Supporting Information for

Rh(I)-catalyzed decarbonylative direct C2-olefination of indoles with vinyl carboxylic acids

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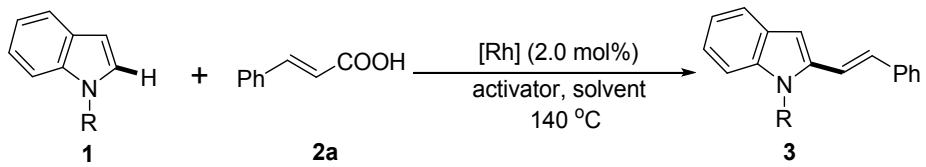
1. General information:

Unless otherwise noted, all experiments were carried out under niotrogen atmosphere, and all commercially available chemicals were used as received from Aldrich, Acros or Strem without further purification. All organic solvents were dried using standard, published methods and were distilled before use. ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker Model Avance DMX 400 Spectrometer (^{1}H 400 MHz and ^{13}C 106 MHz, respectively). Chemical shifts (δ) are given in ppm and are referenced to residual solvent peaks. *N*-(2-pyrimidyl)-indoles (**1a,c-o**),[1-6] *N*-(2-pyridyl)-indole (**1b**),[7] β,β-disubstituted acrylic acids (**2w** and **2x**)[8] and tetra-substituted acrylic acid **4j**[9] were prepared according to the previous reports. Cinnamic anhydride **11** was prepared from the parent acid using the known methods.[10]

2. Screening of reaction conditions

Table S1. Screening conditions for direct olefination of N-protected indoles with cinnamic acid **2a**[a]



Entry	R	[Rh]	Solvent	Activator	Time(h)	Yield(%)[b]
1	2-pyrimidyl (**1a**)	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	95 (**3aa**)
2	2-pyridyl (**1b**)	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	40(**3ba**)
3	Me	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
4	Benzyl	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
5	Acetyl	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
6	Tosyl	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
7	Boc	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
8	Pivaloyl	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
9	PhCO	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
10	Me_2NCO	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
11	H	$[Rh(CO)_2Cl]_2$	toluene	$(t$BuCO$)_2$O	12	0
12	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(t$BuCO$)_2$O	4	96(**3aa**)

13	2-pyrimidyl (**1a**)	$[Rh(COD)Cl]_2$	toluene	$(t\text{BuCO})_2O$	4	55(**3aa**)
14	2-pyrimidyl (**1a**)	$[Rh(1,5\text{-hexadiene})Cl]_2$	toluene	$(t\text{BuCO})_2O$	4	52(**3aa**)
15	2-pyrimidyl (**1a**)	$[Rh(C_2H_4)_2Cl]_2$	toluene	$(t\text{BuCO})_2O$	4	58(**3aa**)
16	2-pyrimidyl (**1a**)	$[Rh(NBD)Cl]_2$	toluene	$(t\text{BuCO})_2O$	4	54(**3aa**)
17	2-pyrimidyl (**1a**)	$[Rh(PPh_3)_3Cl]$	toluene	$(t\text{BuCO})_2O$	4	0
18	2-pyrimidyl (**1a**)	$[Rh(acac)(C_2H_4)_2]$	toluene	$(t\text{BuCO})_2O$	4	24(**3aa**)
19	2-pyrimidyl (**1a**)	$[Rh(acac)(CO)_2]$	toluene	$(t\text{BuCO})_2O$	4	14(**3aa**)
20	2-pyrimidyl (**1a**)	$[Rh(COD)_2]BF_4$	toluene	$(t\text{BuCO})_2O$	4	94(**3aa**)
21	2-pyrimidyl (**1a**)	$[Rh(NBD)_2]BF_4$	toluene	$(t\text{BuCO})_2O$	4	36(**3aa**)
22	2-pyrimidyl (**1a**)	$[RhCp^*Cl_2]_2$	toluene	$(t\text{BuCO})_2O$	4	0
23	2-pyrimidyl (**1a**)	$[Rh(COD)_2]BF_4$	toluene	$(t\text{BuCO})_2O$	1	86(**3aa**)
24	**2-pyrimidyl (1a)**	**$[Rh(COD)_2]OTf$**	**toluene**	**$(t\text{BuCO})_2O$**	**1**	**97(3aa)**
25	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	PhCl	$(t\text{BuCO})_2O$	1	87(**3aa**)
26	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	*p*-xylene	$(t\text{BuCO})_2O$	1	49(**3aa**)
27	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	anisole	$(t\text{BuCO})_2O$	1	81(**3aa**)
28	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	DMF	$(t\text{BuCO})_2O$	1	45(**3aa**)
29	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	DMSO	$(t\text{BuCO})_2O$	1	21(**3aa**)
30	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	decalin	$(t\text{BuCO})_2O$	1	58(**3aa**)
31	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	Boc_2O	1	50(**3aa**)
32	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	Ac_2O	1	43(**3aa**)
33	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	*t*BuCOCl	1	29(**3aa**)
34	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(CF_3CO)_2O$	1	0
35	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(MeOCO)_2O$	1	0
36[c]	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(t\text{BuCO})_2O$	1	34(**3aa**)
37[d]	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(t\text{BuCO})_2O$	1	55(**3aa**)
38[e]	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(t\text{BuCO})_2O$	1	43(**3aa**)
39[f]	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(t\text{BuCO})_2O$	1	93(**3aa**)
40[g]	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	$(t\text{BuCO})_2O$	2	95(**3aa**)
41	2-pyrimidyl (**1a**)	none	toluene	$(t\text{BuCO})_2O$	1	0

