ. NMR Spectra of Coupled Products



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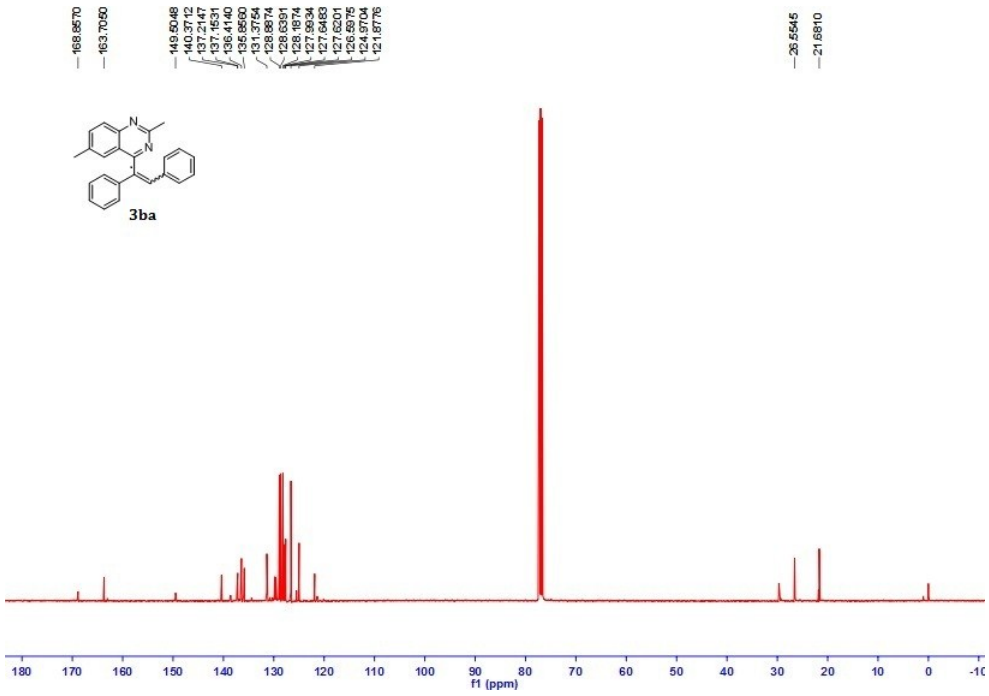
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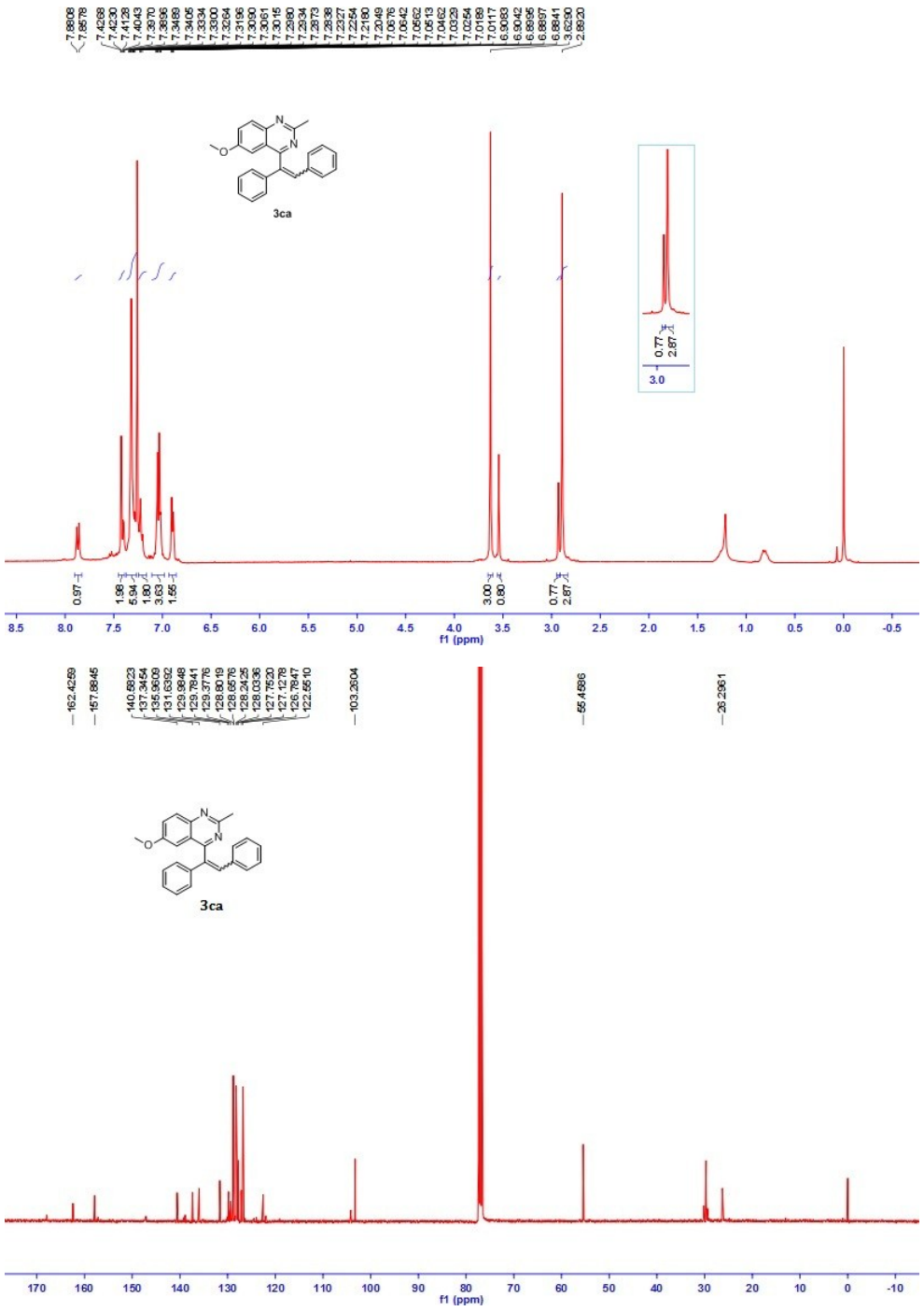
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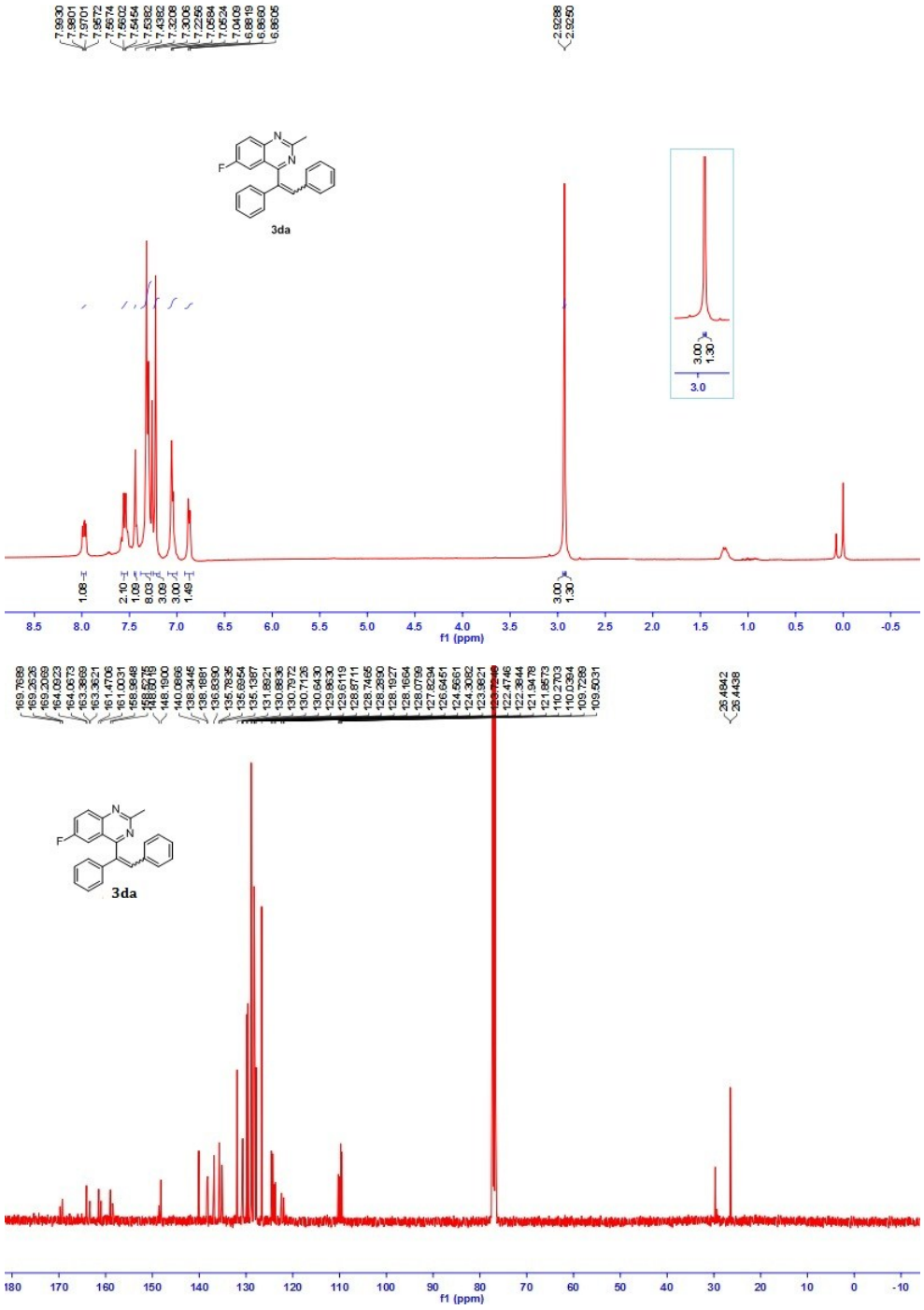
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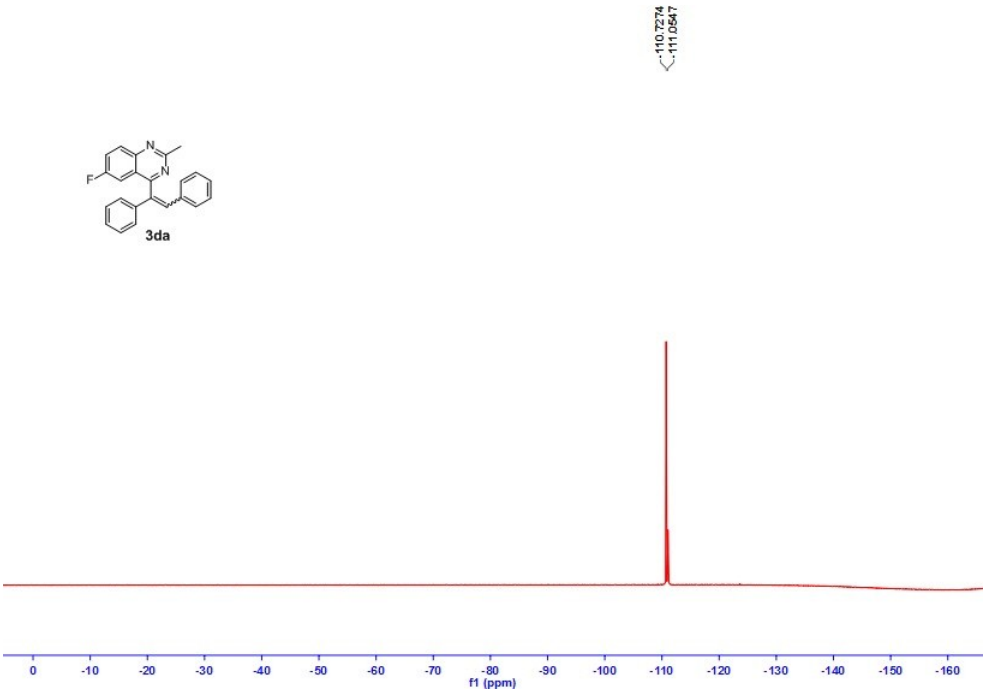
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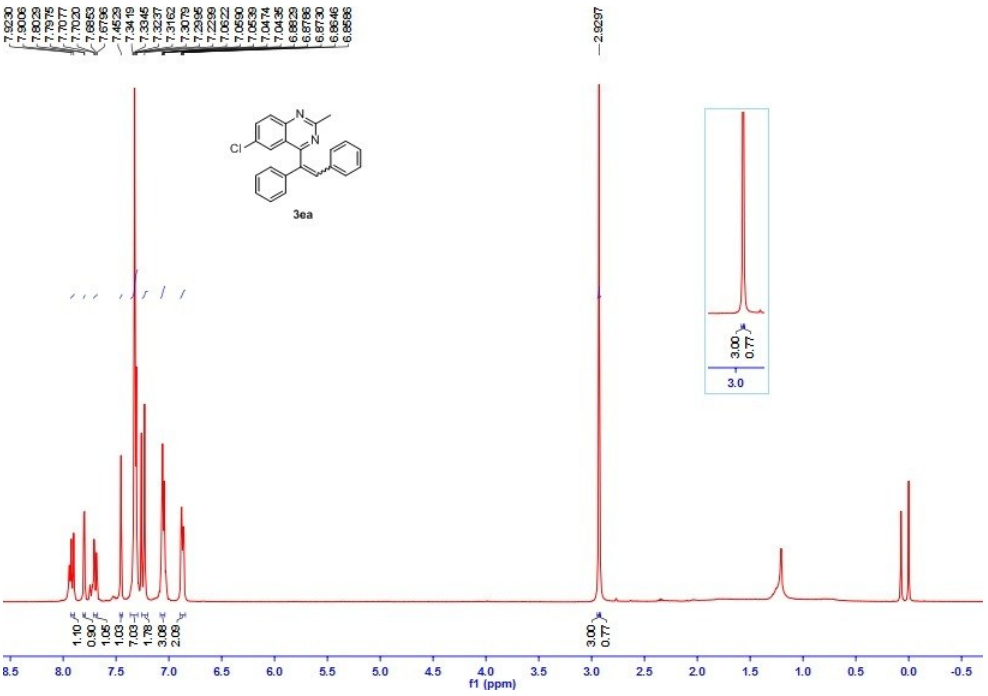
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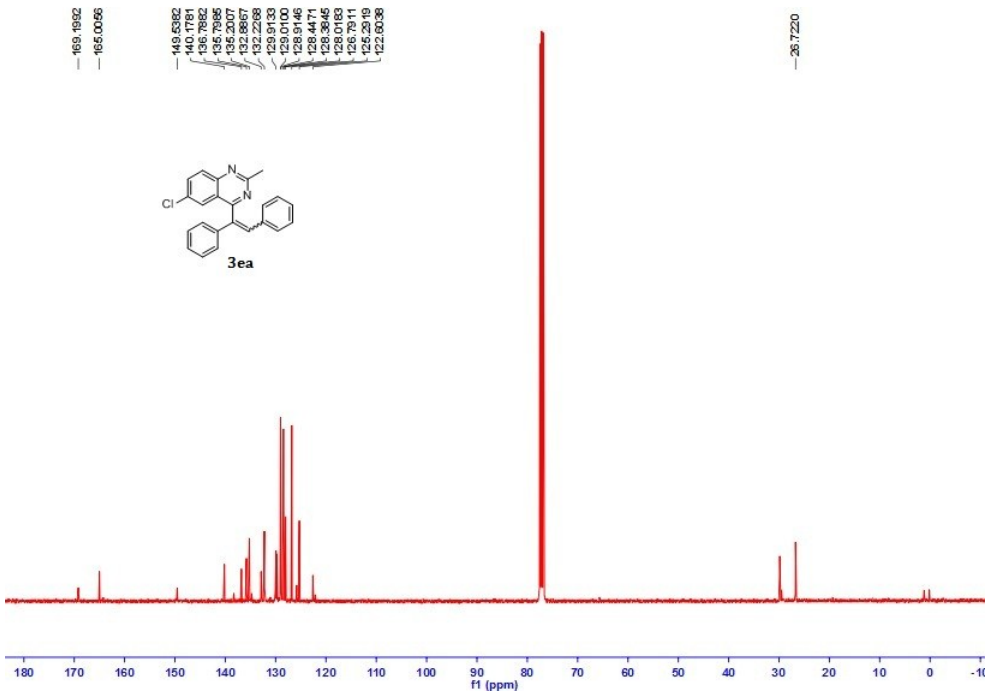
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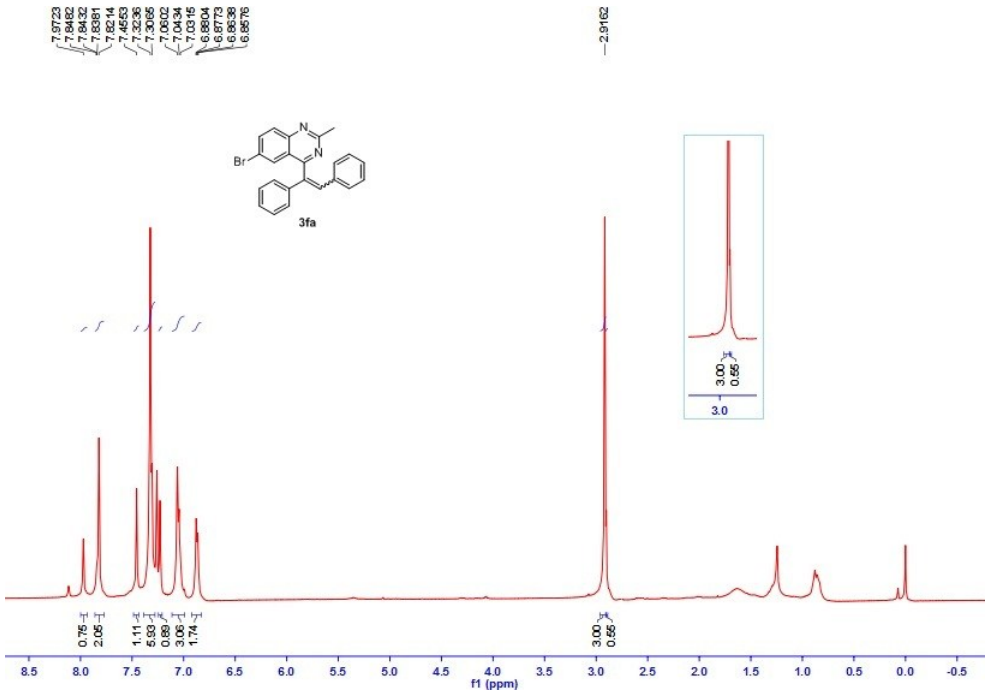
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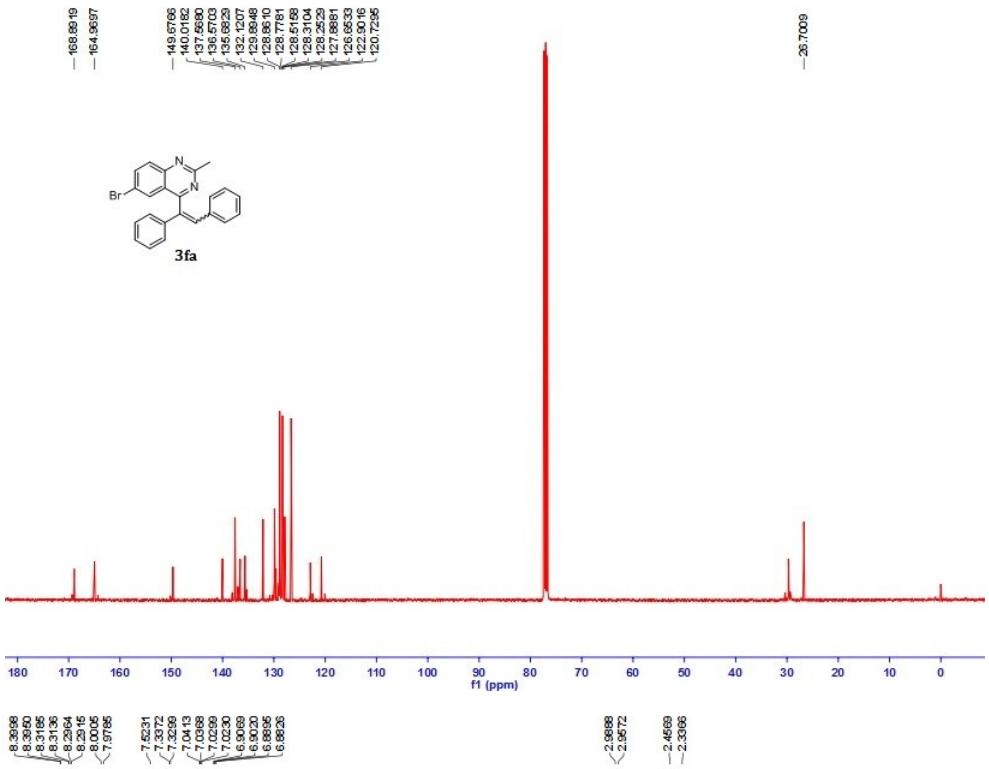
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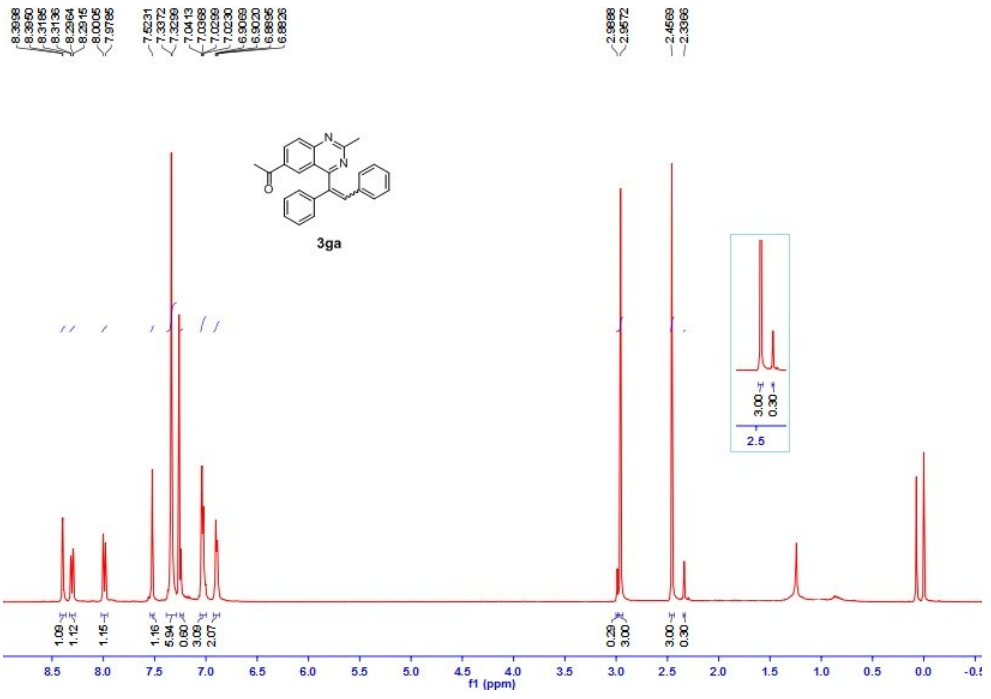
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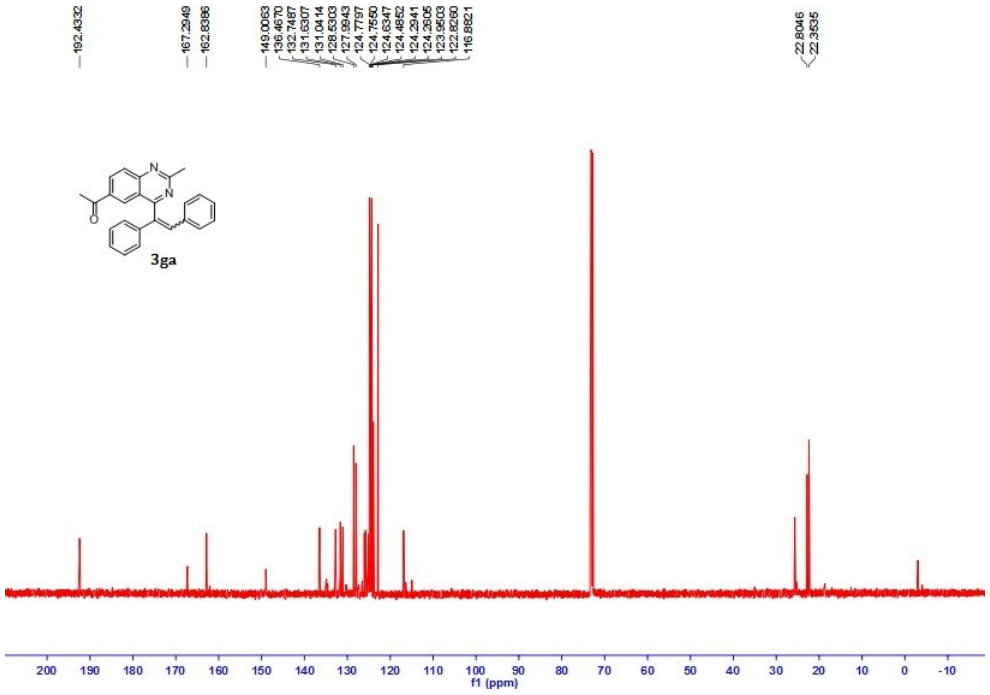
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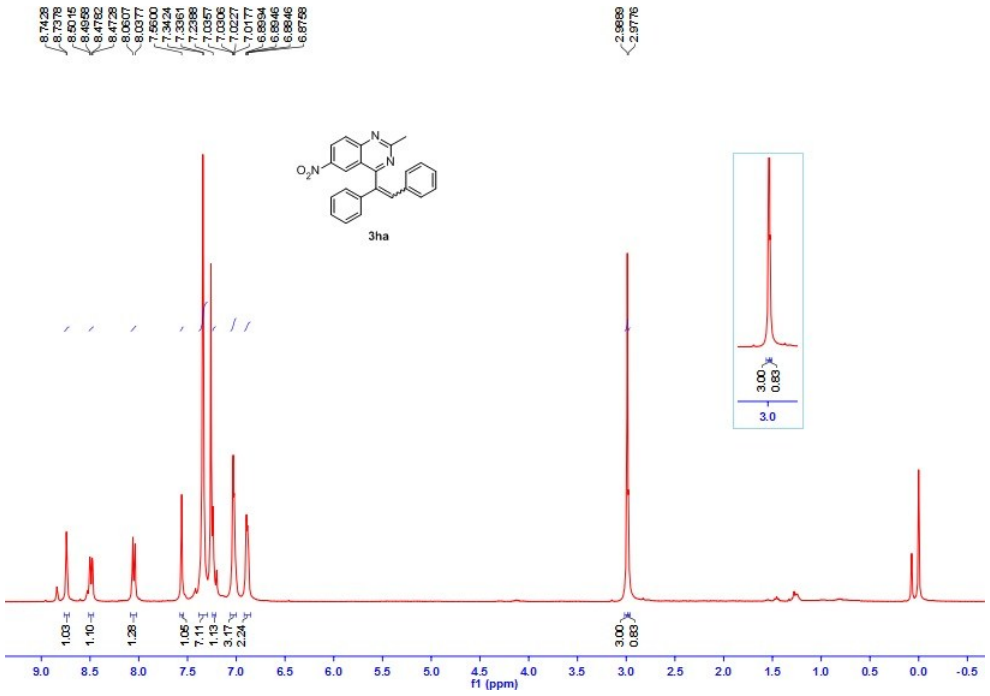
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6.8759
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2.9776
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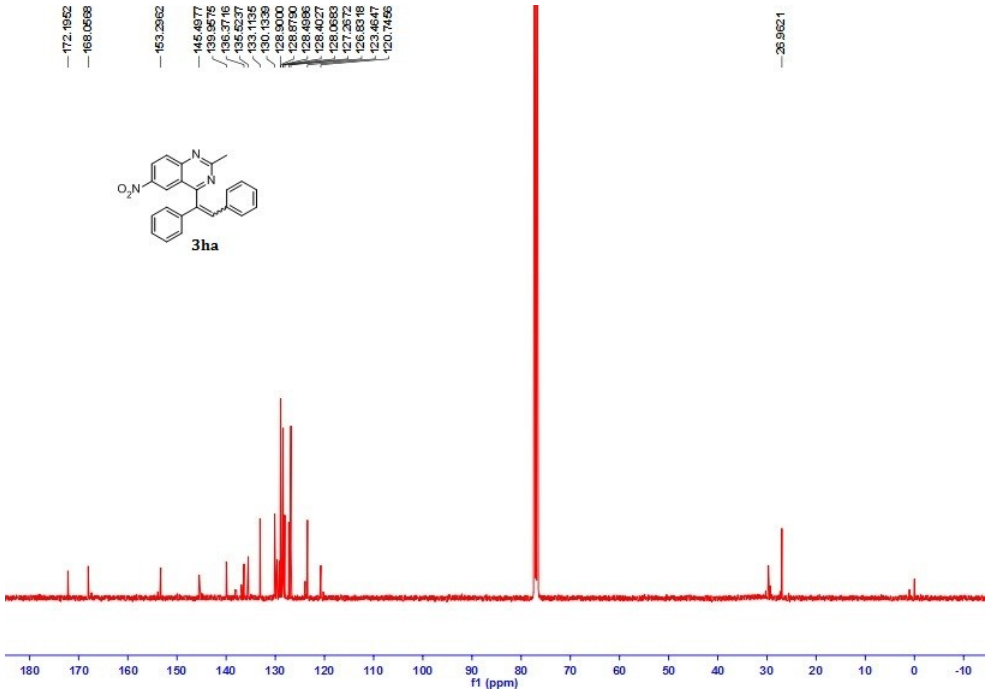
3.0
1.03
1.10
1.28
1.05
7.11
1.13
3.17
2.24
3.00
0.83
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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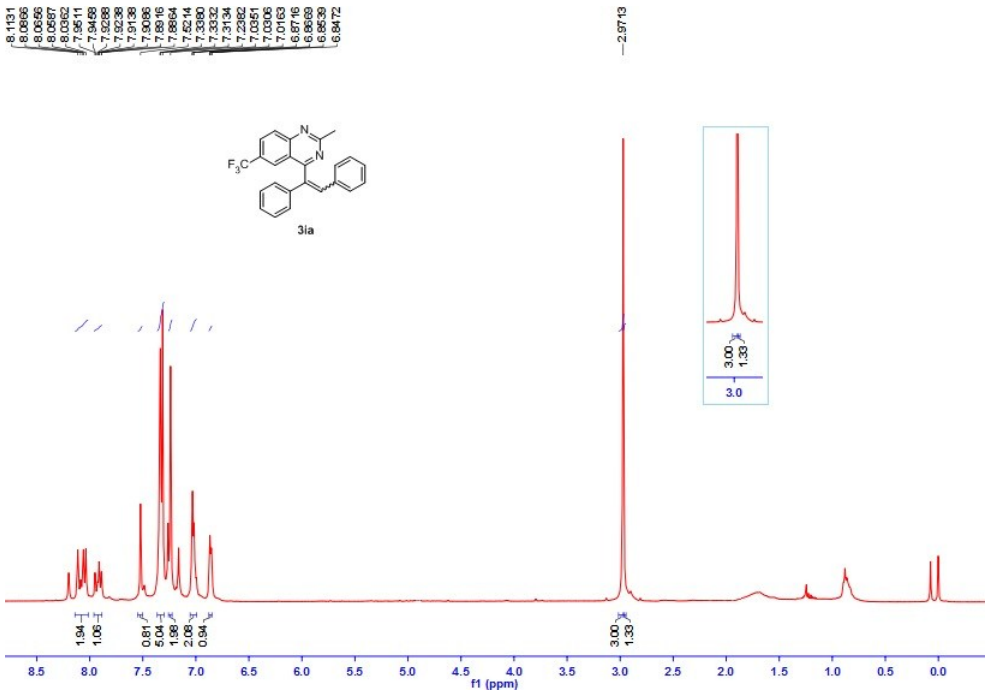
f1 (ppm)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1.33
3.0
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1.06
0.81
5.04
1.98
2.08
0.94
3.00
1.33
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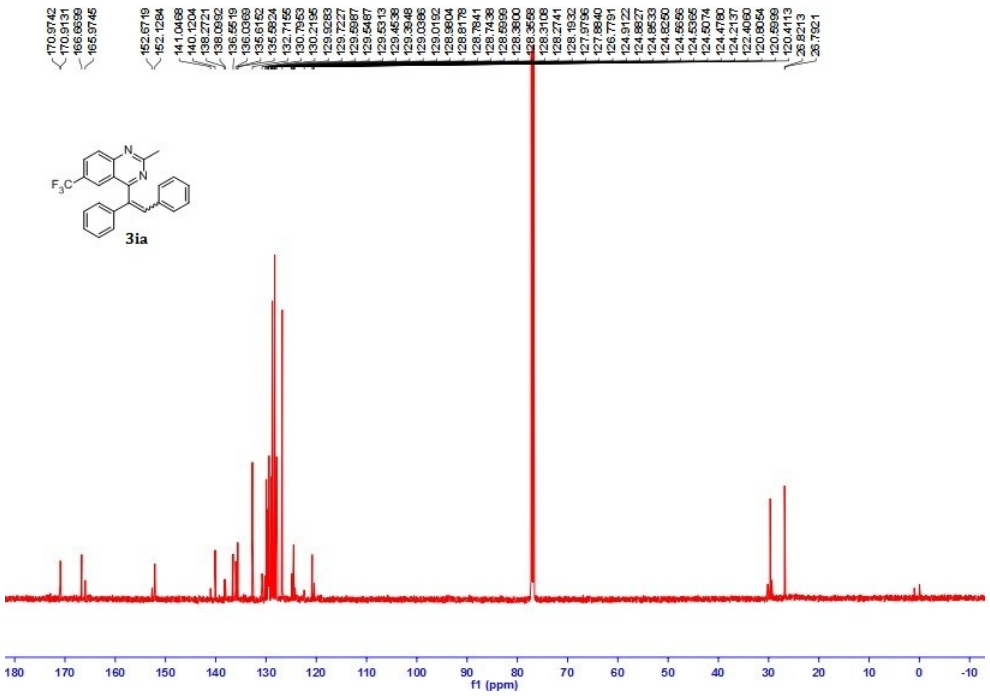
f1 (ppm)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126.7791
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124.8250
124.5656
124.5365
124.5074
124.4780
124.2137
122.4060
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26.8213
26.7921
F3C
3ia
180
170
160
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140
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120
110
100
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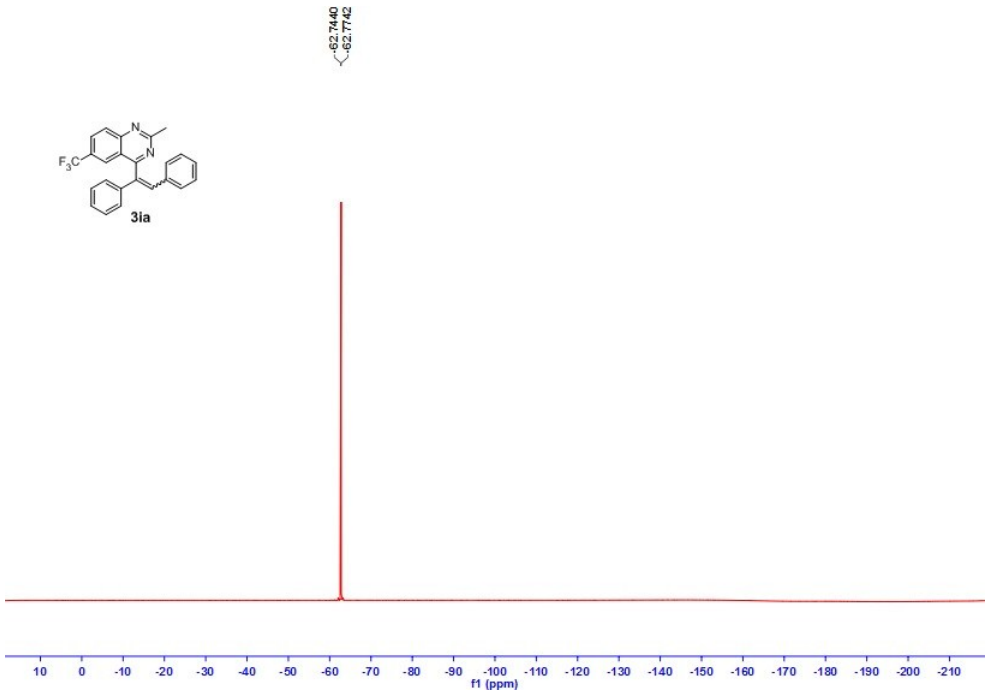
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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-130
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-160
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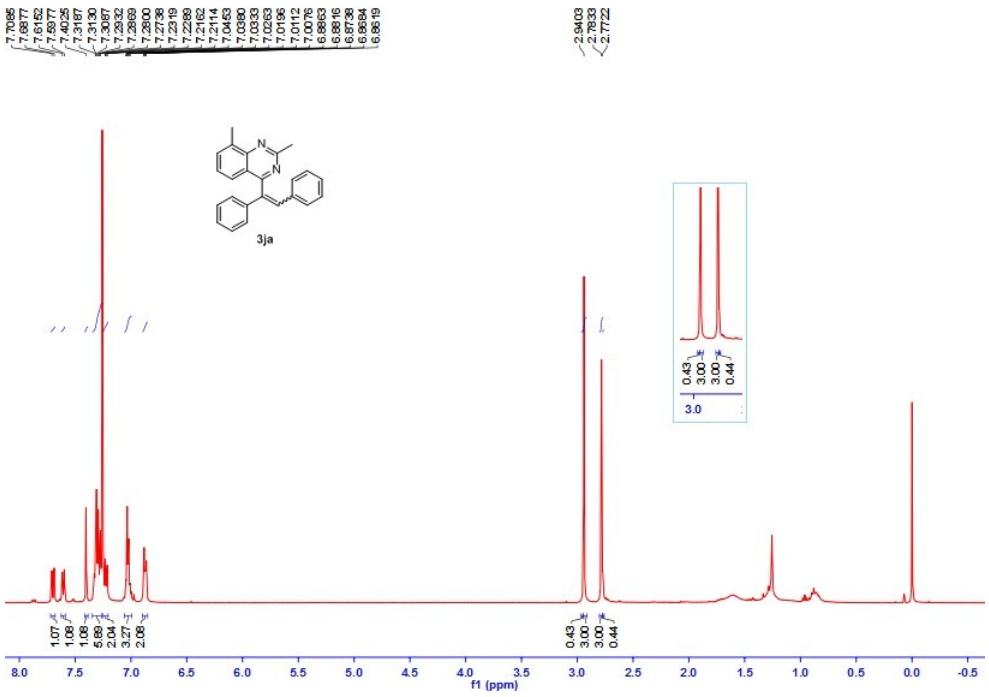
-180
-190
-200
-210