40	2-pyrimidyl (**1a**)	$[Rh(COD)_2]OTf$	toluene	none	1	0

[a] Reaction Conditions: **1a** (0.5 mmol.), **2a** (0.5 mmol), [Rh] (2.0 mol%), activator (0.5 mmol), solvent (3.0 mL), 140 °C. [b] Isolated yield. [c] KI (50 mol%) was added. [d] Reaction temperature 120 °C. [e] $[Rh(COD)_2]OTf$ (1.0 mol%) was used. [f] **2a** (1.5 mmol) and $(tBuCO)_2O$ (1.5 mmol) were used, but no double (C2 and C7) olefination was observed. [g] **2a** (1.5 mmol), $(tBuCO)_2O$ (1.5 mmol) and $[Rh(COD)_2]OTf$ (5.0 mol%) were used, but still no double (C2 and C7) olefination was observed.

3. The general procedure for the direct C2-olefination of indoles

To an oven-dried pressure tube were sequentially added indole **1** (0.5 mmol), acrylic acid **2** (0.5 mmol), $[Rh(COD)_2]OTf$ (4.68 mg, 2 mol%), (tBuCO)$_2$O (93 mg, 0.5 mmol) and anhydrous toluene (3.0 mL). After being degassed three times, the tube was heated and stirred vigorously at 140 °C for 1 h in the oil bath under nitrogen atmosphere. Then the tube was removed from the oil bath and cooled to room temperature. The solvent was removed by vacuum evaporation, and the residue was purified by column chromatography on silica gel using a mixture of ethyl acetate and hexane to give the pure product.

(*E*)-1-(pyrimidin-2-yl)-2-styryl-1H-indole (3aa), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.07 (s, 1H), 7.18~7.23 (m, 2H), 7.26~7.35 (m, 3H), 7.40 (t, J = 7.36 Hz, 2H), 7.55 (d, J = 7.44 Hz, 2H), 7.65~7.67 (m, 1H), 7.75 (d, J = 16.2Hz, 1H), 8.36 (d, J = 8.24 Hz, 1H), 8.87 (d, J = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.3, 114.1, 117.3, 120.4, 120.7, 122.4, 123.6, 126.7, 127.7, 128.7, 129.4, 129.7, 137.4, 137.5, 138.9, 158.2, 158.3; HRMS (ESI) calcd. for $C_{20}H_{16}N_3[M+H]^+$: 298.1339, found: 298.1339.

(*E*)-1-(pyridin-2-yl)-2-styryl-1H-indole (3ba), red oil ; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.04 (s, 1H), 7.15 (d, J = 4.76 Hz, 2H), 7.23 (t, J = 3.84 Hz, 2H), 7.28~7.30 (m, 1H), 7.34~7.39 (m, 3H), 7.45 (d, J = 8.60 Hz, 3H), 7.54~7.56 (m, 1H), 7.67~7.70 (m, 1H), 7.92 (t, J = 7.52 Hz, 1H), 8.78 (d, J = 4.56 Hz, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 102.4, 110.9, 118.4, 120.6, 121.4, 121.6, 122.1, 122.9, 126.5, 127.8, 128.7, 130.6, 137.2, 137.9, 138.1, 138.4, 149.7, 151.3; HRMS (ESI) calcd. for $C_{21}H_{17}N_2$ $[M+H]^+$: 297.1386, found:297.1388.

(*E*)-4-methyl-1-(pyrimidin-2-yl)-2-styryl-1H-indole (3ca), grey solid, mp: 138.4 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.65 (s, 3H), 7.09 (d, J = 7.20 Hz, 1H), 7.11 (s, 1H), 7.18 (t, J = 4.76 Hz, 1H), 7.21~7.25 (m, 2H), 7.30 (t, J = 7.24 Hz, 1H), 7.40 (t, J = 7.52 Hz, 2H), 7.55 (d, J = 7.80 Hz, 2H), 7.75 (d, J = 16.16 Hz, 1H), 8.18 (d, J = 8.40 Hz, 1H), 8.86 (d, J = 4.76 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 18.7, 103.8, 111.6, 117.3, 120.8, 122.7, 123.7, 126.6, 127.6, 128.7, 129.1, 129.4, 129.8, 137.2, 137.6, 138.3, 158.2, 158.3; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found: 312.1497.

(*E*)-5-Methyl-1-pyrimidin-2-yl-2-styryl-1H-indole (3da), red oil; ^{1}H NMR (400

MHz, $CDCl_3$) δ 2.58(s, 3H), 7.05(s, 1H), 7.09(t, *J*=4.76Hz, 1H), 7.21~7.27(m, 2H), 7.35(t, *J*=7.28Hz, 1H), 7.45(t, *J*=7.48Hz, 2H), 7.50(s, 1H), 7.60(d, *J*=7.64Hz, 2H), 7.85(d, *J*=16.16Hz, 1H), 8.35(d, *J*=8.52Hz, 1H), 8.82(d, *J*=4.76Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 21.5, 105.2, 114.1, 117.1, 120.3, 121.1, 125.2, 126.7, 127.7, 128.8, 129.4, 129.8, 131.8, 135.8, 137.7, 139.0, 158.3; HRMS (ESI) calcd. for $C_{21}H_{17}N_3Na[M+Na]^+$: 334.1315, found: 334.1313.

(*E*)-6-Methyl-1-pyrimidin-2-yl-2-styryl-1H-indole (3ea), yellow solid, mp: 121.1 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 2.56(s, 3H), 7.03(s, 1H), 7.12(d, *J*=7.92Hz, 1H), 7.16~7.20(m, 2H), 7.30(t, *J*=7.28Hz, 1H), 7.40(t, *J*=7.44Hz, 2H), 7.55(dd, *J*=3.12, 8.12Hz, 3H), 7.72(d, *J*=16.20Hz, 1H), 8.16(s, 1H), 8.87(d, *J*=4.80Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 22.2, 105.3, 113.9, 117.2, 120.1, 120.8, 124.0, 126.6, 127.2, 127.5, 128.7, 129.1, 133.6, 137.7, 137.8, 138.3, 158.2, 158.3; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found: 312.1493.

(*E*)-7-Methyl-1-pyrimidin-2-yl-2-styryl-1H-indole (3fa), red oil; ^1H NMR (400 MHz, $CDCl_3$) δ 2.00(s, 3H), 7.03~7.05(m, 2H), 7.16(t, *J*=7.32Hz, 3H), 7.25~7.29(m, 1H), 7.33~7.37(m, 3H), 7.42~7.44(m, 2H), 7.56(d, *J*=7.80Hz, 1H), 8.93(d, *J*=4.84Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 19.9, 102.9, 118.0, 118.6, 119.5, 121.9, 122.0, 125.9, 126.6, 127.8, 128.7, 129.8, 131.0, 137.2, 137.4, 139.5, 158.6, 158.9; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found: 312.1499.