f1 (ppm)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7.0380
7.0333
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7.0196
7.0112
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6.8738
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2.7722
3ja
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2.08
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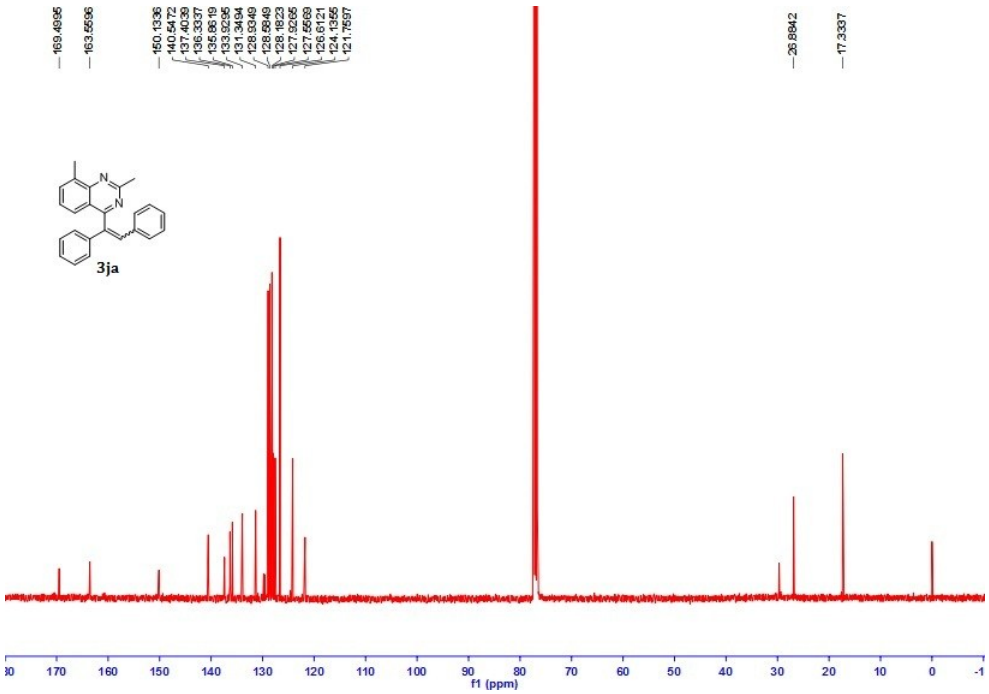
0.44
f1 (ppm)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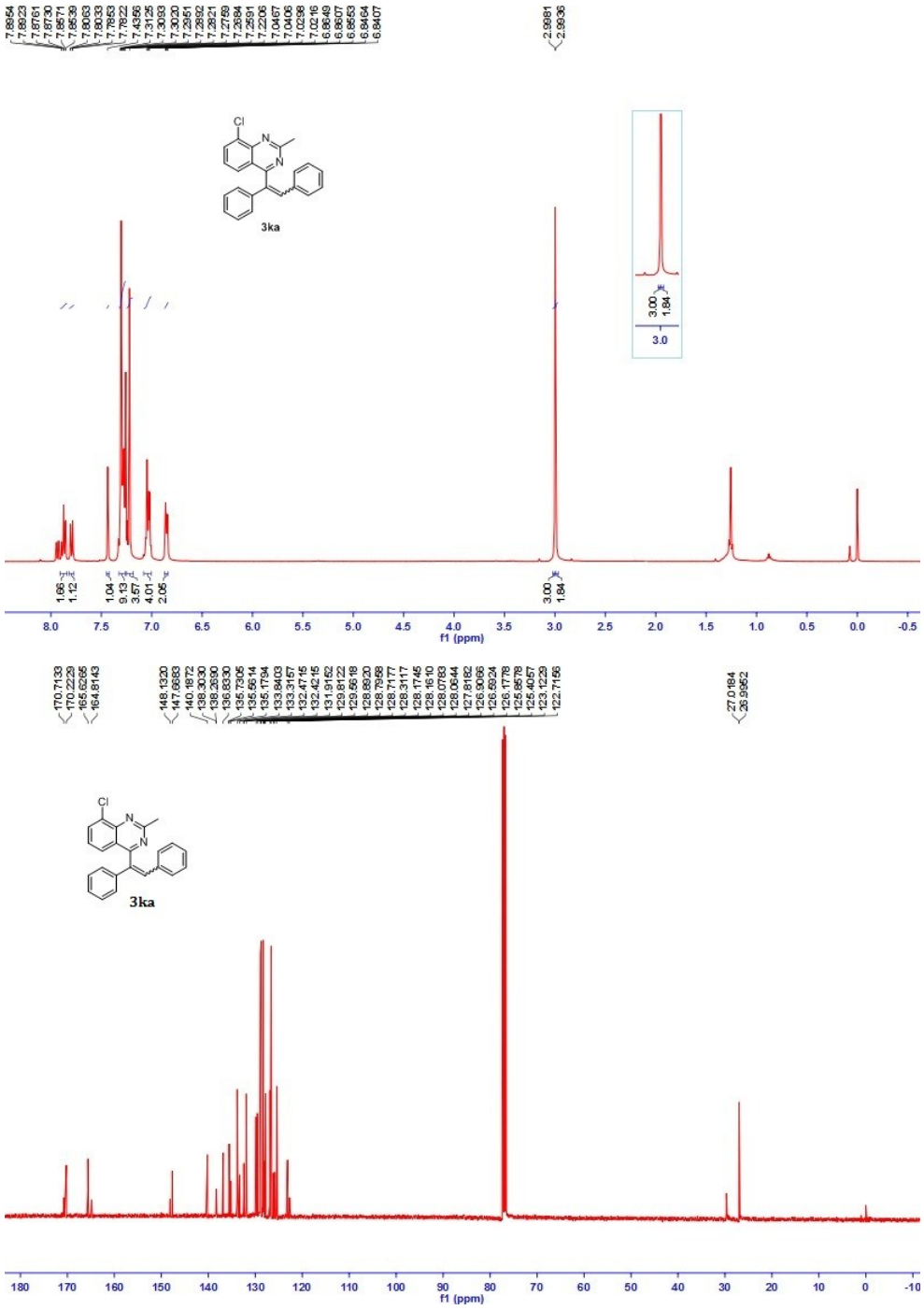
f1 (ppm)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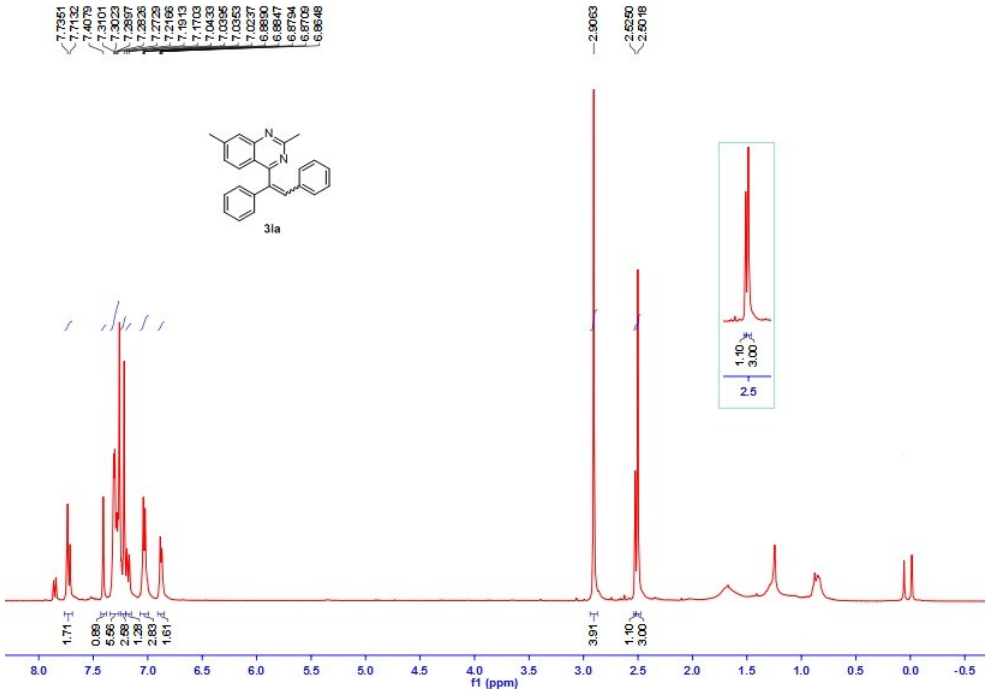
3ka
f1 (ppm)
f1 (ppm)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7.0053
7.0037
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2.89
1.28
2.83
1.61
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1.10
3.00
2.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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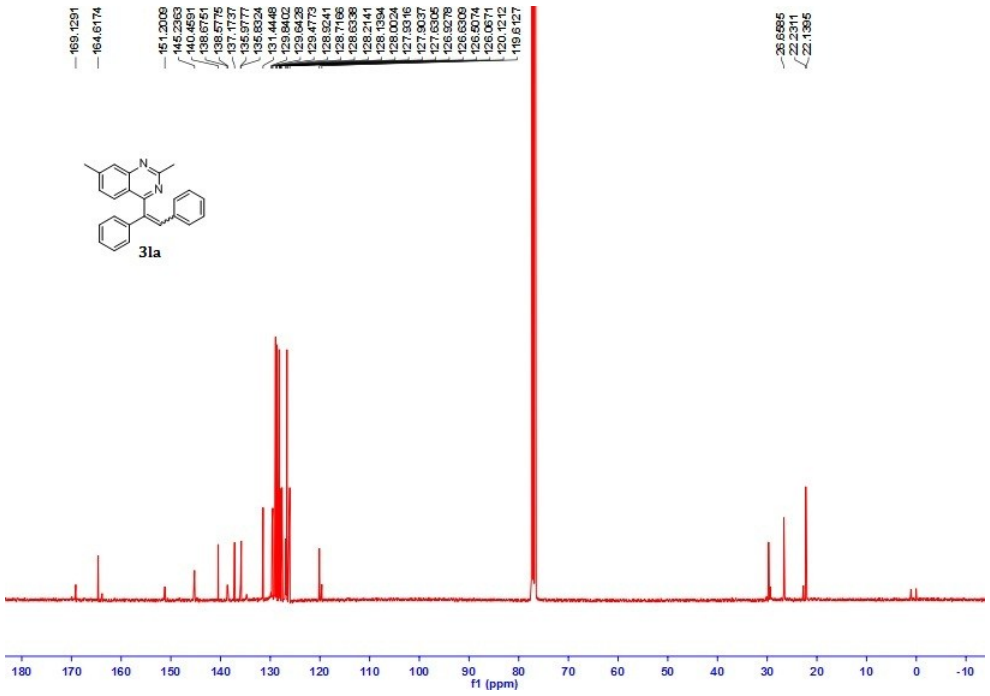
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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3la
180
170
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140
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120
110
100
90
80
70
60
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40
30
20
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0
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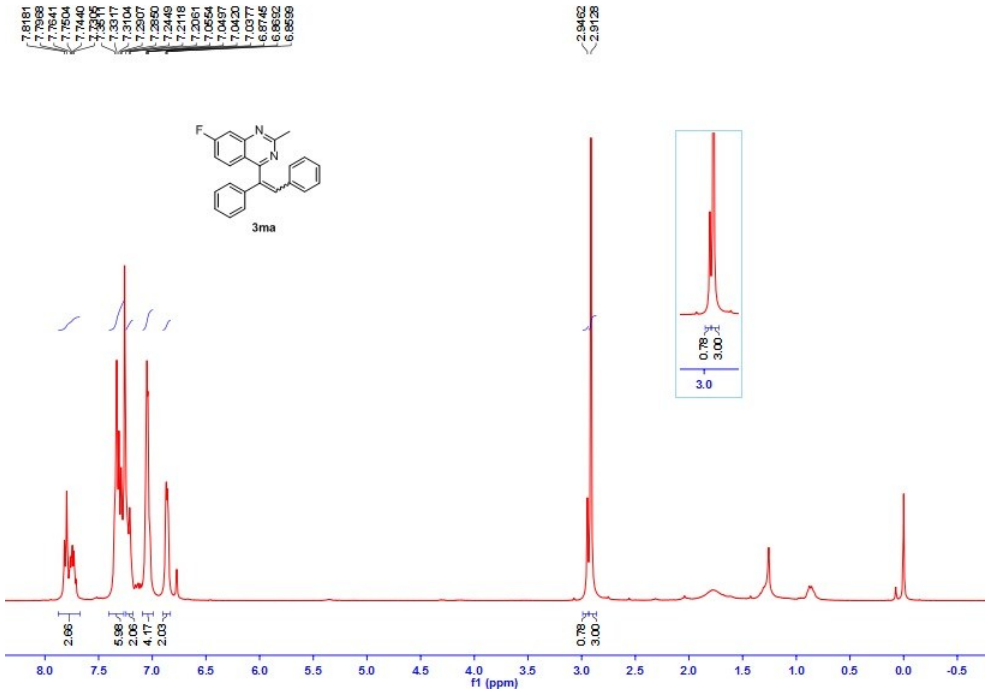
f1 (ppm)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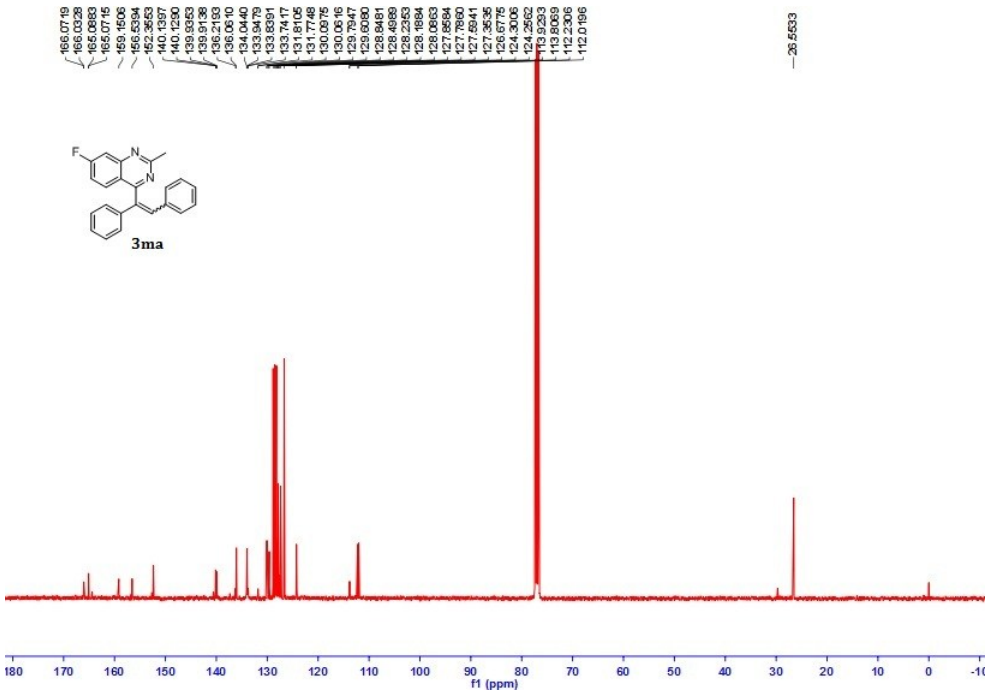
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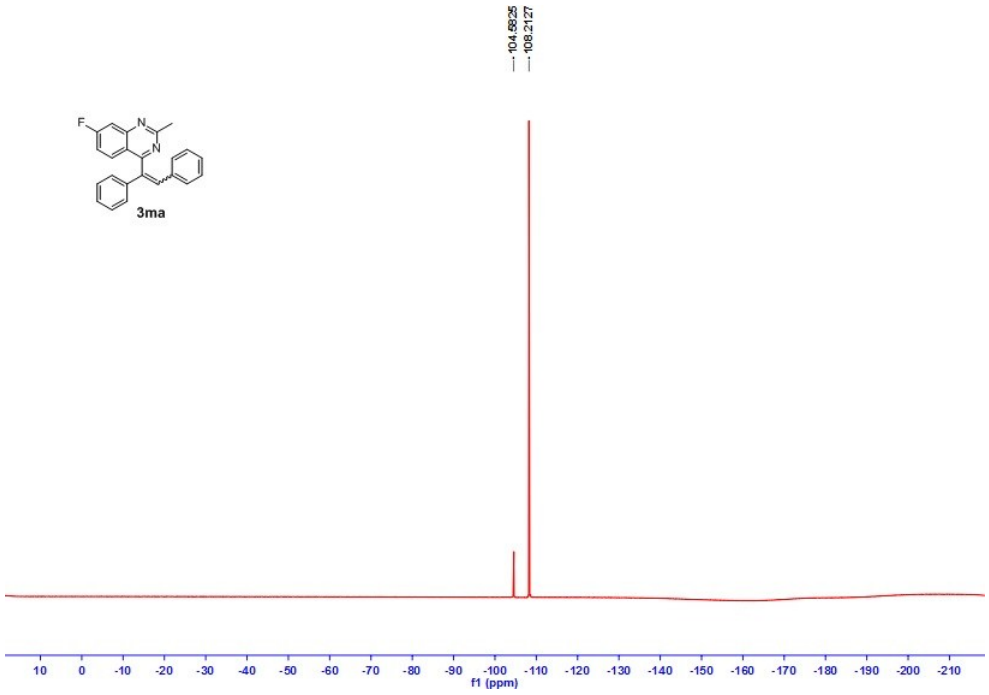
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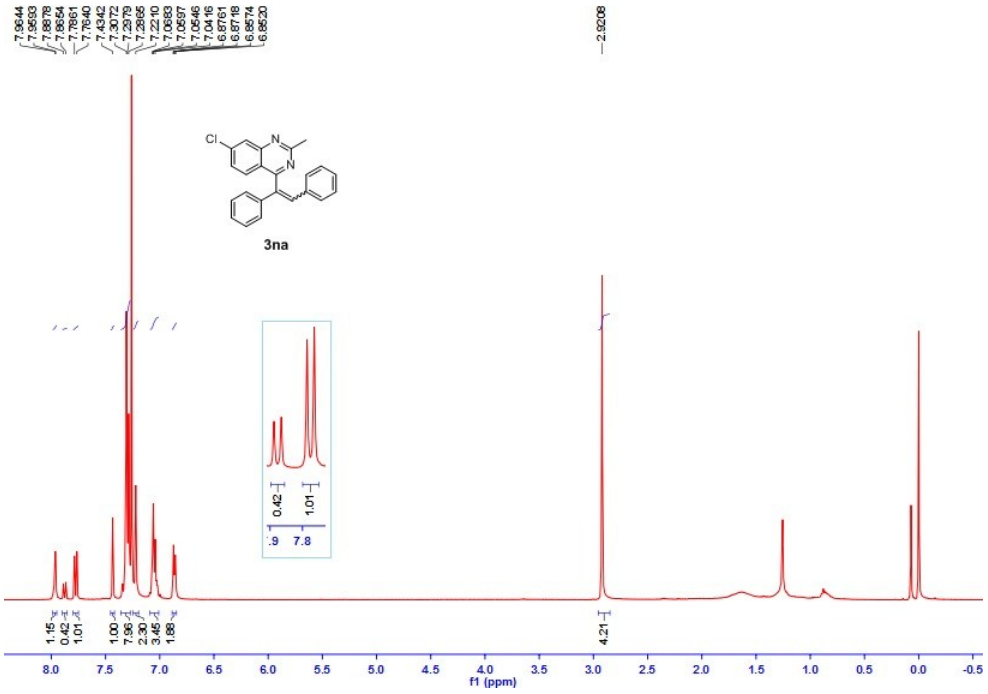
f1 (ppm)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7.0597
7.0546
7.0416
6.8761
6.8718
6.8574
6.8520
2.9208
3na
0.42
1.01
7.9 7.8
1.15
0.42
1.01
1.00
7.96
2.30
3.45
1.88
4.21
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
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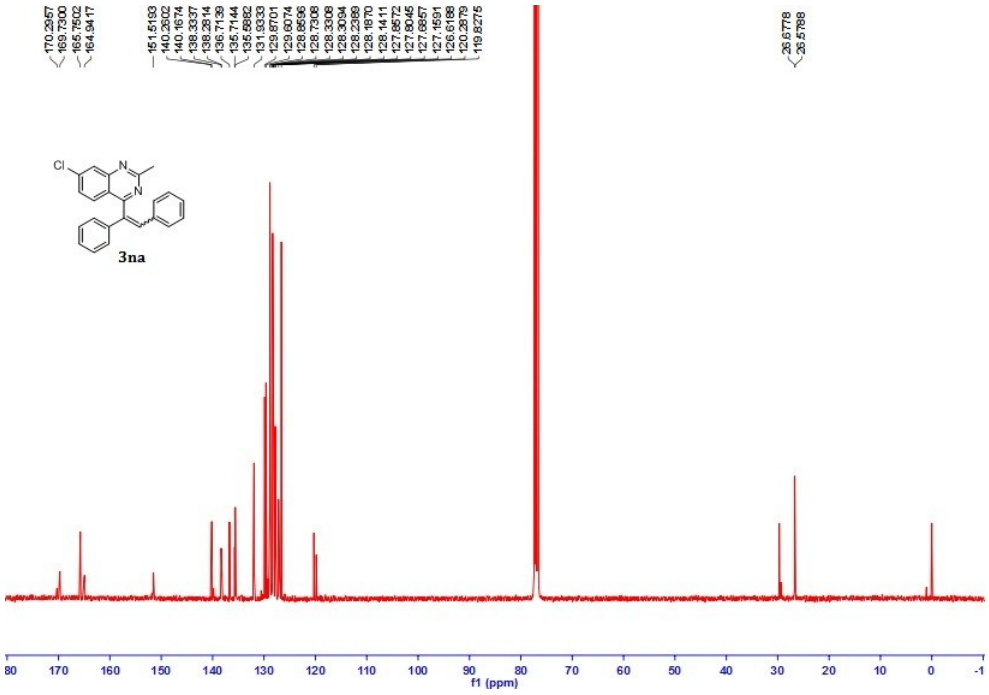
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N
N
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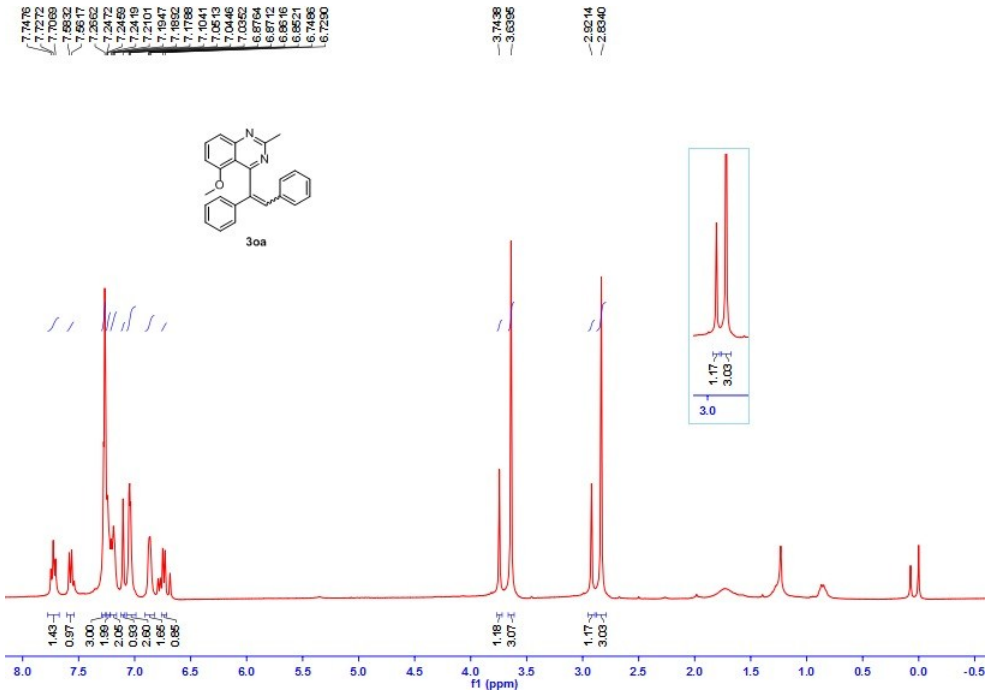
f1 (ppm)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N
O
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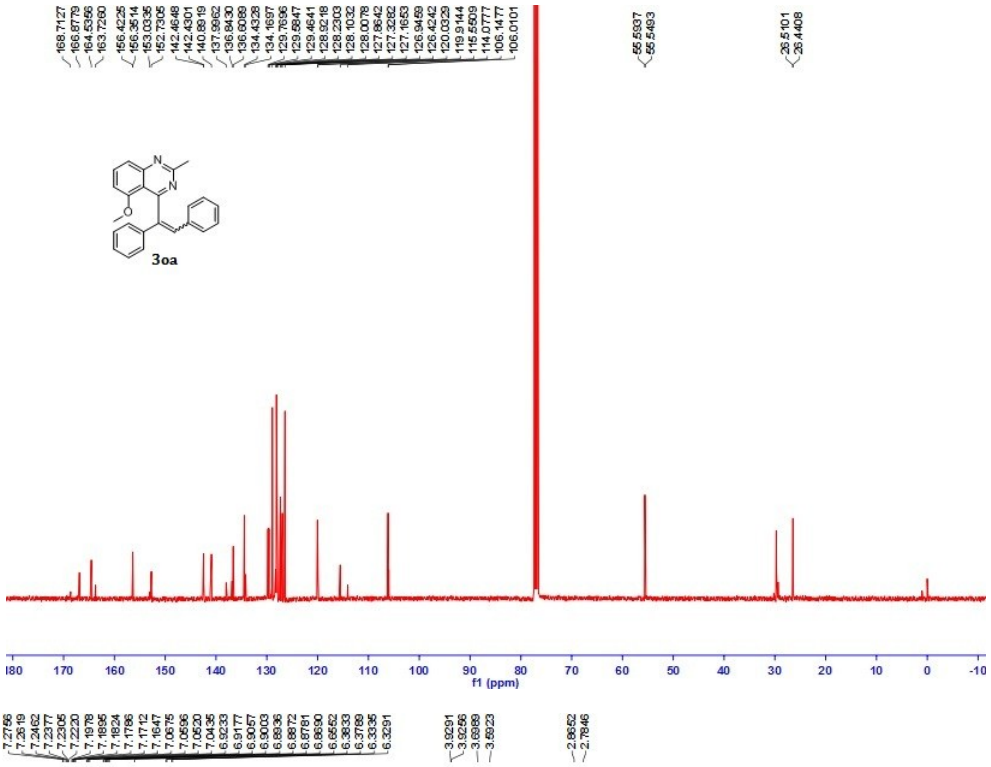
f1 (ppm)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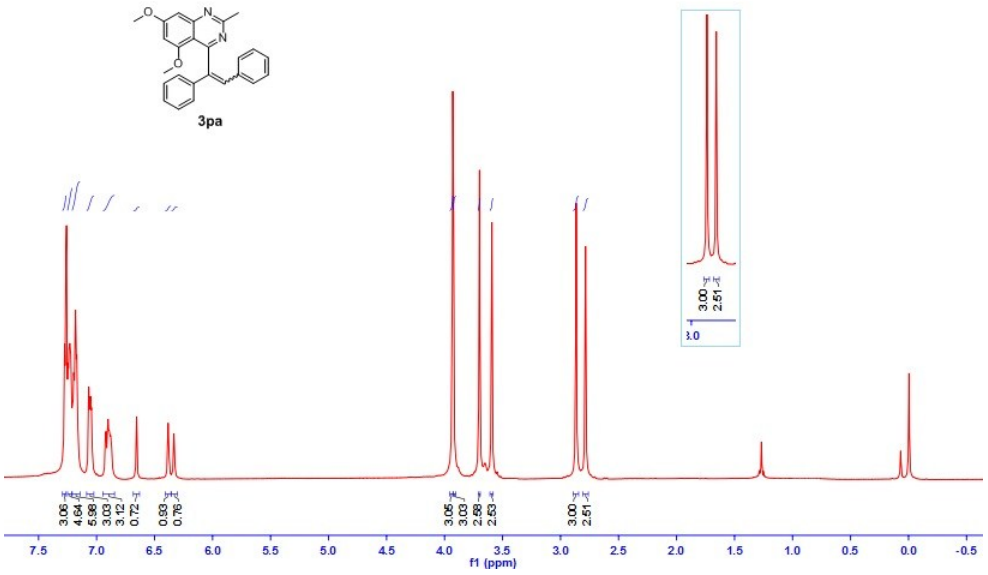