(*E*)-5-Methoxy-1-pyrimidin-2-yl-2-styryl-1H-indole (3ga), yellow solid, mp: 99.2 °C ; ^1H NMR (400 MHz, $CDCl_3$) δ 3.93(s, 3H), 6.97~7.00(m, 2H), 7.09~7.11(m, 2H), 7.19(d, *J*=16.20Hz, 1H), 7.28~7.33(m, 1H), 7.41(t, *J*=7.44Hz, 2H), 7.56(d, *J*=7.56Hz, 2H), 7.82(d, *J*=16.2Hz, 1H), 8.34(d, *J*=9.08Hz, 1H), 8.80(d, *J*=4.80Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 55.7, 102.3, 105.3, 112.9, 115.4, 117.0, 121.05, 126.7, 127.6, 128.7, 129.5, 130.2, 132.4, 137.6, 139.5, 155.8,158.1, 158.2; HRMS (ESI) calcd. for $C_{21}H_{17}N_3NaO[M+Na]^+$: 350.1264, found: 350.1258.

(*E*)-5-Chloro-1-pyrimidin-2-yl-2-styryl-1H-indole (3ha), Orange solid, mp: 106.1 °C ; ^1H NMR (400 MHz, $CDCl_3$) δ 6.94(s, 1H), 7.14~7.20(m, 2H), 7.26(dd, *J*=1.76, 8.84Hz, 1H), 7.32(t, *J*=7.20Hz, 1H), 7.41(t, *J*=7.44Hz, 2H), 7.53~7.59(m, 3H), 7.74(d, *J*=16.20Hz, 1H), 8.30(d, *J*=8.88Hz, 1H), 8.81(d, *J*=4.80Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 104.4, 115.5, 117.5, 119.7, 120.4, 123.5, 126.8, 127.8, 127.9, 128.8, 130.4, 130.6, 135.7, 137.3, 140.3, 157.9, 158.3; HRMS (ESI) calcd. for $C_{20}H_{14}ClN_3Na[M+Na]^+$: 354.0768, found: 354.0772.

(*E*)-5-Bromo-1-pyrimidin-2-yl-2-styryl-1H-indole (3ia), brown solid, mp: 104 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 6.92(s, 1H), 7.13(t, *J*=4.80Hz, 1H), 7.18(d, *J*=16.16Hz, 1H), 7.33(t, *J*=7.32Hz, 1H), 7.38~7.43(m, 3H), 7.54(d, *J*=7.64Hz, 2H), 7.74(t, *J*=7.80Hz, 2H), 8.25(d, *J*=8.88Hz, 1H), 8.80(d, *J*=4.84Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 104.3, 115.6, 115.9, 117.6, 120.4, 122.7, 126.1, 126.8, 127.9, 128.8, 130.5, 131.2, 136.0, 137.3, 140.1, 157.8, 158.3; HRMS (ESI) calcd. for $C_{20}H_{15}BrN_3[M+H]^+$: 376.0444, found: 376.0435.

(*E*)-5-Fluoro-1-pyrimidin-2-yl-2-styryl-1H-indole (3ja), yellow solid, mp: 120.6 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 6.99(s, 1H), 7.05~7.13(m, 2H), 7.20(d, *J*=16.20Hz, 1H), 7.29~7.35(m, 2H), 7.42(t, *J*=7.48Hz, 2H), 7.56(d, *J*=7.68Hz, 2H), 7.79(d, *J*=16.20Hz, 1H), 8.36(dd, *J*=4.64, 9.08Hz, 1H), 8.80(d, *J*=4.80Hz, 2H); ^{13}C NMR

(100.6 MHz, $CDCl_3$) δ 104.9, 105.0, 105.2, 105.4, 111.2, 111.4, 115.4, 115.5, 117.4, 120.6, 126.8, 127.9, 128.8, 130.1, 130.3, 133.8, 137.4, 140.5, 157.9, 158.1, 158.3, 160.4; HRMS (ESI) calcd. for $C_{20}H_{15}FN_3[M+H]^+$: 316.1245, found:316.1238.