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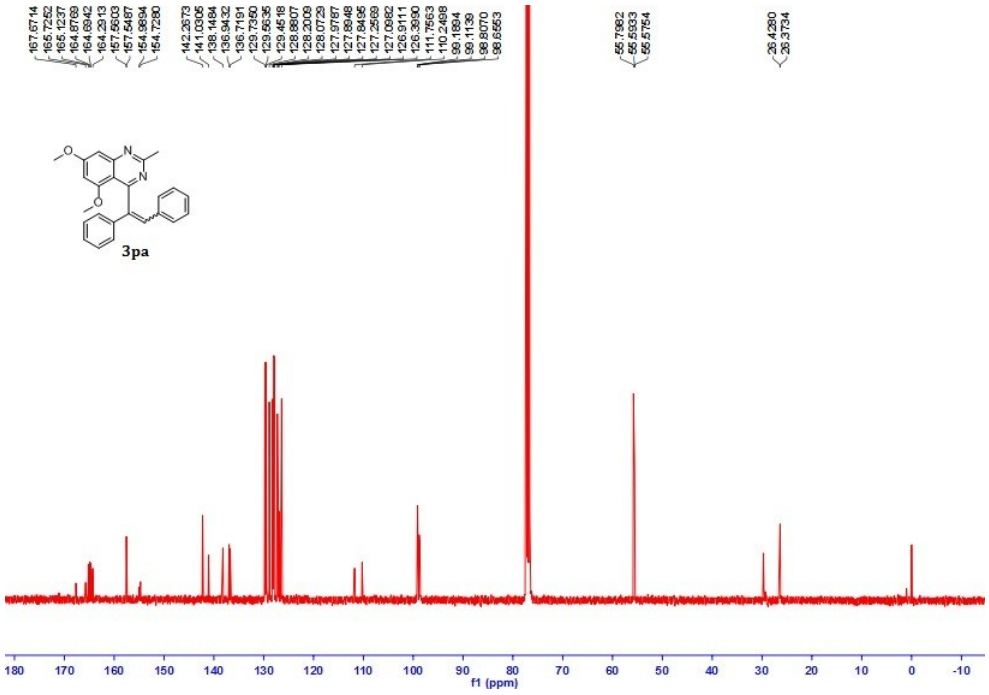
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180
170
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120
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100
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80
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60
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40
30
20
10
0
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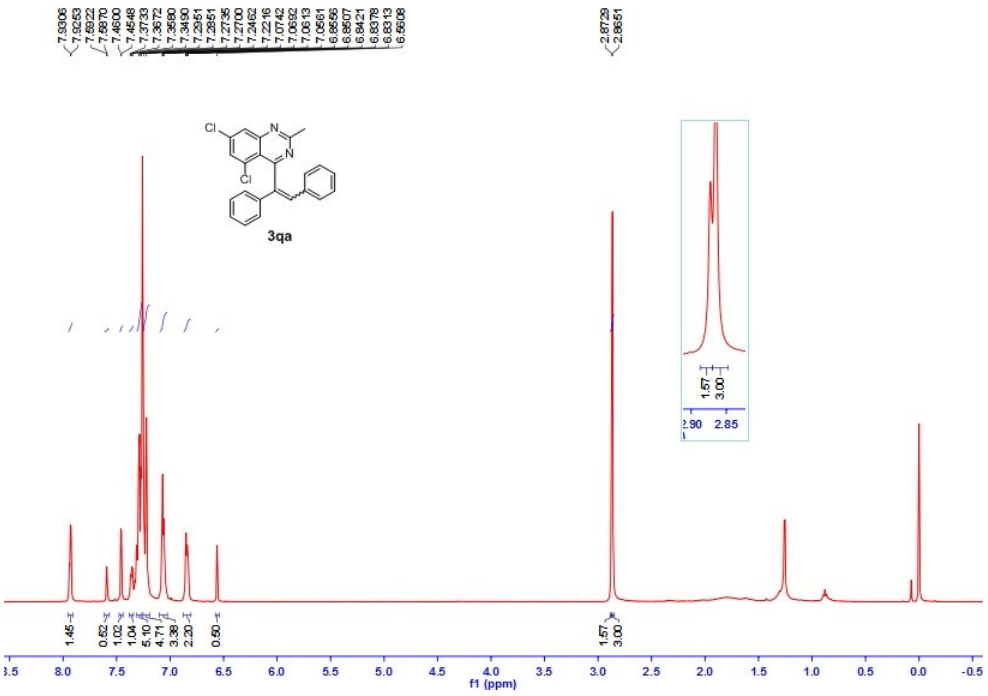
f1 (ppm)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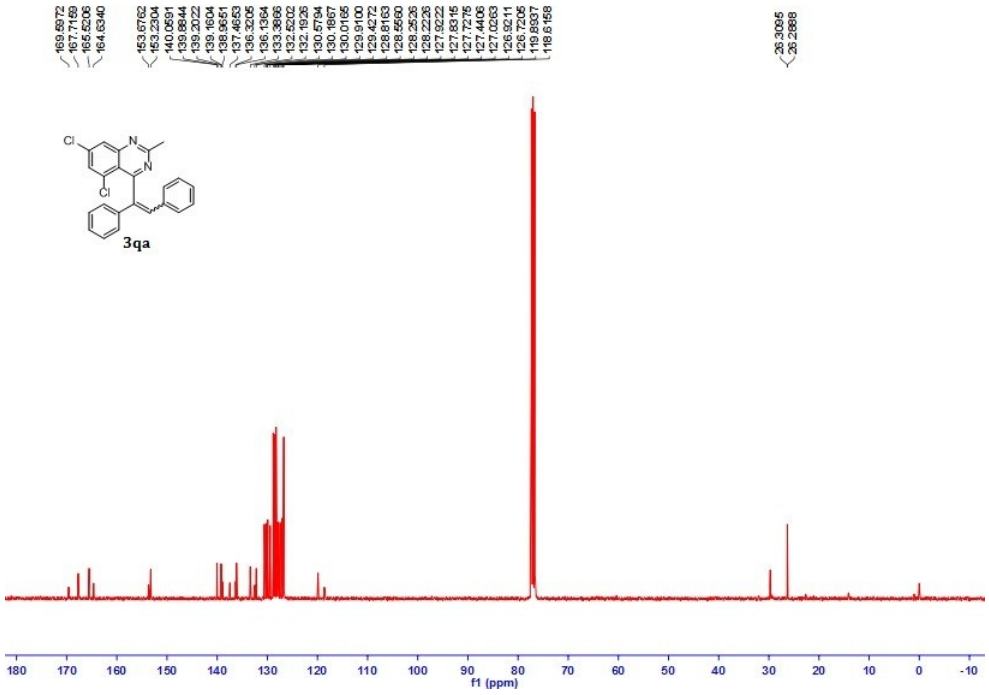
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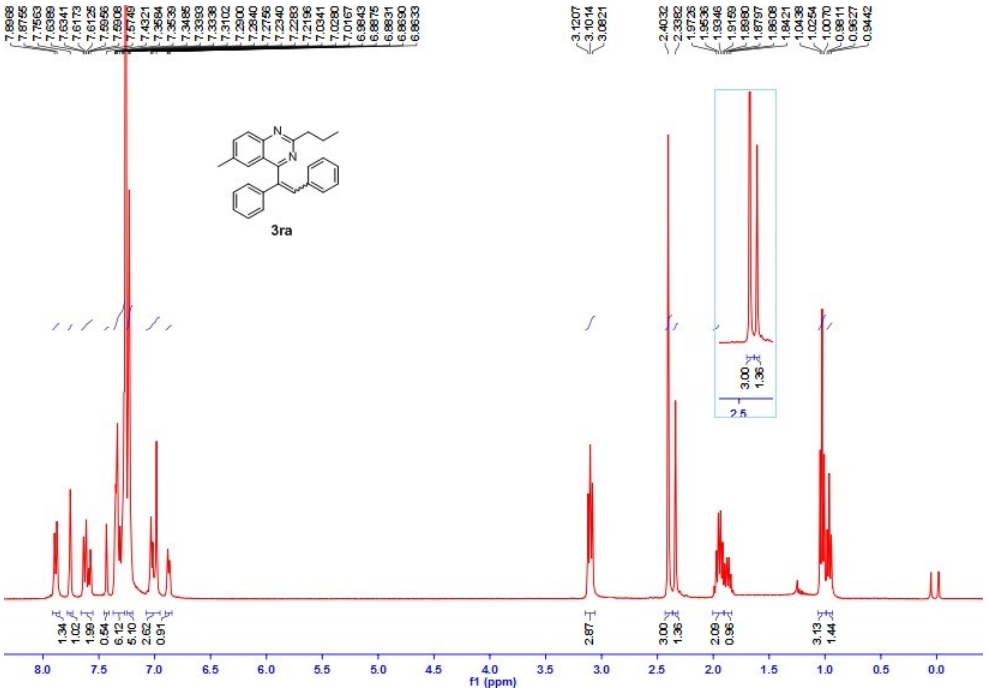
f1 (ppm)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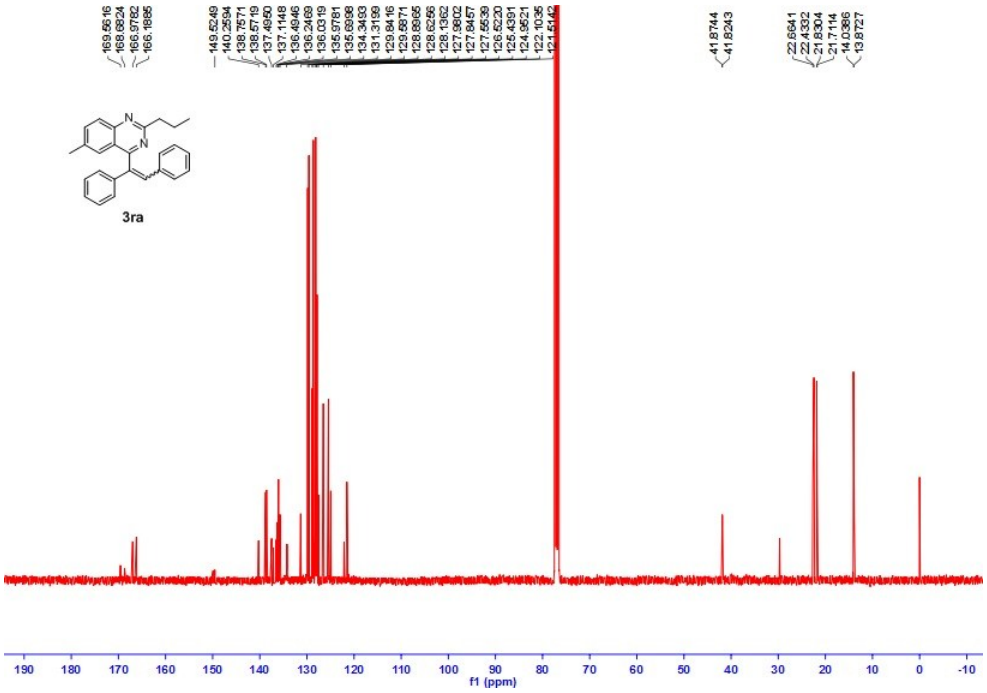
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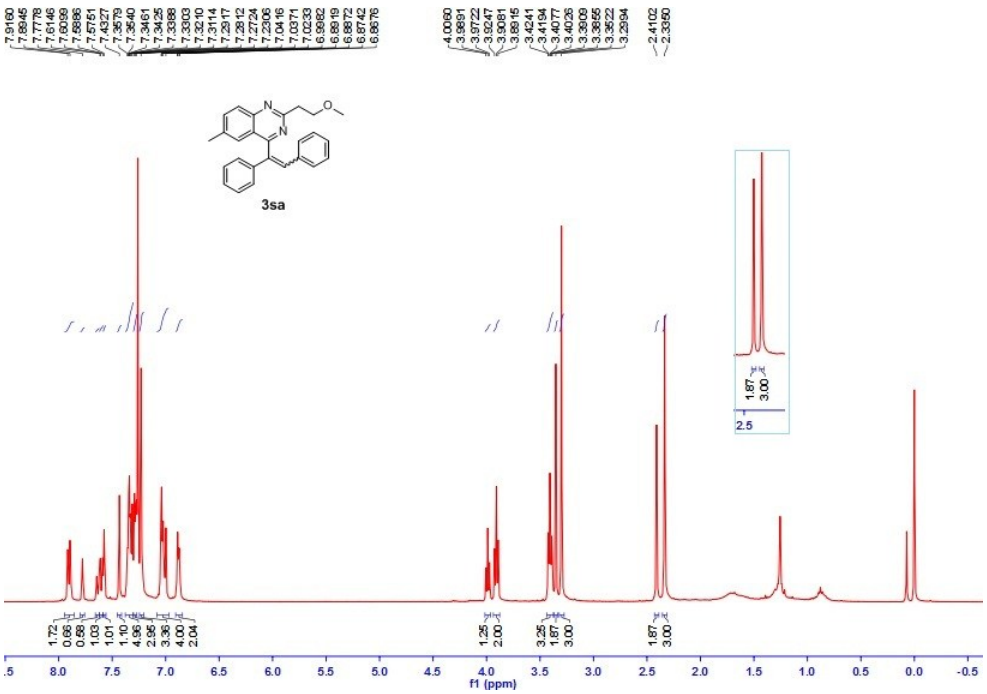
f1 (ppm)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2.04
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2.00
3.25
1.87
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1.87
3.00
2.5
.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
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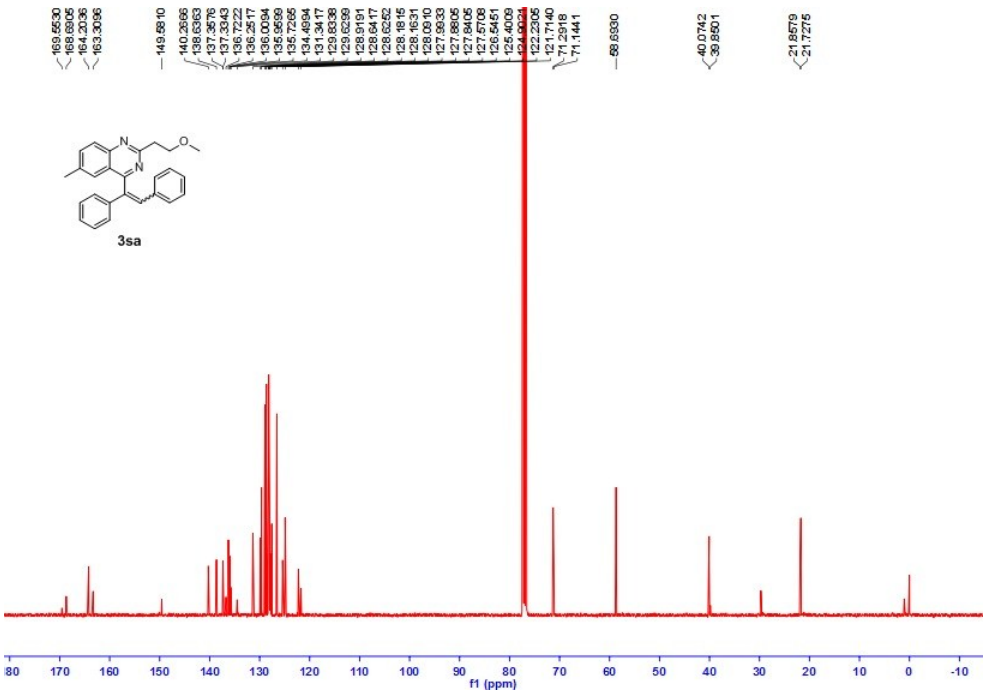
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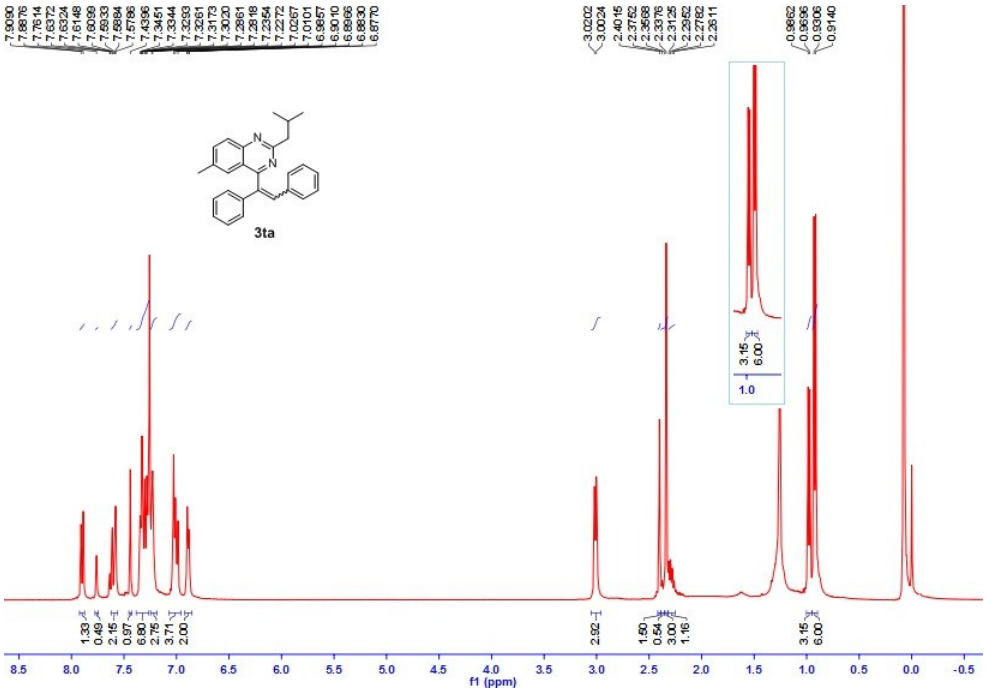
f1 (ppm)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6.9910
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3.0024
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2.3376
2.3125
2.2962
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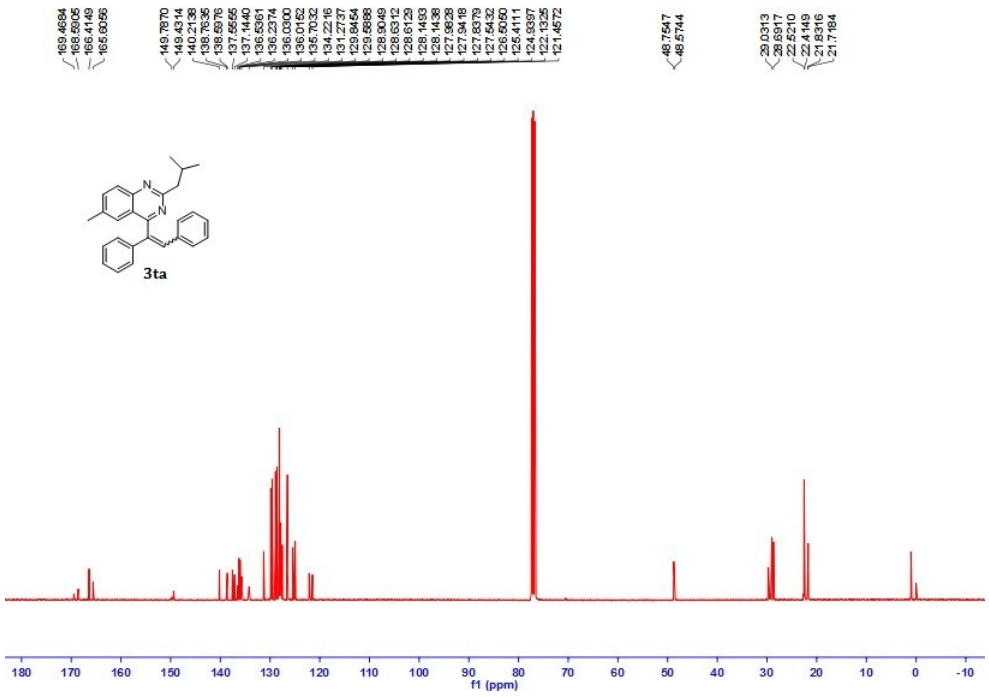
f1 (ppm)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124.9397
123.1325
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48.5744
29.0313
28.6917
22.5210
22.4149
21.8316
21.7184
3ta
180
170
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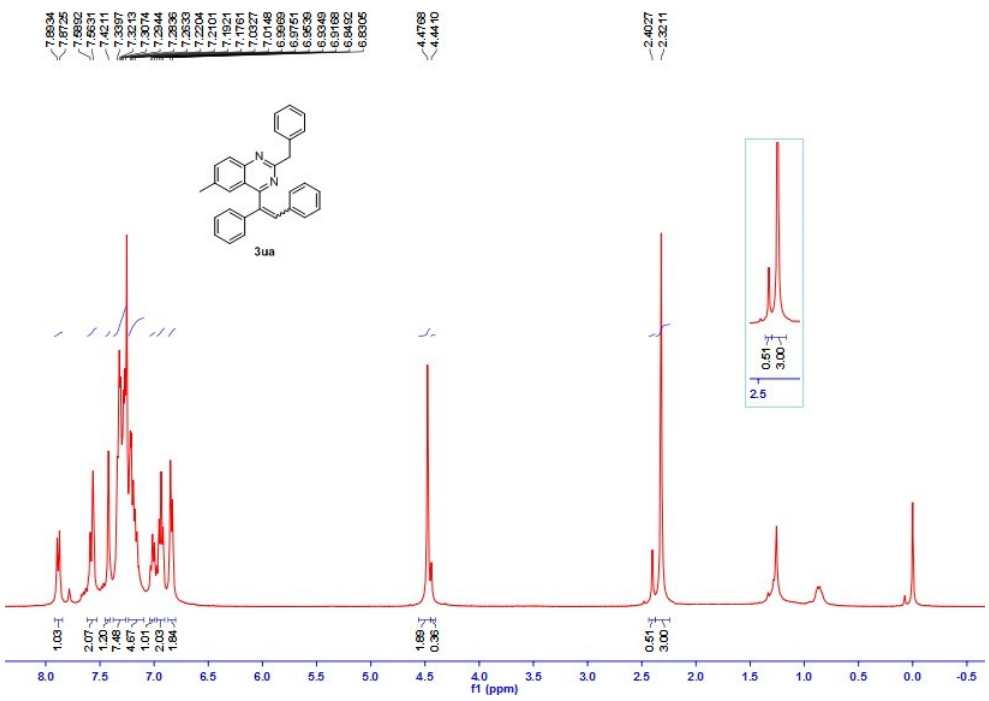
f1 (ppm)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7.2204
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7.1921
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7.0327
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6.9969
6.9751
6.9639
6.9349
6.9168
6.9032
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4.4768
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2.3211
3ua
1.03
2.07
1.20
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1.01
2.03
1.84
1.89
0.36
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3.00
0.51
3.00