(*E*)-5-Nitro-1-pyrimidin-2-yl-2-styryl-1H-indole (3ka), yellow solid, mp: 173.8 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.08(s, 1H), 7.21(d, *J*=16.24Hz, 1H), 7.31~7.34(m, 2H), 7.39(t, *J*=7.48Hz, 2H), 7.52(d, *J*=7.68Hz, 2H), 7.65(d, *J*=16.20Hz, 1H), 8.13(dd, *J*=1.88, 9.20Hz, 1H), 8.31(d, *J*=9.16Hz, 1H), 8.49(d, *J*=1.80Hz, 1H), 8.91(d, *J*=4.80Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.3, 114.1, 116.6, 118.5, 119.4, 126.8, 128.2, 128.8, 128.9, 131.9, 136.9, 140.1, 142.1, 143.4, 157.4, 158.4, 158.6; HRMS (ESI) calcd. for $C_{20}H_{15}N_4O_2[M+H]^+$: 343.1190, found:343.1188.

(*E*)-1-Pyrimidin-2-yl-2-styryl-1H-indole-5-carboxylic acid methyl ester (3la), red oil; ^1H NMR (400 MHz, $CDCl_3$) δ 3.98(s, 3H), 7.07(s, 1H), 7.18(d. *J*=8.96Hz, 1H), 7.21(t, *J*=4.92Hz, 1H), 7.30(d, *J*=7.40Hz, 1H), 7.38(t. *J*=7.28Hz, 2H), 7.52(d, *J*=7.36Hz, 2H), 7.68(d, *J*=16.2Hz, 1H), 7.99(dd, *J*=1.68, 8.80Hz, 1H), 8.31(d, *J*=8.84Hz, 1H), 8.37(d, *J*=1.40Hz, 1H), 8.85(d, *J*=4.84Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 52.0, 105.5, 113.7, 117.9, 120.1, 122.8, 124.2, 124.7, 126.7, 127.9, 128.7, 129.0, 130.6, 137.2, 139.9, 140.3, 157.8, 158.4, 167.8; HRMS (ESI) calcd. for $C_{22}H_{17}N_3NaO_2[M+Na]^+$: 378.1213, found: 378.1207.

(*E*)-3-Methyl-1-pyrimidin-2-yl-2-styryl-1H-indole (3ma), white solid, mp: 120.6 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 2.60(s, 3H), 6.85(d, *J*=16.44Hz, 1H), 7.12(t, *J*=4.76Hz, 1H), 7.28~7.44(m, 5H), 7.56~7.62(m, 3H), 7.67(d, *J*=7.48Hz, 1H), 8.38(d, *J*=8.08Hz, 1H), 8.82(d, *J*=4.76Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 10.7, 113.8, 115.7, 116.9, 118.9, 120.9, 122.0, 124.1, 126.5, 127.5, 128.7, 130.9, 131.4, 134.0, 136.6, 137.9, 158.2, 158.4; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found:312.1484.

(*E*)-3-Phenyl-1-pyrimidin-2-yl-2-styryl-1H-indole (3na), red oil; ^1H NMR (400 MHz, $CDCl_3$) δ 6.45(d, *J*=16.52Hz, 1H), 7.21~7.24(m, 2H), 7.26~7.33(m, 5H), 7.35~7.40(m, 1H), 7.45(d, *J*=7.44Hz, 1H), 7.52~7.57(m, 3H), 7.63~7.68(m, 3H), 8.23(d, *J*=8.28Hz, 1H), 8.89(d, *J*=4.80Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 113.1, 117.8, 118.9, 119.7, 121.6, 122.4, 124.3, 126.4, 127.0, 127.6, 128.6, 128.7, 129.8, 130.6, 133.2, 133.7, 134.8, 137.3, 137.6, 158.5, 158.5; HRMS (ESI) calcd. for $C_{26}H_{20}N_3[M+H]^+$: 374.1652, found:374.1657.

(*E*)-1-Pyrimidin-2-yl-2-styryl-1H-indole-3-carbonitrile (3oa), yellow solid, mp: 174.1 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.28~7.38(m, 6H), 7.52(dd, *J*=5.00, 12.68Hz, 3H), 7.67~7.75(m, 2H), 8.12~8.14(m, 1H), 8.89(dd, *J*=0.56, 4.84Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 88.2, 114.3, 116.5, 117.1, 119.1, 123.9, 125.3, 127.2, 128.2, 128.8, 129.0, 135.8, 136.0, 136.3, 144.5, 156.9, 158.4, 158.7; HRMS (ESI) calcd. for $C_{21}H_{14}N_4Na[M+Na]^+$: 345.1111, found: 345.1107.

(*E*)-1-Pyrimidin-2-yl-2-(2-p-tolyl-vinyl)-1H-indole (3ab), colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 2.44(s, 3H), 7.08(s, 1H), 7.15(t, *J*=4.80Hz, 1H), 7.20~7.24(m, 3H), 7.28~7.38(m, 2H), 7.48(d, *J*=7.96Hz, 2H), 7.68~7.76(m, 2H), 8.38~8.40(d, *J*=8.12Hz, 1H), 8.86(d, *J*=4.80Hz, 2H);; ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 21.4, 105.1, 114.1, 117.3, 119.7, 120.4, 122.4, 123.5, 126.6, 129.5, 129.5, 129.8, 134.8, 137.4, 137.6, 139.1, 158.2, 158.3; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495,

found:312.1485.

(*E*)-2-[2-(4-Methoxy-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3ac), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.86(s, 3H), 6.93(d, *J*=8.60Hz, 2H), 7.02(s, 1H), 7.14~7,19(m, 2H), 7.25~7.31(m, 2H), 7.48(d, *J*=8.56Hz, 2H), 7.59~7.66(m, 2H), 8.33(d, *J*=8.04Hz, 1H), 8.86(d, *J*=4.80Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 55.3, 104.7, 114.0, 114.1, 117.3, 118.5, 120.3, 122.3, 123.3, 127.9, 129.4, 129.5, 130.4, 137.3, 139.2, 158.2, 158.3, 159.4; HRMS (ESI) calcd. for $C_{21}H_{18}N_3O[M+H]^+$: 328.1444, found:328.1448.

(*E*)-2-[2-(4-Chloro-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3ad), colorless solid, mp: 103.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.05 (s, 1H), 7.12 (d, *J* = 16.16 Hz, 1H), 7.17 (t, *J* = 4.76 Hz, 1H), 7.27~7.36 (m, 4H), 7.44 (d, *J* = 8.40 Hz, 2H), 7.66 (d, *J* = 7.52 Hz, 1H), 7.72 (d, *J* = 16.16 Hz, 1H), 8.37 (d, *J* = 8.20 Hz, 1H), 8.84 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.6, 114.2, 117.3, 120.5, 121.3, 122.5, 123.8, 127.8, 128.2, 128.8, 129.4, 133.1, 136.1, 137.4, 138.5, 158.1, 158.3; HRMS (ESI) calcd. for $C_{20}H_{15}ClN_3[M+H]^+$: 332.0949, found:332.0937.

(*E*)-2-[2-(4-Bromo-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3ae), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.04 (s, 1H), 7.10 (d, *J* = 16.20 Hz, 1H), 7.17 (t, *J* = 4.80 Hz, 1H), 7.26~7.30 (m, 1H), 7.31~7.38 (m, 3H), 7.49 (d, *J* = 8.36 Hz, 2H), 7.65 (d, *J* = 7.56 Hz, 1H), 7.73 (d, *J* = 16.16 Hz, 1H), 8.37 (d, *J* = 8.24 Hz, 1H), 8.84 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.7, 114.2, 117.3, 120.5, 121.3, 121.5, 122.5, 123.8, 128.1, 128.2, 129.4, 131.8, 136.5, 137.4, 138.5, 158.1, 158.3; HRMS (ESI) calcd. for $C_{20}H_{15}BrN_3[M+H]^+$: 376.0444, found:376.0439.