2.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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2.0
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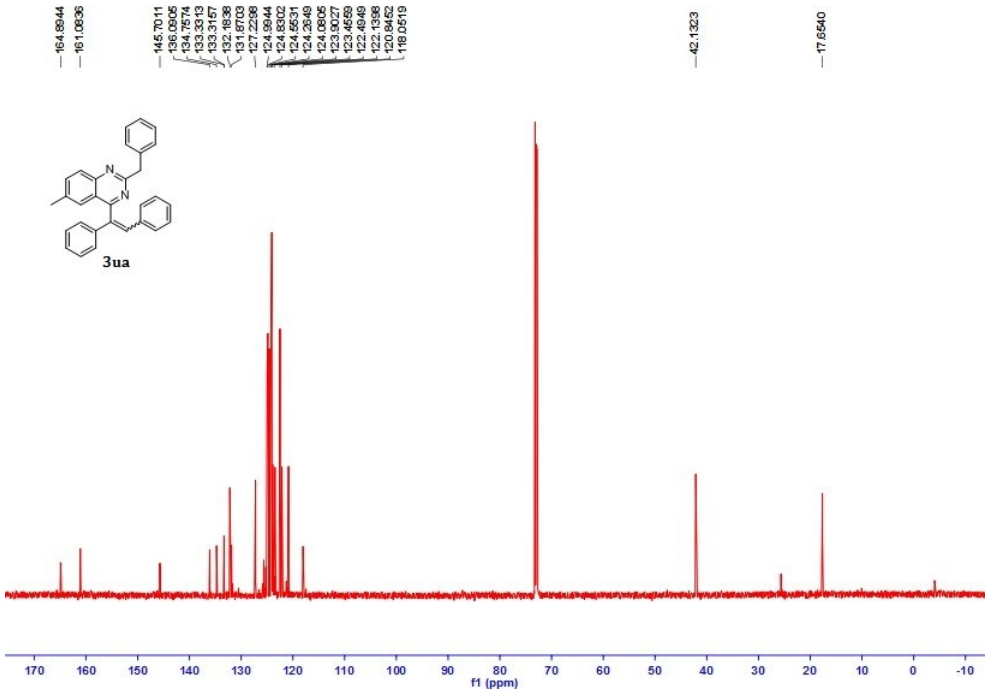
f1 (ppm)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123.4456
122.4949
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119.0519
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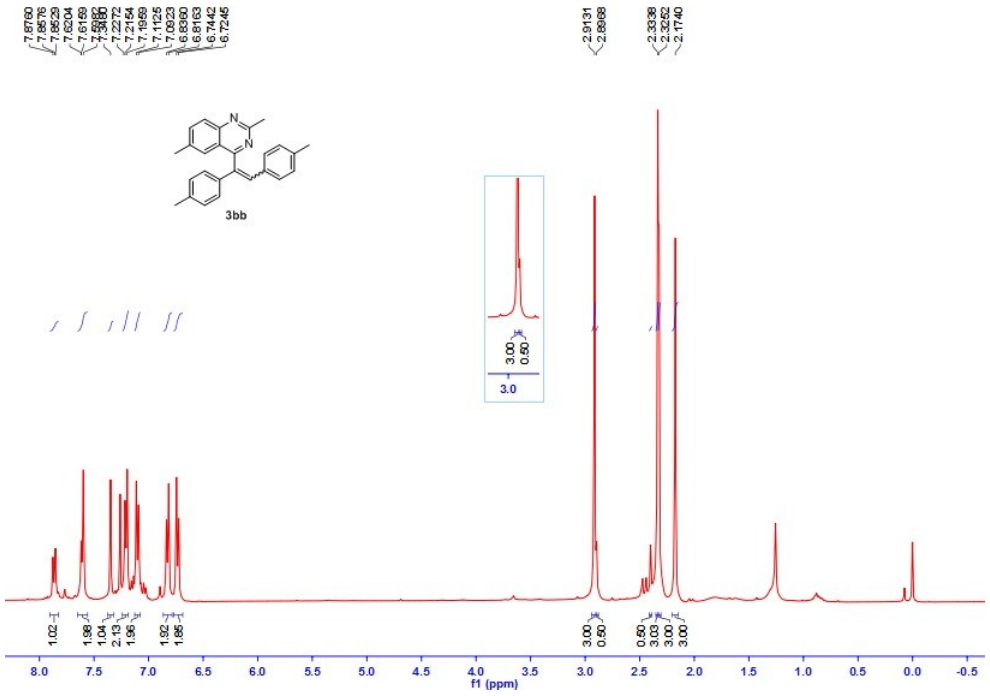
3ua
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.2154
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7.1125
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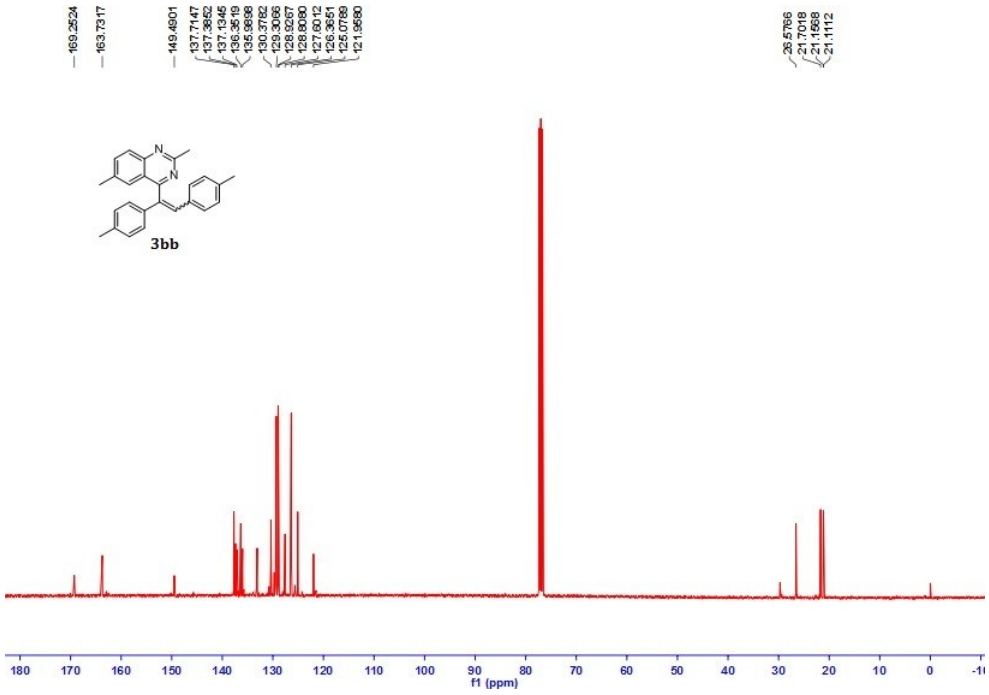
6.8163
6.7442
6.7245
2.9131
2.8898
2.3338
2.3252
2.1740
3bb
3.00
0.50
3.0
1.02
1.98
1.04
2.13
1.96
1.92
1.85
3.00
0.50
0.50
3.03
3.00
3.00
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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128.8080
127.6012
126.3651
125.0789
121.9580
26.5766
21.7018
21.1668
21.1112
3bb
180
170
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150
140
130
120
110
100
90
80
70
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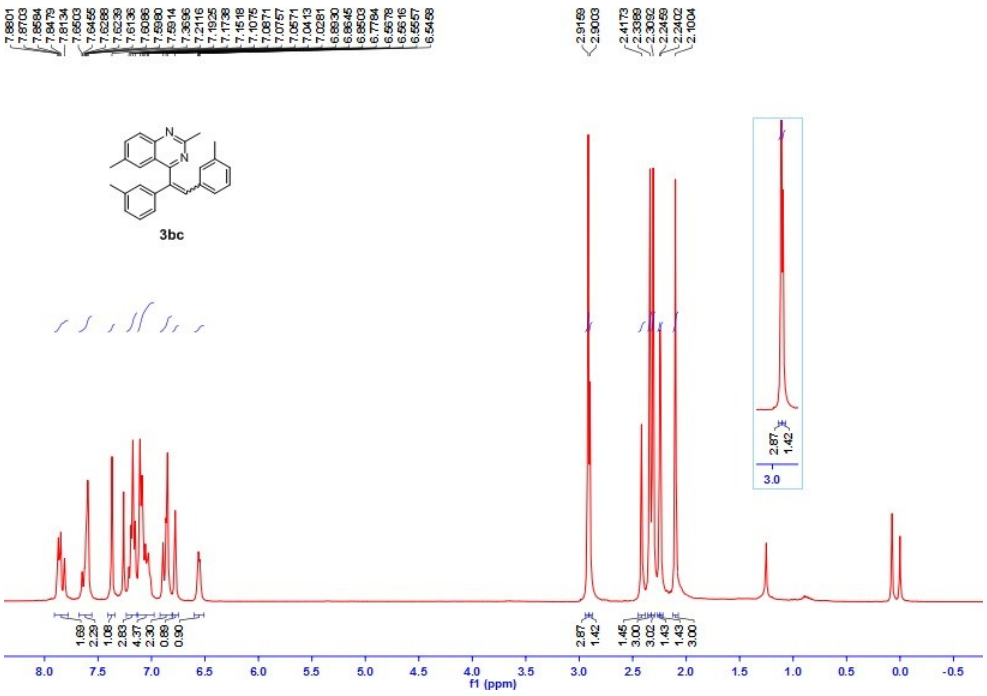
50
40
30
20
10
0
f1 (ppm)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7.5914
7.3696
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7.1935
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7.0413
7.0281
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6.8645
6.8503
6.7784
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6.5516
6.5557
6.5458
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2.4173
2.3389
2.3092
2.2469
2.2402
2.1004
3bc
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3.0
1.69
2.29
1.08
2.83
4.37
2.30
0.89
0.90
2.87
1.42
1.45
3.00
3.02
1.43
1.43
3.00
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7.0
6.5
6.0
5.5
5.0
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3.0
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2.0
1.5
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0.5
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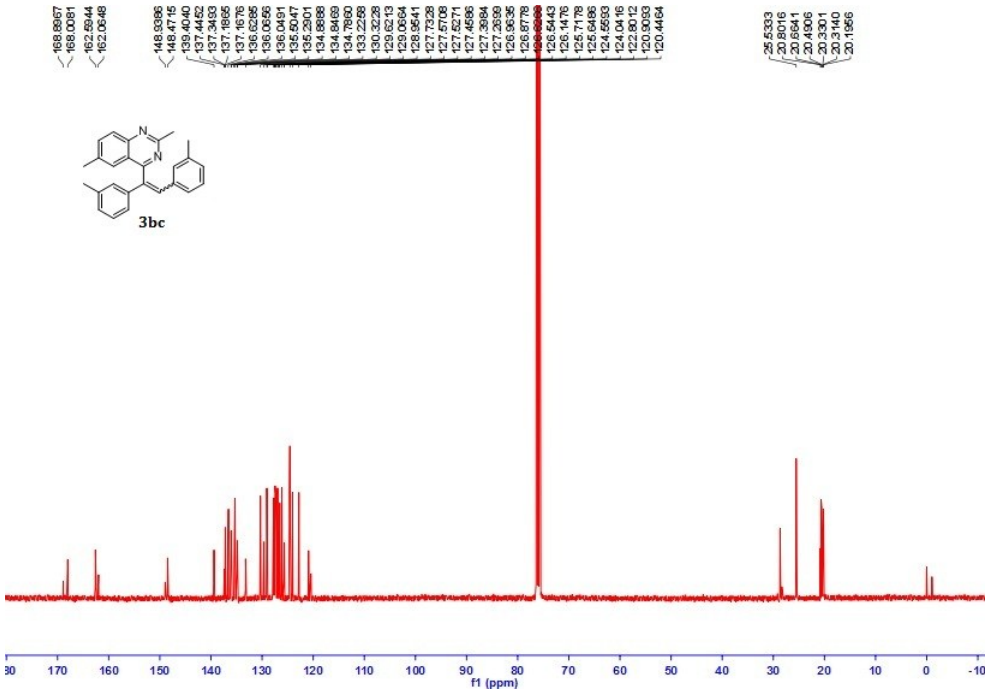
-0.5
f1 (ppm)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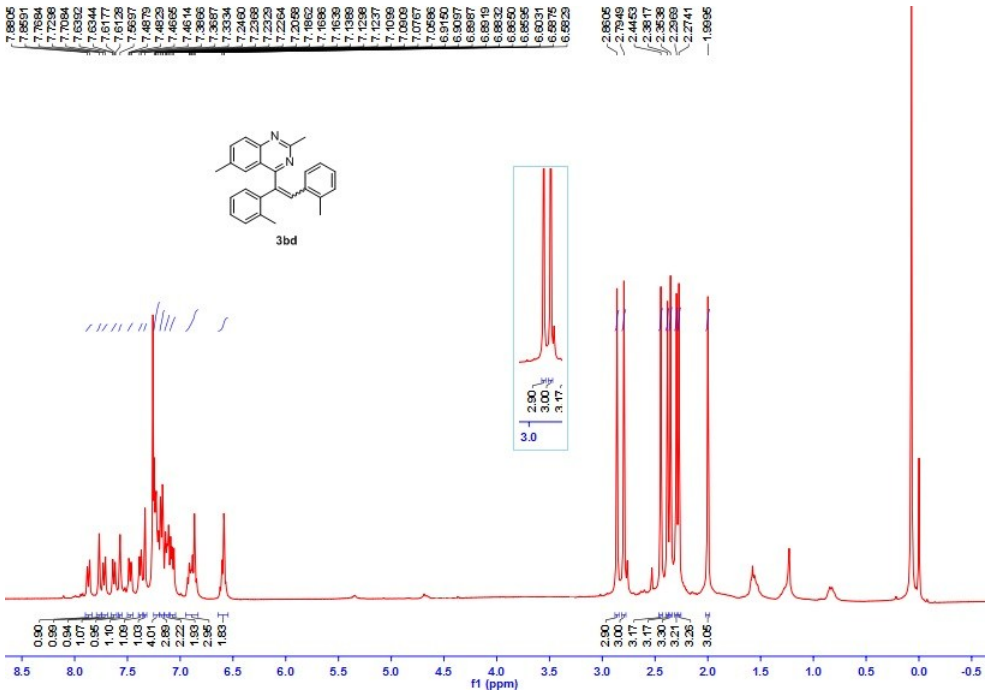
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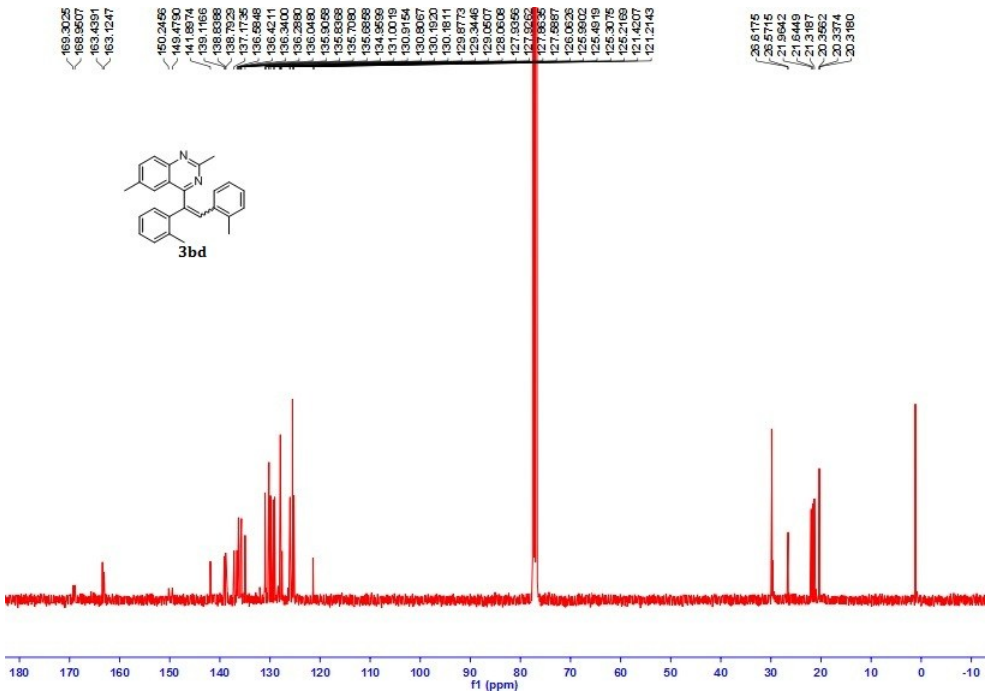
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125.4819
125.3075
125.2169
121.4207
121.2143
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26.5715
21.9642
21.6449
21.3197
20.3562
20.3374