(*E*)-2-[2-(4-Fluoro-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3af), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.04~7.18 (m, 5H), 7.27~7.35 (m, 2H), 7.49 (dd, *J* = 5.64, 8.36 Hz, 2H), 7.65 (s, 1H), 7.68 (d, *J* = 7.28 Hz, 1H), 8.37 (d, *J* = 8.16 Hz, 1H), 8.85 (d, *J* = 4.76 HZ, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.3, 114.2, 115.5, 115.7, 117.3, 120.4, 120.5, 122.4, 123.6, 128.1, 128.2, 128.4, 129.4, 133.8, 137.4, 138.7, 158.1, 158.3; HRMS (ESI) calcd. for $C_{20}H_{15}FN_3[M+H]^+$: 316.1245, found:316.1238.

(*E*)-4-[2-(1-Pyrimidin-2-yl-1H-indol-2-yl)-vinyl]-phenol (3ag), orange solid, mp: 102.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.03 (s, 1H), 7.08 (d, *J* = 8.56 Hz, 2H), 7.16 (d, *J* = 16.28 Hz, 1H), 7.21 (t, *J* = 4.80 Hz, 1H), 7.24~7.27 (m, 1H), 7.28~7.33 (m, 1H), 7.52 (d, *J* = 8.56 Hz, 2H), 7.63~7.69 (m, 2H), 8.34 (d, *J* = 8.24Hz, 1H), 8.86 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.4, 114.1, 117.3, 120.4, 120.9, 121.7, 122.4, 123.6, 127.5, 128.7, 129.4, 135.1, 137.4, 138.7, 150.6, 158.1, 158.3; HRMS (ESI) calcd. for $C_{20}H_{16}N_3O[M+H]^+$: 314.1288, found:314.1285.

(*E*)-1-Pyrimidin-2-yl-2-[2-(4-trifluoromethyl-phenyl)-vinyl]-1H-indole (3ah), colorless solid, mp: 98.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.08 (s, 1H), 7.15~7.20 (m, 2H), 7.29 (t, *J*= 7.56 Hz, 1H), 7.35 (t, *J* = 7.28 Hz, 1H), 7.58~7.67 (m, 5H), 7.83 (t, *J* = 16.16 Hz, 1H), 8.39 (d, *J* = 8.28 Hz, 1H), 8.86 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 106.2, 114.3, 117.3, 120.6, 122.6, 123.3, 124.0, 125.6, 125.6, 126.7, 127.7, 128.9, 129.3, 137.5, 138.1, 141.0, 158.1, 158.3; HRMS (ESI) calcd. for $C_{21}H_{14}F_3N_3Na[M+Na]^+$: 388.1032, found: 388.1029.

(*E*)-2-[2-(4-Nitro-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3ai), orange solid, mp: 217.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14 (s, 1H), 7.20 (d, *J* = 16.28 Hz, 1H),

7.25~7.29 (m, 2H), 7.32~7.37 (m, 1H), 7.65 (dd, *J* = 7.80, 13.56 Hz, 3H), 7.94 (d, *J* = 16.24 Hz, 1H), 8.23 (d, *J* = 8.80 Hz, 2H), 8.38 (d, *J* = 8.32 Hz, 1H), 8.89 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 106.9, 114.4, 117.4, 120.8, 122.7, 124.2, 124.4, 125.4, 126.7, 126.9, 129.2, 137.6, 137.7, 144.1, 158.1, 158.4; HRMS (ESI) calcd. for $C_{20}H_{14}N_4NaO_2[M+Na]^+$: 365.1009, found: 365.0997.

(*E*)-4-[2-(1-Pyrimidin-2-yl-1H-indol-2-yl)-vinyl]-benzoic acid methyl ester (3aj), yellow solid, mp: 117.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.95 (s, 3H), 7.08 (s, 1H), 7.16~7.20 (m, 2H), 7.27 (t, *J* = 7.24 Hz, 1H), 7.33 (t, *J*=7.24Hz, 1H), 7.55 (d, *J* = 8.16 Hz, 2H), 7.65(d, *J* = 7.60 Hz, 1H), 7.86 (d, *J* = 16.16 Hz, 1H), 8.04 (d, *J* = 8.12 Hz, 2H), 8.37 (d, *J* = 8.28 Hz, 1H), 8.85 (d, *J* = 4.76 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 52.1, 106.1, 114.3, 117.3, 120.6, 122.5, 123.3, 124.0, 126.4, 128.2, 128.8, 129.3, 130.0, 137.5, 138.2, 142.0, 158.1, 158.3, 166.9; HRMS (ESI) calcd. for $C_{22}H_{18}N_3O_2[M+H]^+$: 356.1394, found:356.1388.