20.3180
3bd
180
170
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140
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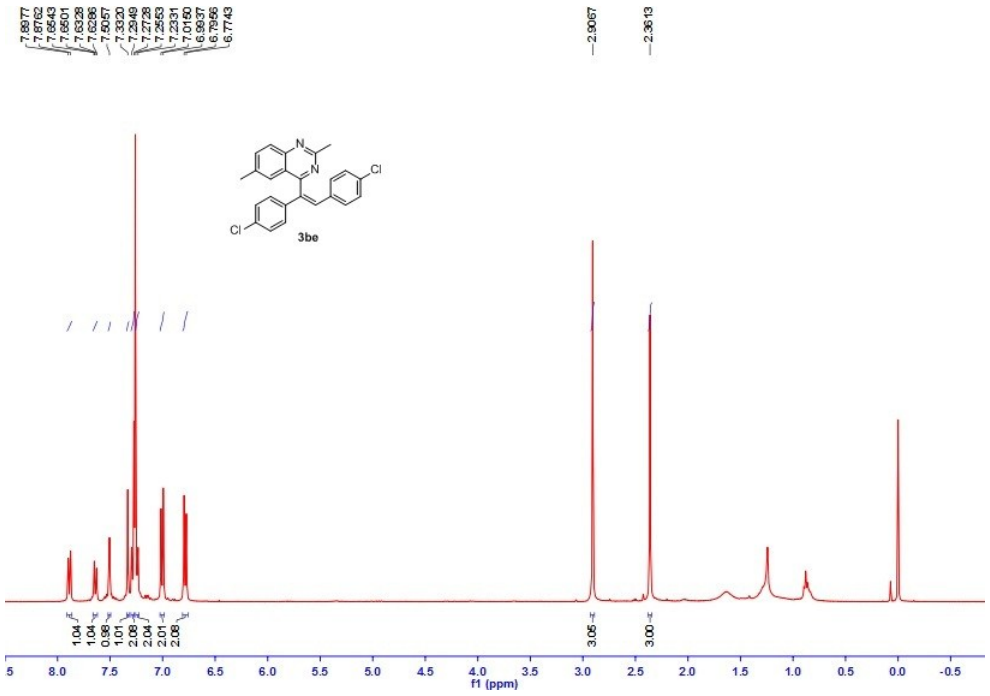
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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7.2553
7.2331
7.0160
6.9937
6.7956
6.7743
2.9067
2.3613
Cl
Cl
3be
1.04
1.04
0.98
1.01
2.08
2.04
2.01
2.08
3.05
3.00
5
8.0
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7.0
6.5
6.0
5.5
5.0
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3.0
2.5
2.0
1.5
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0.5
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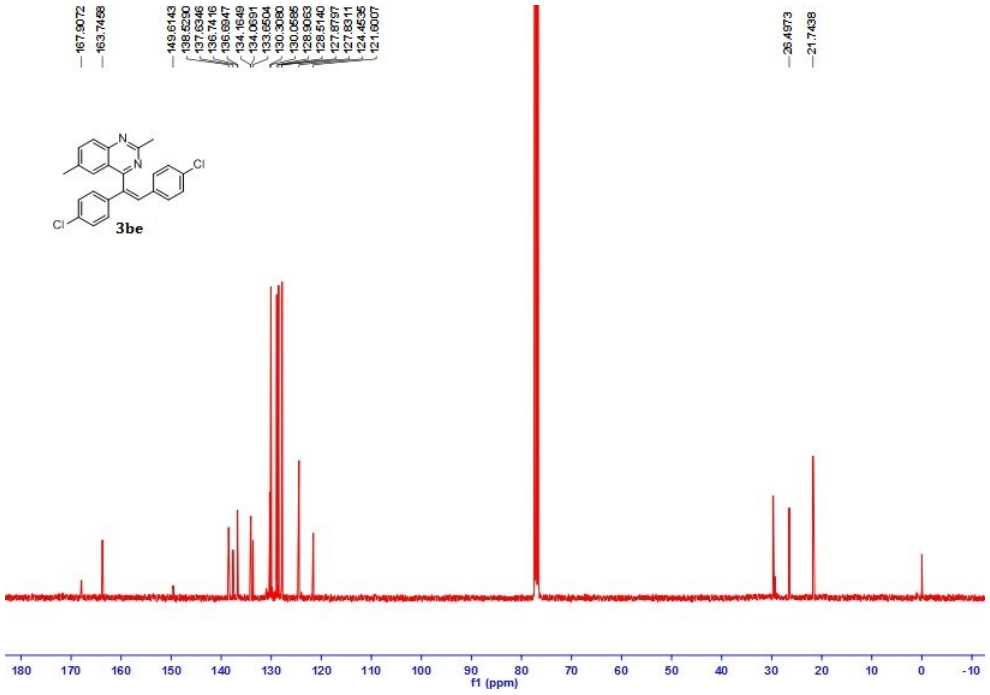
-0.5
f1 (ppm)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130.0885
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128.5140
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127.8311
124.4535
121.6007
26.4973
21.7438
N
N
Cl
Cl
3be
180
170
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140
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120
110
100
90
80
70
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40
30
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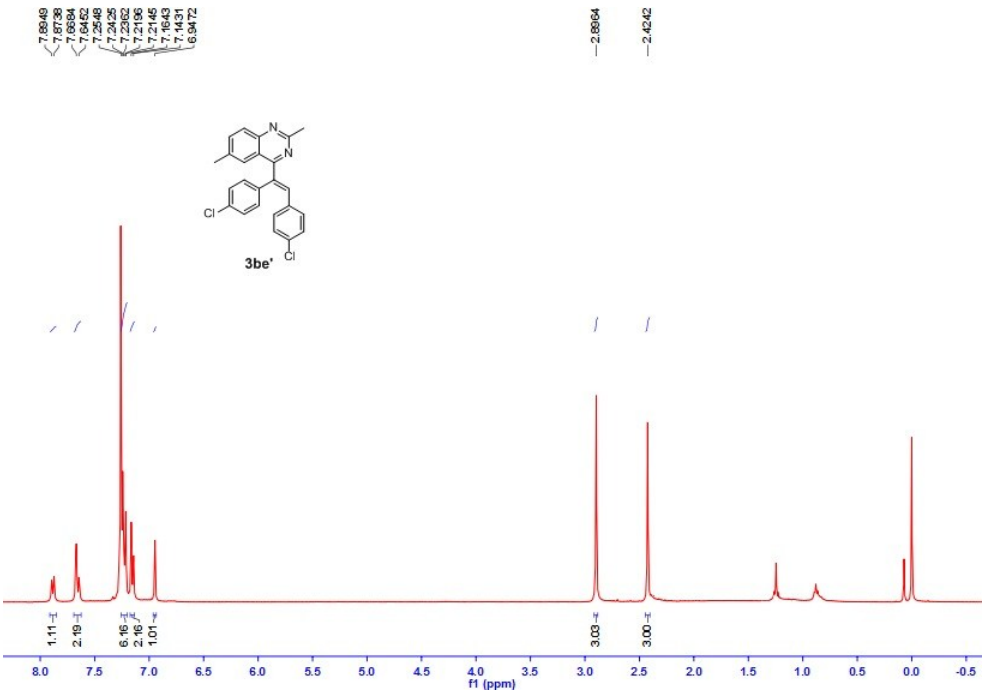
-10
f1 (ppm)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6.9472
2.8864
2.4242
N
N
Cl
Cl
3be'
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2.19
6.16
2.16
1.01
3.03
3.00
8.0
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7.0
6.5
6.0
5.5
5.0
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3.0
2.5
2.0
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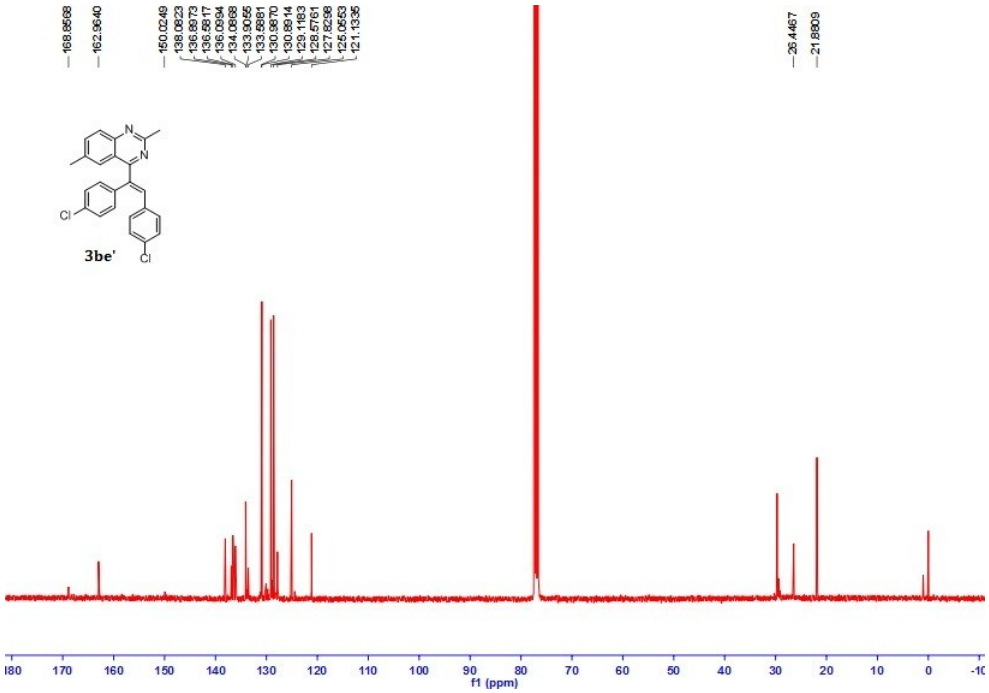
0.5
0.0
-0.5
f1 (ppm)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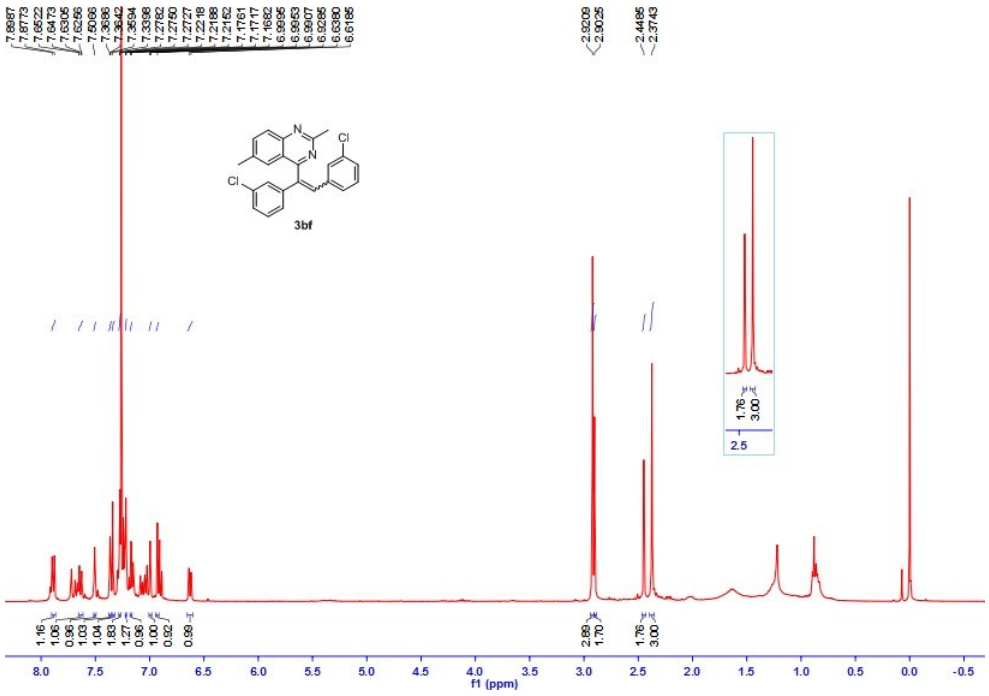
127.8298
125.0553
121.1335
26.4467
21.8809
3be'
f1 (ppm)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7.2782
7.2750
7.2727
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7.2188
7.2162
7.1761
7.1717
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1.06
0.96
1.03
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0.96
1.00
0.92
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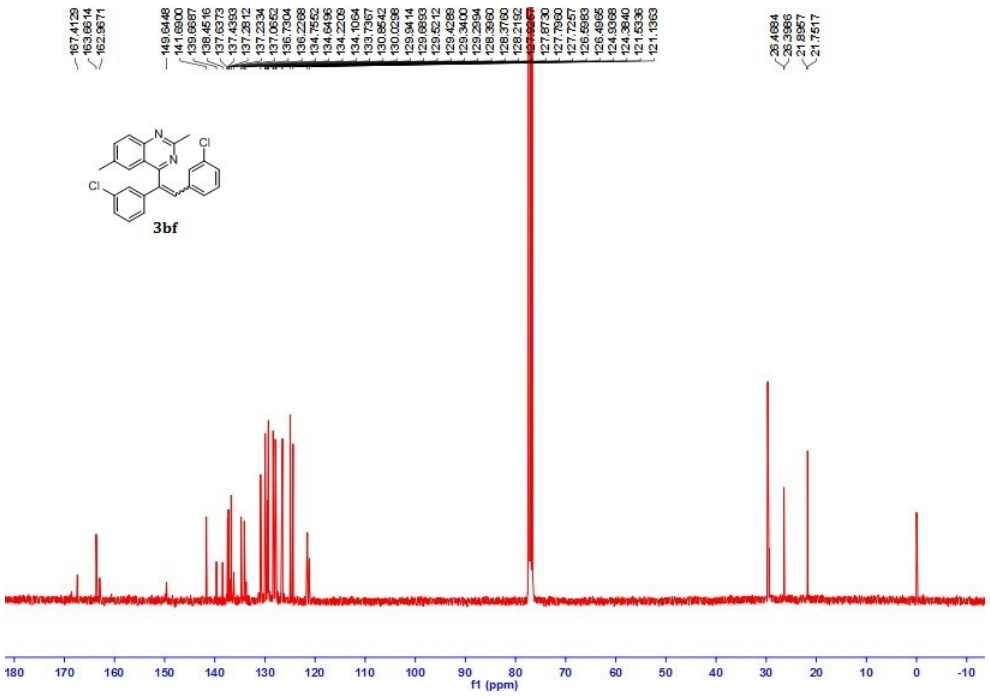
1.76
3.00
f1 (ppm)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3bf
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


7.8940
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7.6230
7.5389
7.3135
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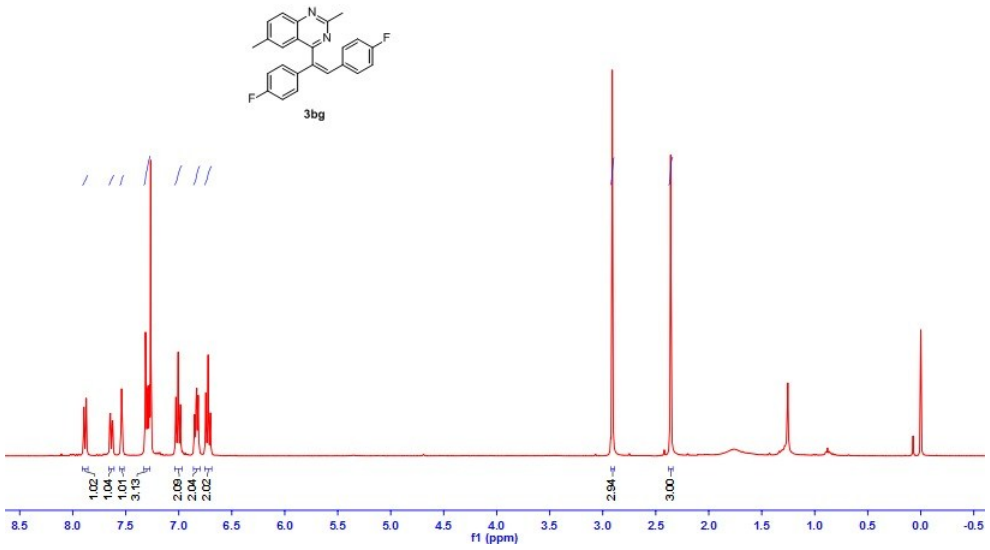
2.9101
2.3693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2.02
2.94
3.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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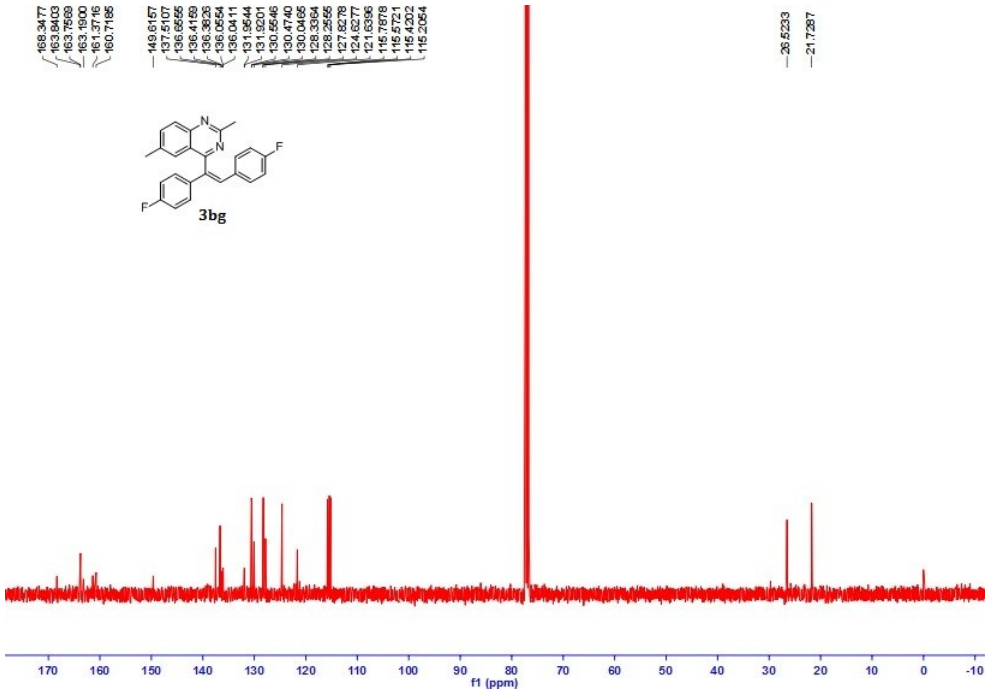
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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124.6277
121.6396
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116.5721
116.4202
116.2054
26.5233
21.7397
3bg
170
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140
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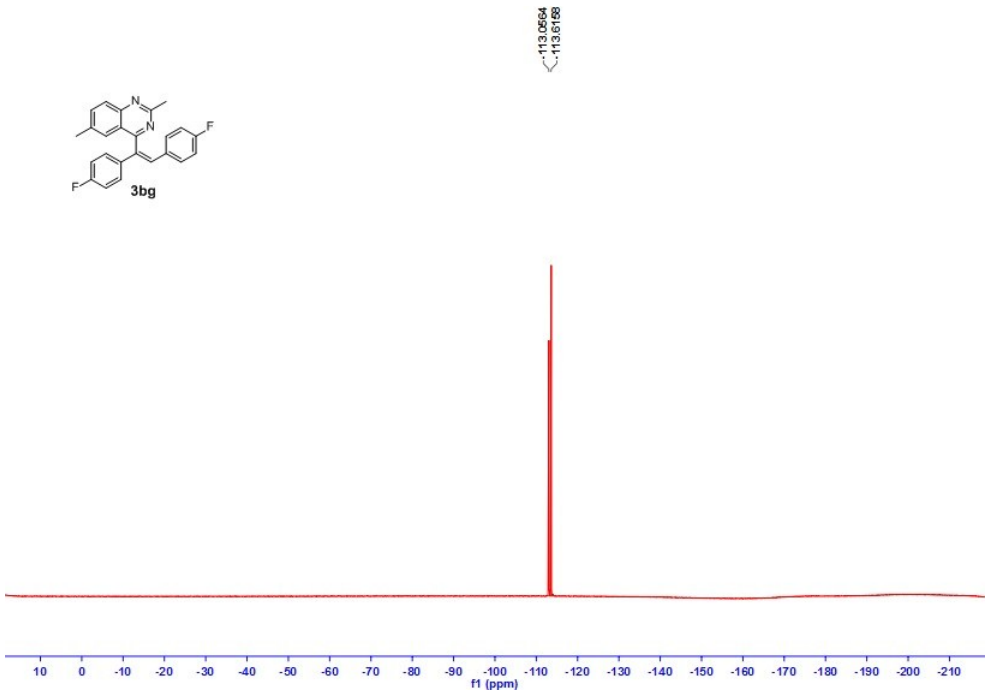
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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-113.6168
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10
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-10
-20
-30
-40
-50
-60
-70
-80
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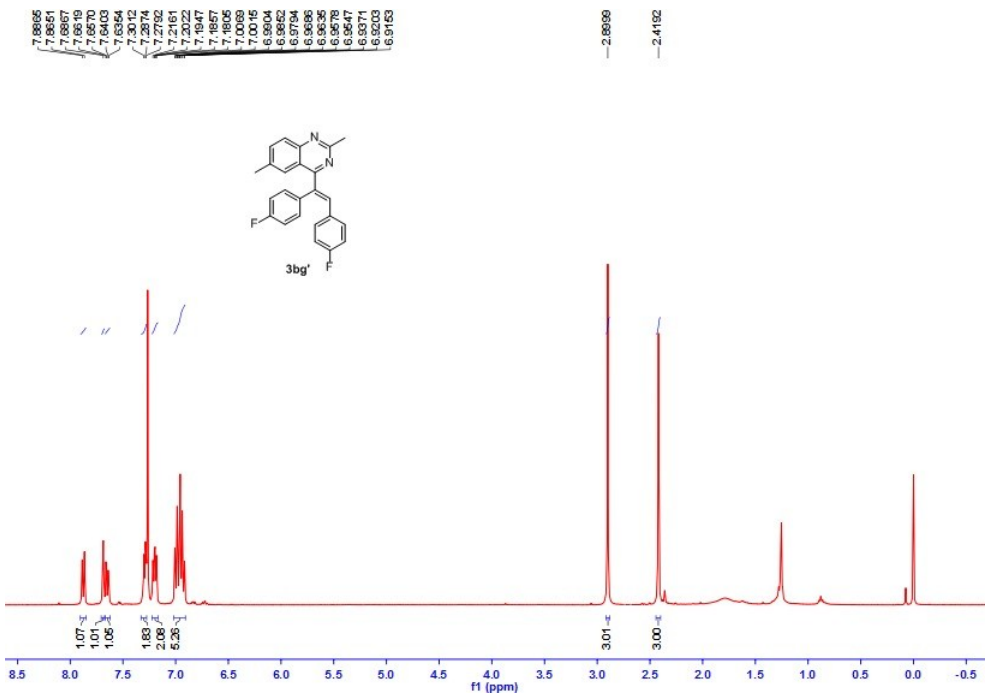
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)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7.2022
7.1947
7.1857
7.1805
7.0069
7.0015
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6.9686
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6.9579
6.9547
6.9371
6.9203
6.9153
2.8999
2.4192
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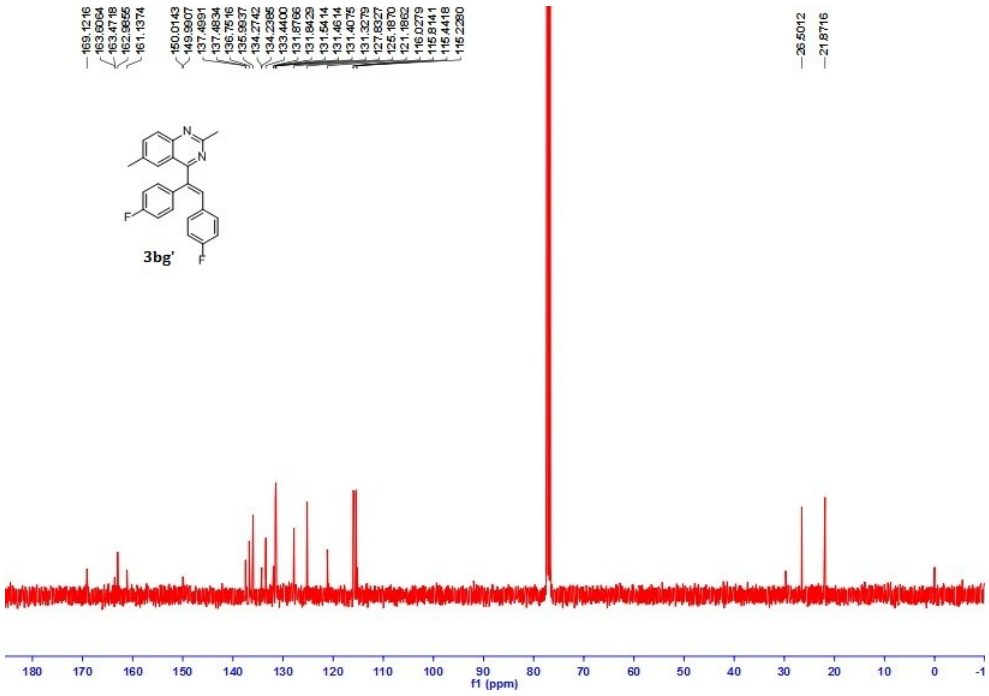
1.01
1.06
1.83
2.08
5.26
3.01
3.00
f1 (ppm)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131.4075
131.3279
127.8827
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121.0273
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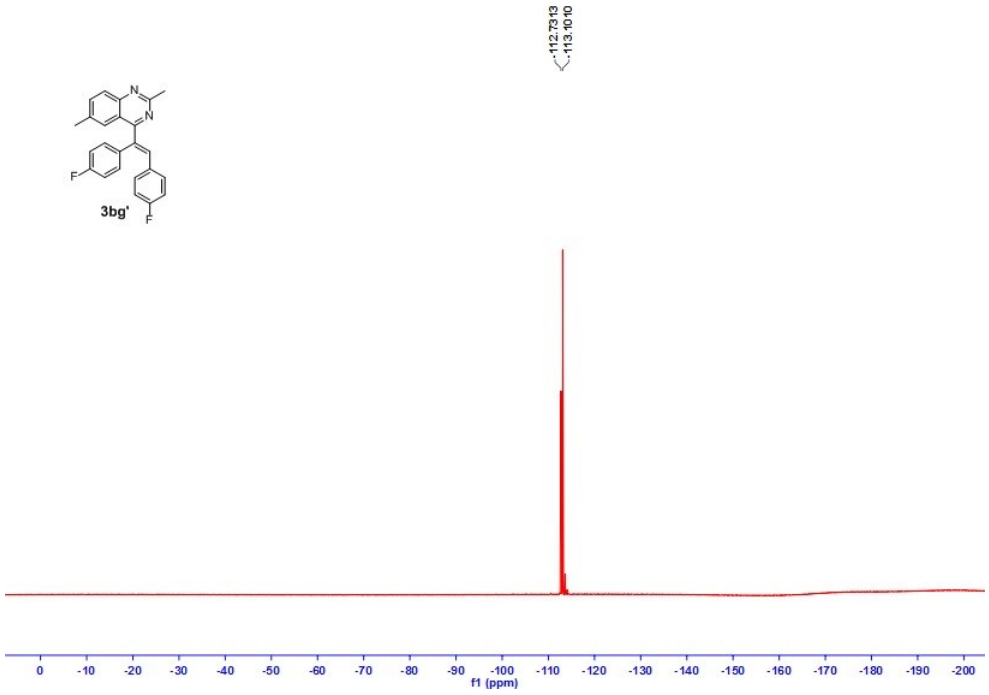
115.4418
115.2280
26.5012
21.8716
3bg'
f1 (ppm)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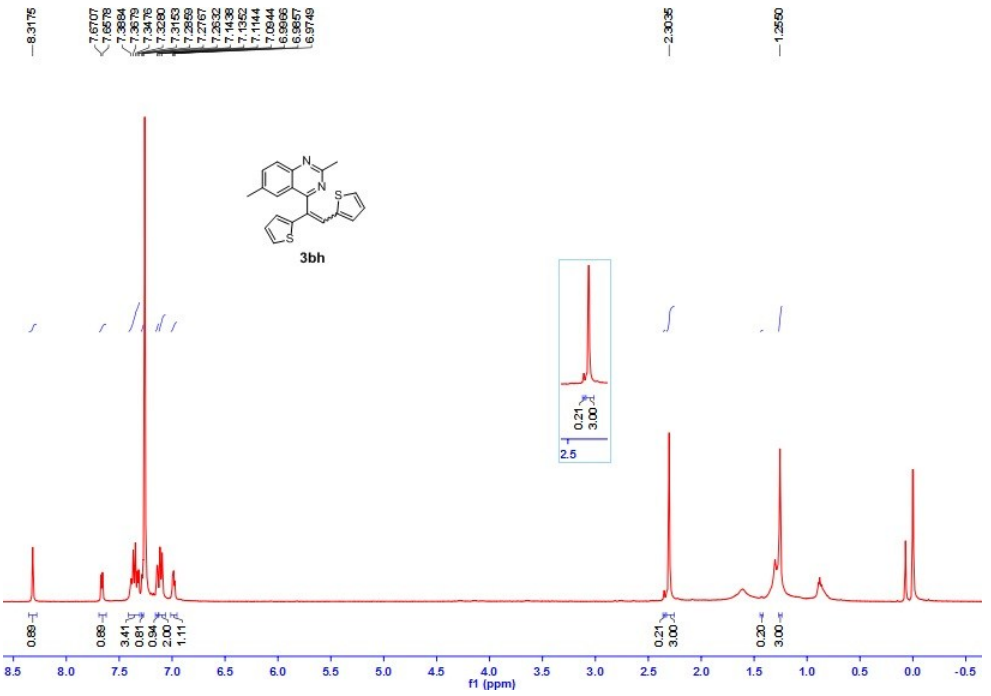
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7.1438
7.1352
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6.9749
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0.89
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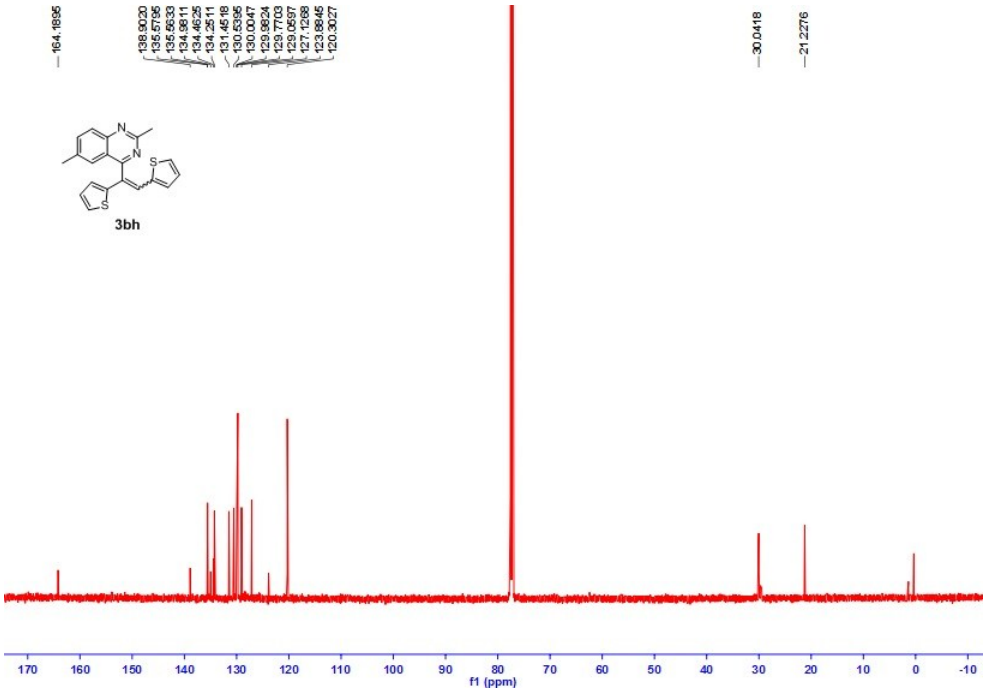
0.81
0.94
2.00
1.11
0.21
3.00
0.20
3.00
f1 (ppm)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129.0597
127.1268
123.8845
120.3027
30.0418
21.2276
3bh
170
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140
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120
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100
90
80
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60
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40
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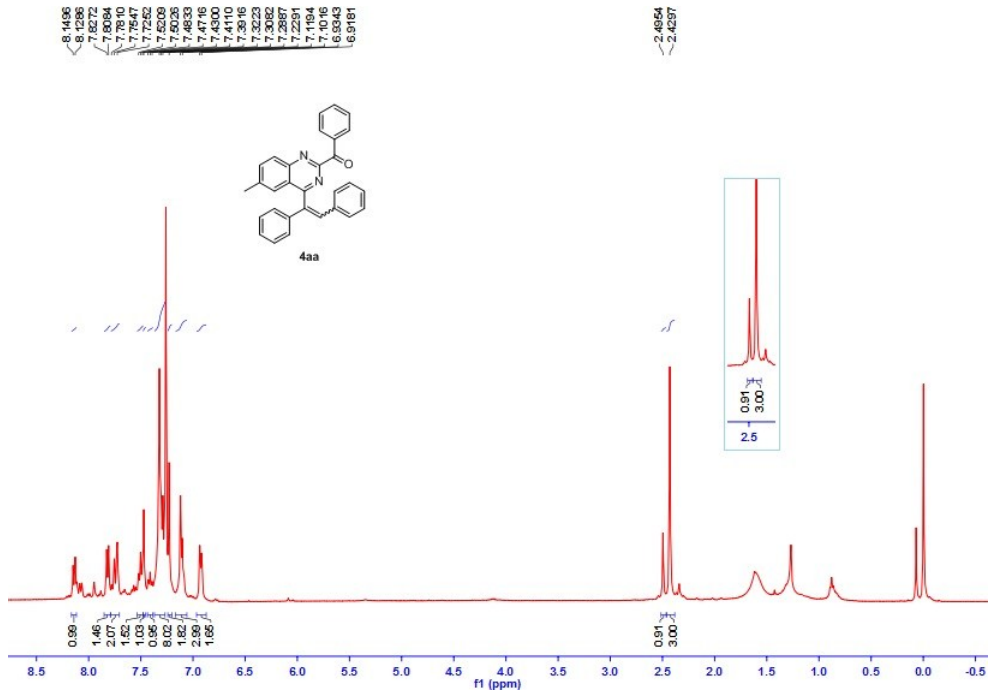
f1 (ppm)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7.4300
7.4110
7.3916
7.3223
7.3062
7.2897
7.2291
7.1194
7.1016
6.9343
6.9181
2.4954
2.4297
4aa
0.91
3.00
2.5
0.99
1.46
2.07
1.52
1.03
0.95
8.02
1.82
2.99
1.65
0.91
3.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
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3.0
2.5
2.0
1.5
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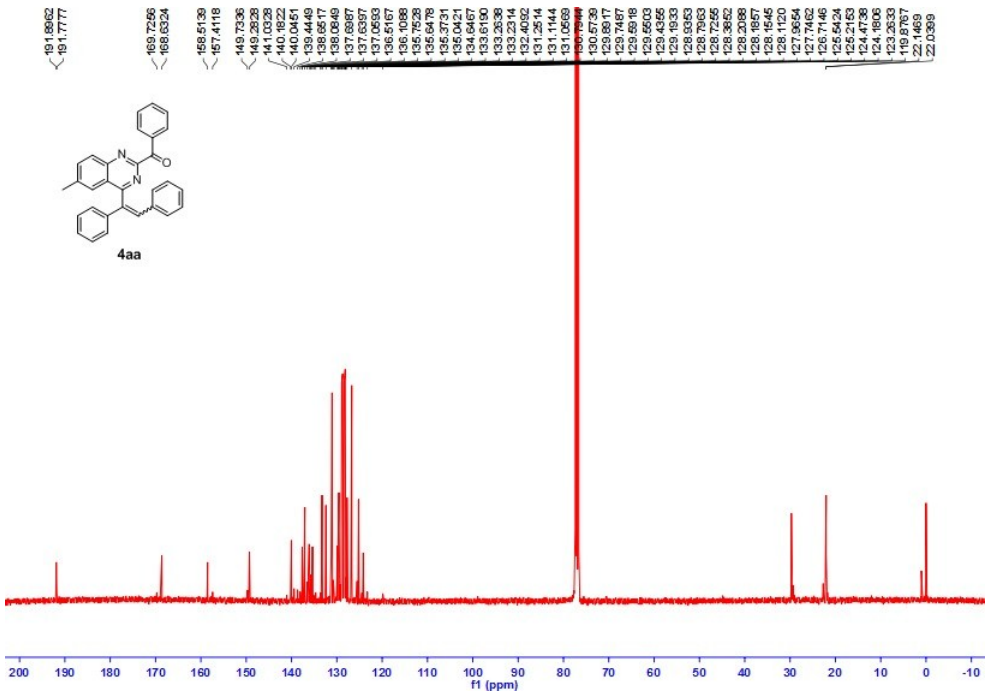
0.5
0.0
-0.5
f1 (ppm)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4aa
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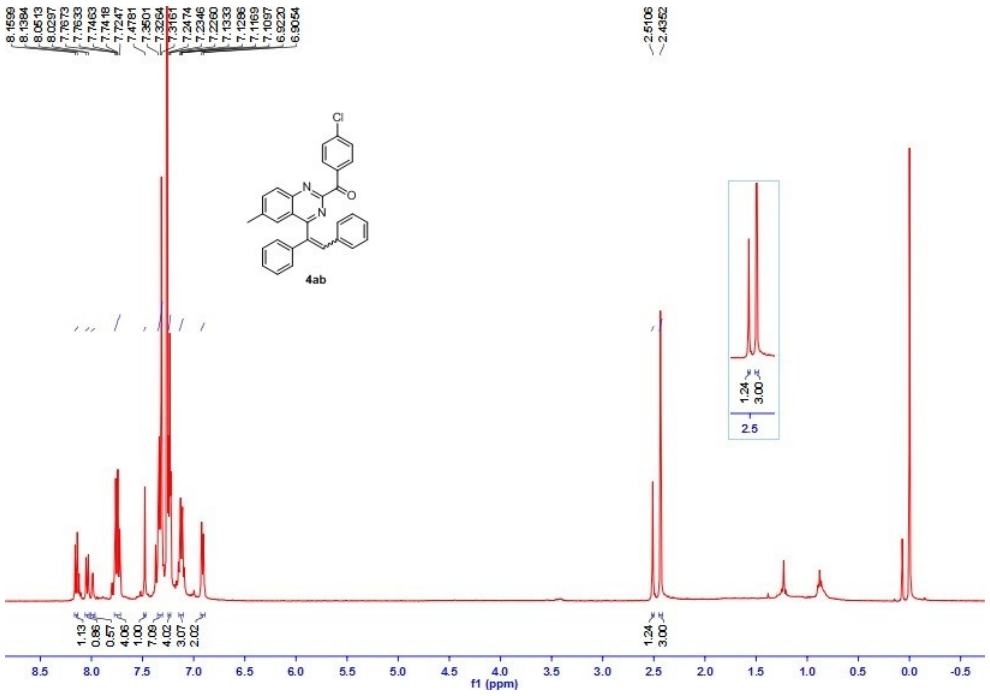
f1 (ppm)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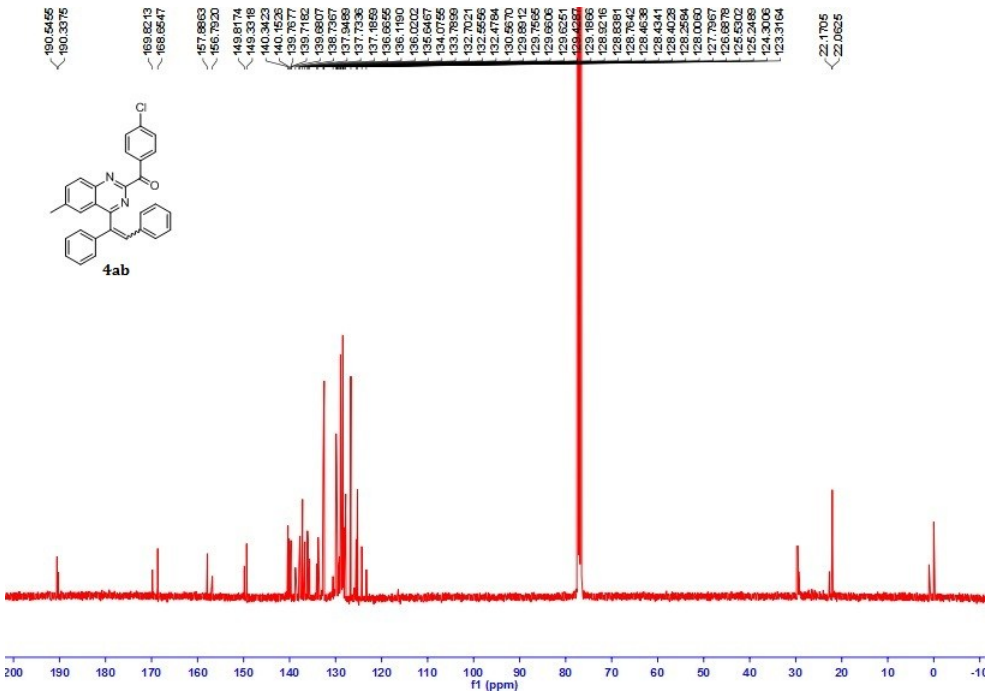
7.3264
7.3161
7.2474
7.2346
7.2260
7.1333
7.1286
7.1169
7.1097
6.9220
6.9054
2.5106
2.4352
Cl
4ab
1.24
3.00
2.5
1.13
0.96
0.57
4.65
1.00
7.09
4.02
3.07
2.02
1.24
3.00
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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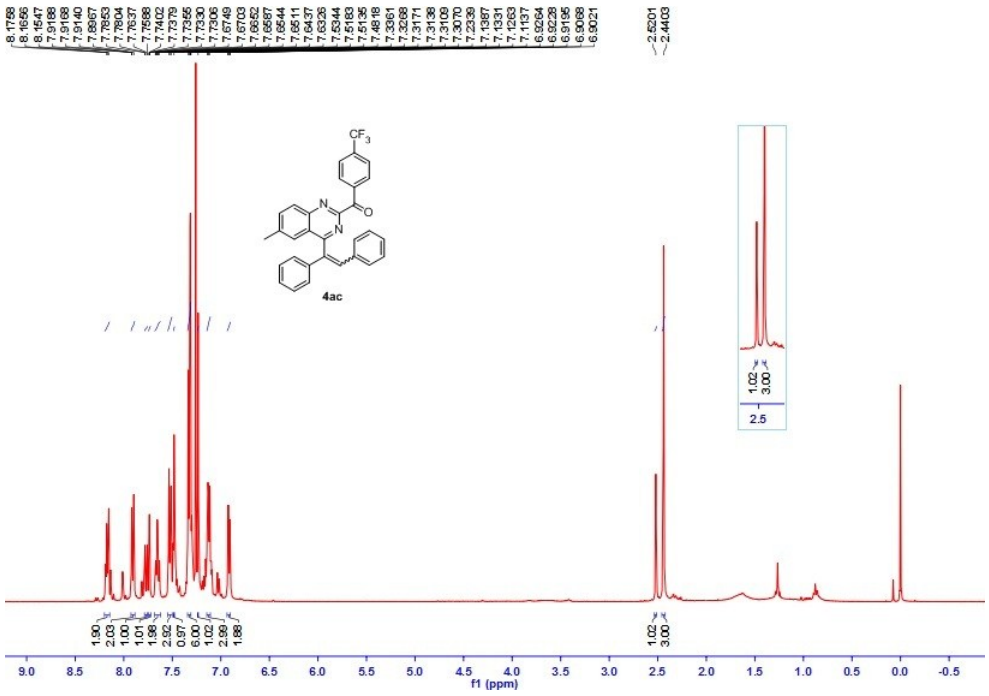
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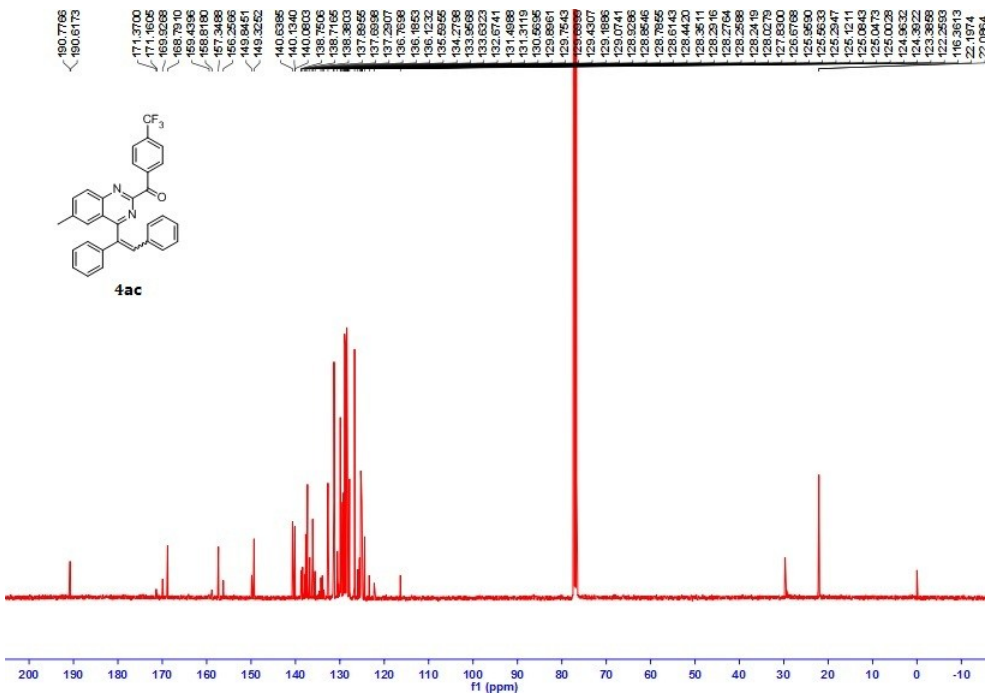
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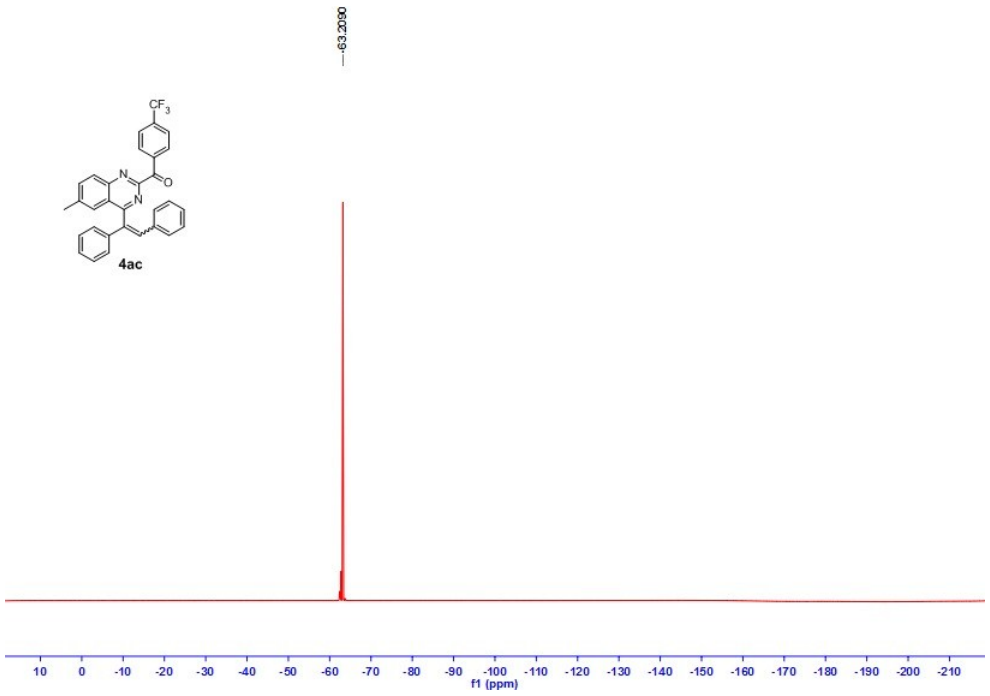
f1 (ppm)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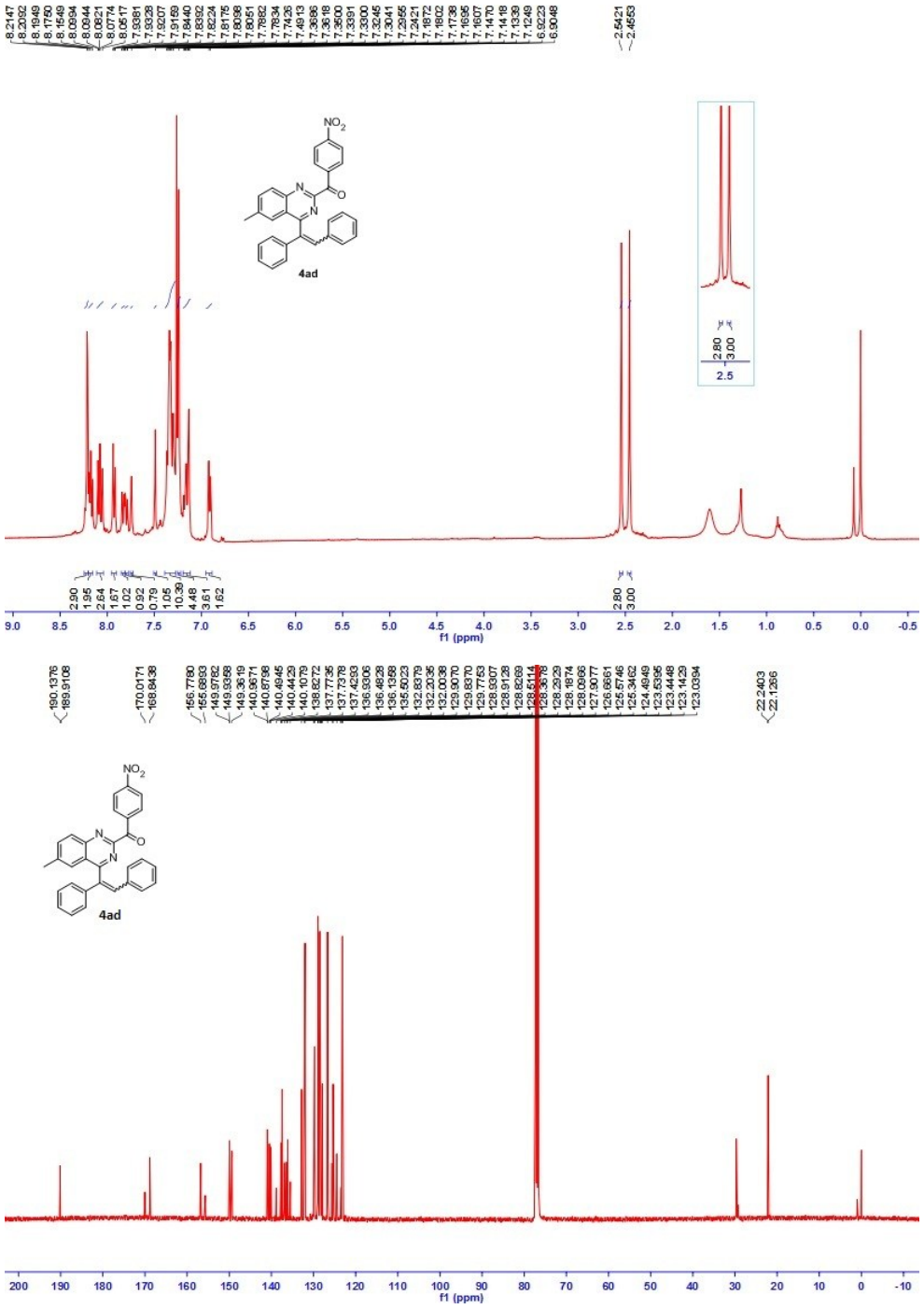
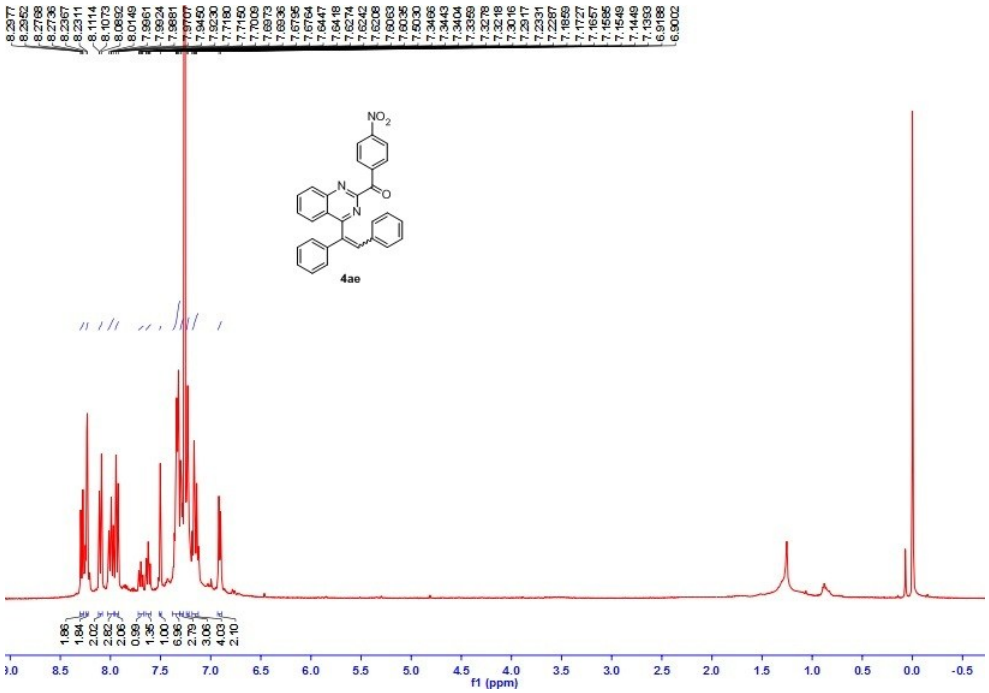

4ad
f1 (ppm)
4ad
f1 (ppm)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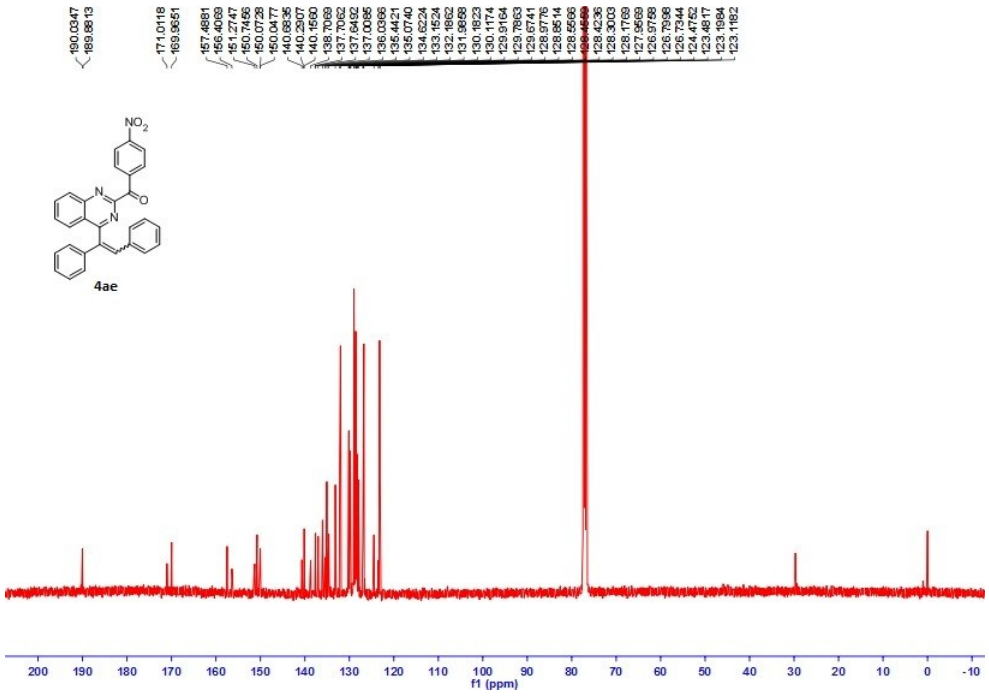
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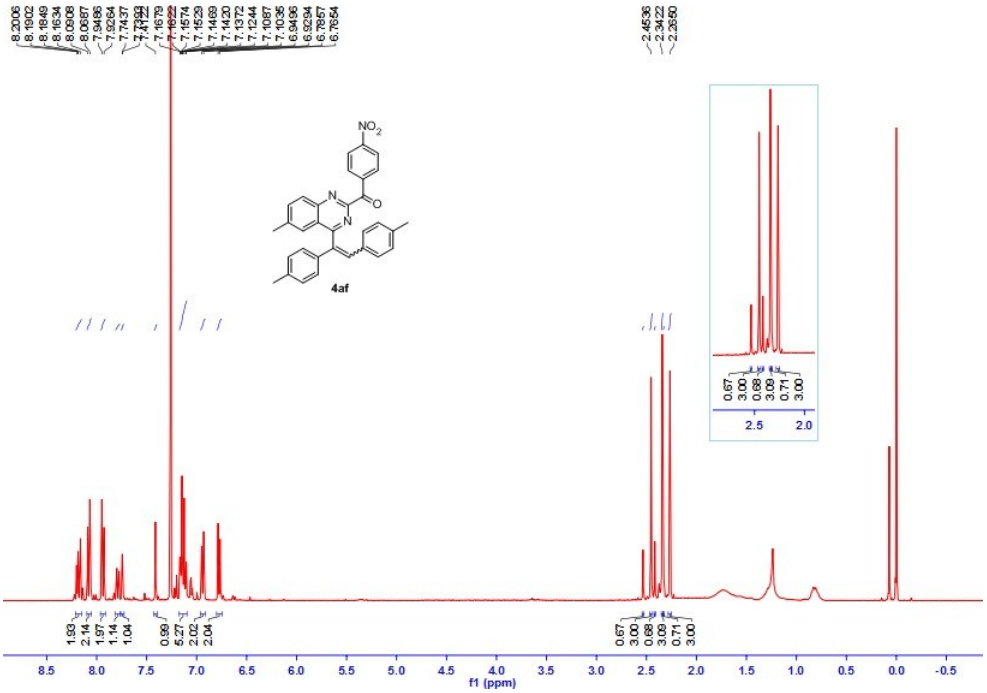
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7.7211
7.1679
7.1622
7.1574
7.1529
7.1469
7.1420
7.1372
7.1244
7.1087
7.1035
6.9496
6.9294
6.7857
6.7654
2.4536
2.3422
2.2650
NO2
N
O
N
4af
1.93
2.14
1.97
1.14
1.04
0.98
5.27
2.02
2.04
0.67
3.00
0.88
3.09
0.71
3.00
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8.0
7.5
7.0
6.5
6.0
5.5
5.0
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3.0
2.5
2.0
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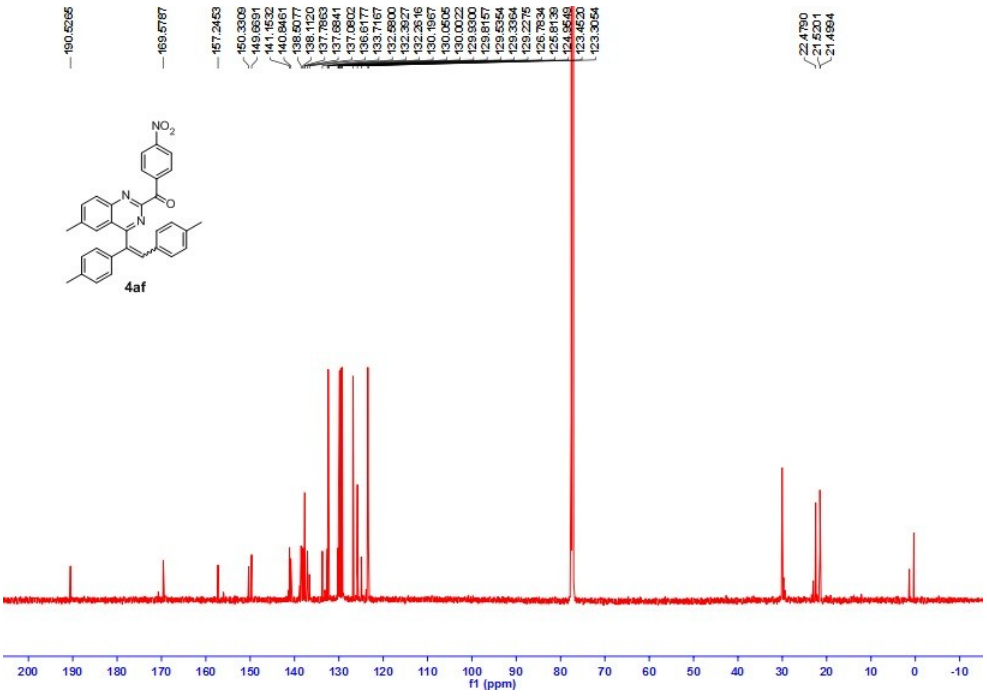
-0.5
f1 (ppm)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133.7167
132.6800
132.3927
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130.1957
130.0606
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129.8157
129.5354
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125.8139
124.9549
123.4530
123.3054
22.4790
21.5201
21.4994
NO2
N
O
N
4af
200
190
180
170
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100
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80
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40
30
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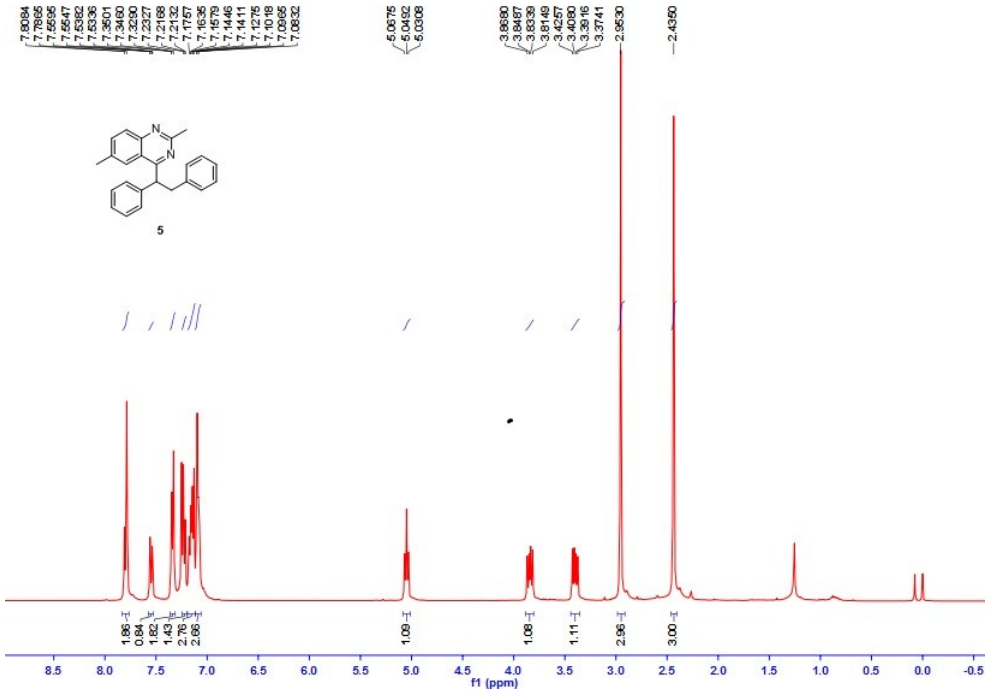
f1 (ppm)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7.1757
7.1635
7.1579
7.1446
7.1411
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5.0675
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5.0308
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3.8339
3.8149
3.4257
3.4080
3.3916
3.3741
2.9530
2.4360
5
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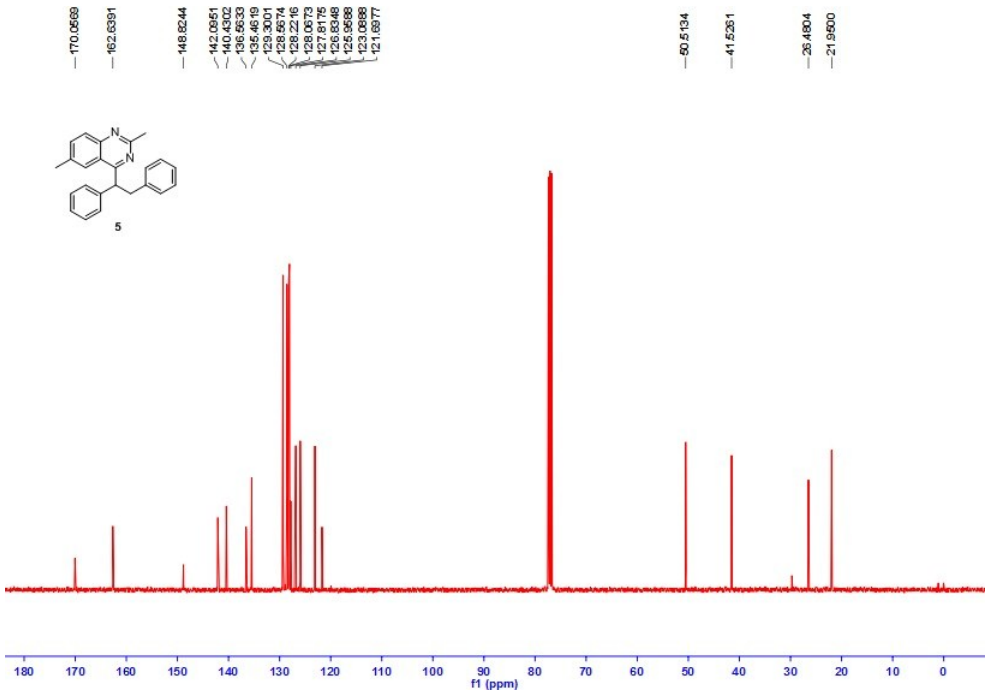
1.43
2.78
2.69
1.09
1.08
1.11
2.96
3.00
f1 (ppm)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26.4804
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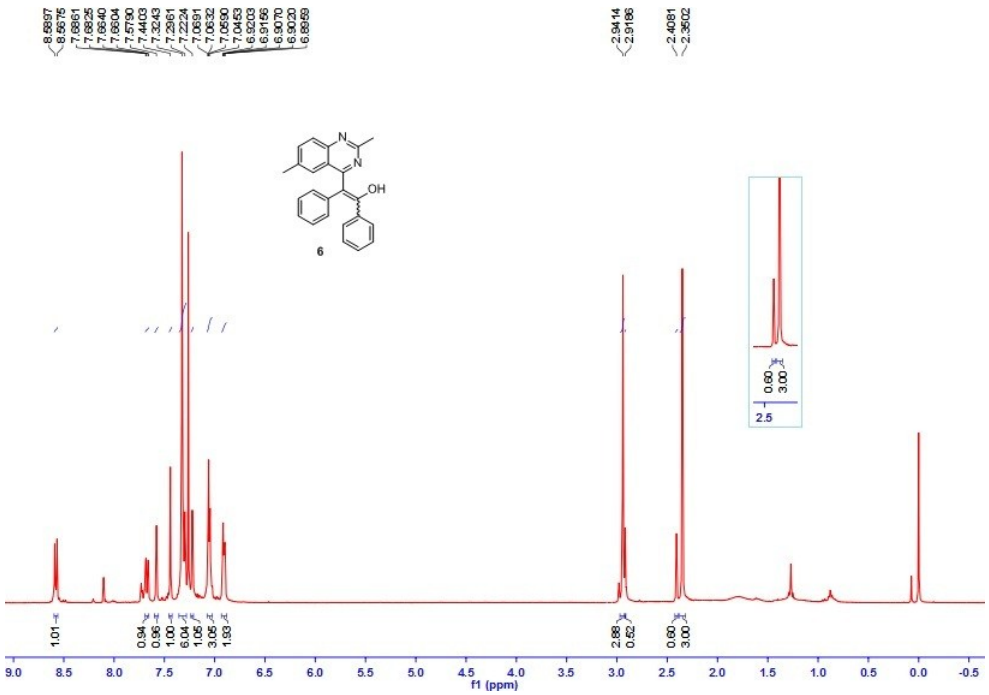
5
f1 (ppm)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7.2224
7.0691
7.0632
7.0490
7.0453
6.9703
6.9195
6.9070
6.9033
6.8869
2.9414
2.9195
2.4081
2.3502
OH
6
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0.94
0.96
1.00
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3.05
1.93
2.88
0.52
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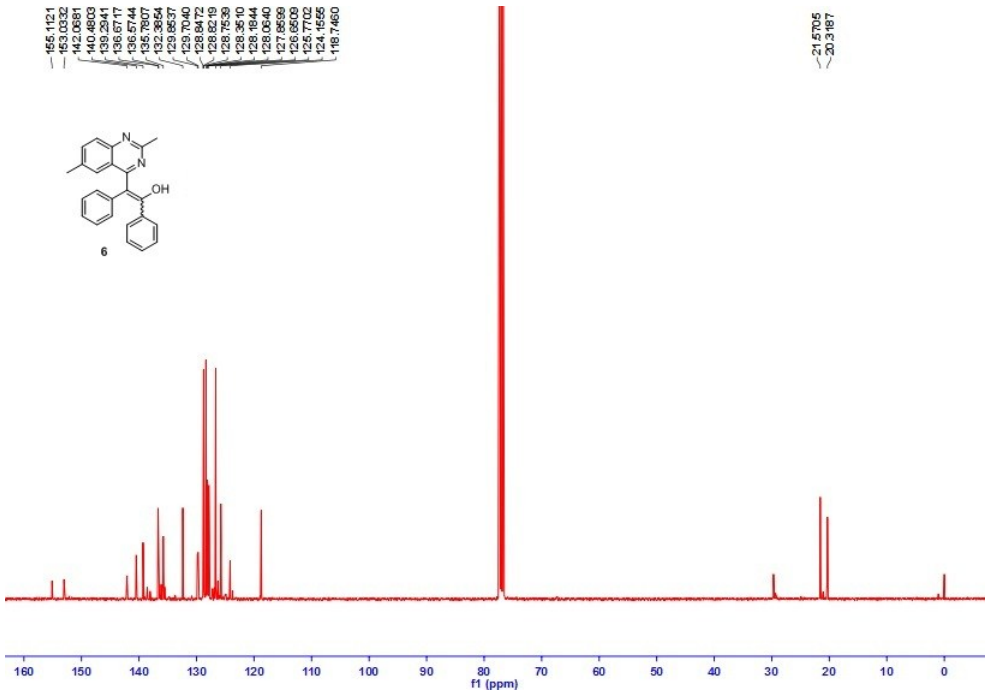
2.5
f1 (ppm)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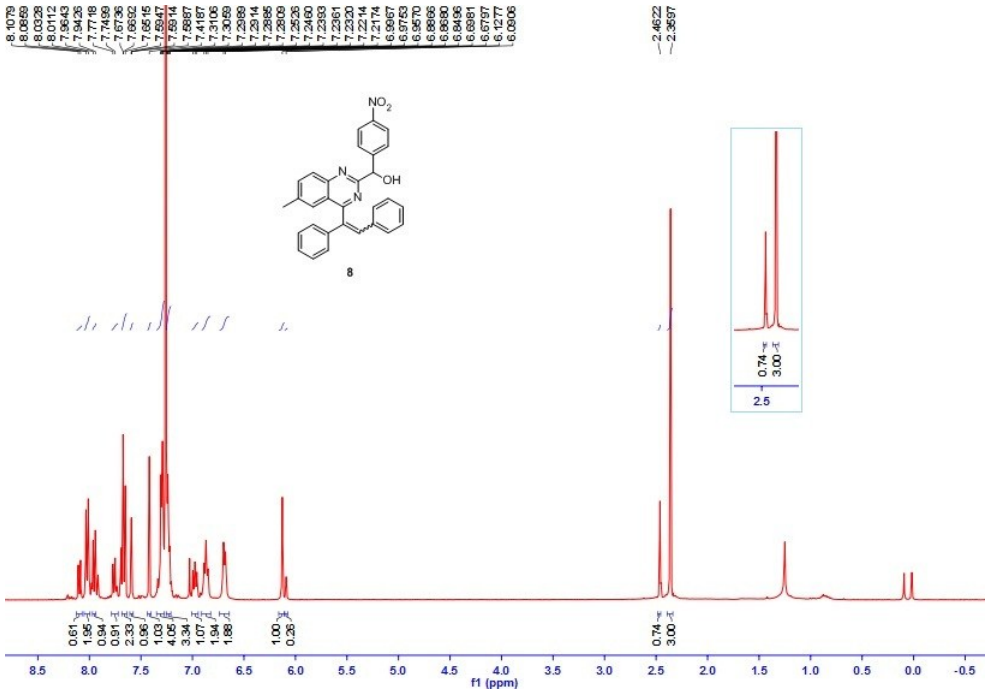
OH
6
f1 (ppm)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7.5887
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7.2214
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6.8880
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OH
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0.91
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3.34
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1.88
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6.0
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2.0
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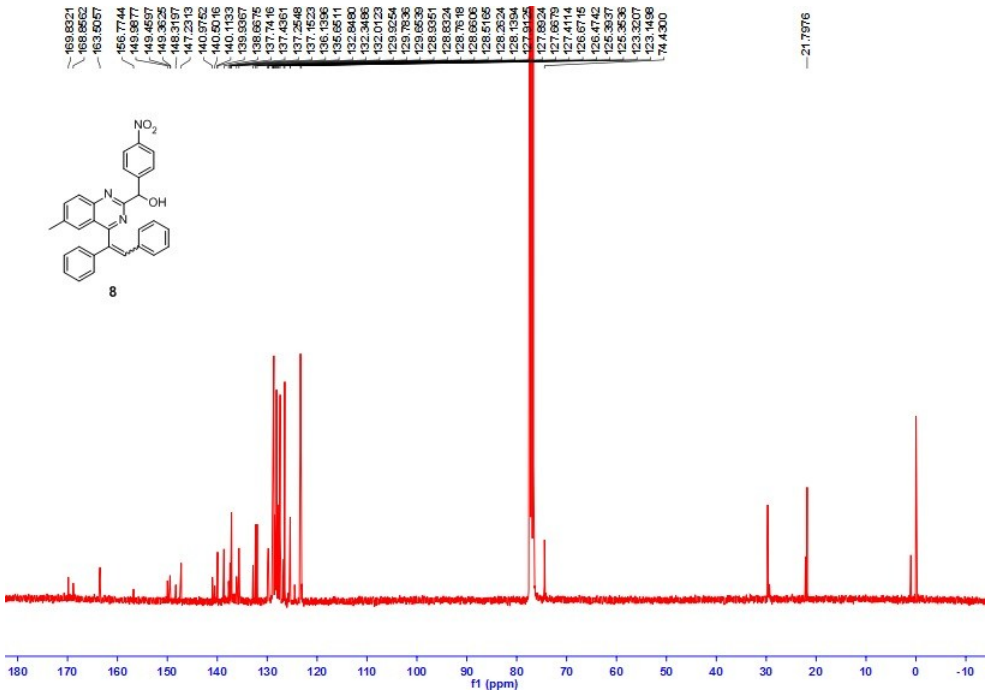
f1 (ppm)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123.3207
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21.7976
NO2
OH
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N
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170
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140
130
120
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80
70
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50
40
30
20
10
0
-10
f1 (ppm)