(*E*)-2-[2-(3-Methoxy-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3ak), brown solid, mp: 90.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.88(s, 3H), 6.88(dd, *J*=2.20, 8.12Hz, 1H), 7.09(d, *J*=11.12Hz, 2H), 7.14~7.21(m, 3H), 7.28~7.36(m, 3H), 7.68(d, *J*=7.40Hz, 1H), 7.76(d, *J*=16.12Hz, 1H), 8.38(d, *J*=8.12Hz, 1H), 8.84(d, *J*=4.76HZ, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 55.3, 105.4, 112.2, 113.1, 114.1, 117.3, 119.4, 120.4, 121.1, 122.4, 123.6, 129.4, 129.5, 129.7, 137.4, 138.8, 139.0, 158.1, 158.3, 159.9; HRMS (ESI) calcd. for $C_{21}H_{18}N_3O[M+H]^+$: 328.1444, found:328.1338.

(*E*)-2-[2-(3-Bromo-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3al), white solid, mp: 108.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.04 (s, 1H), 7.08 (d, *J* = 16.16Hz, 1H), 7.17 (t, *J* = 4.80 Hz, 1H), 7.23 (t, *J* = 7.84Hz, 1H), 7.27~7.31 (m, 1H), 7.32~7.36 (m, 1H), 7.41 (d, *J* = 7.88 Hz, 2H), 7.65~7.67 (m, 2H), 7.73 (d, *J* = 16.20 Hz, 1H), 8.38 (d, *J* = 8.28, 1H), 8.84 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.9, 114.3, 117.3, 120.6, 122.2, 122.5, 122.9, 123.9, 125.4, 127.8, 129.3, 130.2, 130.4, 137.5, 138.3, 139.8, 158.0, 158.4; HRMS (ESI) calcd. for $C_{20}H_{15}BrN_3[M+H]^+$: 376.0444, found:376.0436.

(*E*)-2-[2-(2-Bromo-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3am), yellow solid, mp: 134.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.12~7.17 (m, 3H), 7.28~7.37 (m, 3H), 7.54 (d, *J* = 16.12 Hz, 1H), 7.63 (dd, *J* = 0.80, 8.00 Hz, 1H), 7.69 (d, *J* = 7.72 Hz, 2H), 7.75 (d, *J* = 16.12Hz, 1H), 8.38 (d, *J* = 8.20 Hz, 1H), 8.84 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 106.3, 114.3, 117.3, 120.6, 122.5, 123.3, 123.9, 124.1, 126.8, 127.6, 128.0, 128.8, 129.4, 133.2, 137.2, 137.5, 138.4, 158.1, 158.3; HRMS (ESI) calcd. for $C_{20}H_{15}BrN_3[M+H]^+$: 376.0444, found:376.0434.

(*E*)-2-[2-(2-Chloro-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3an), brown solid, mp: 110.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14~7.17 (m, 2H), 7.22 (t, *J* = 7.44 Hz, 1H), 7.26~7.36 (m, 3H), 7.44 (d, *J* = 7.84 Hz, 1H), 7.58 (d, *J* = 16.2 Hz, 1H), 7.69 (t, *J* = 7.68 Hz, 2H), 7.78 (d, *J* = 16.2 Hz, 1H), 8.38 (d, *J* = 8.24 Hz, 1H), 8.84 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 106.2, 114.2, 117.3, 120.6, 122.5, 123.2, 123.8, 125.3, 126.6, 126.9, 128.5, 129.4, 129.9, 133.4, 135.5, 137.5, 138.5, 158.1, 158.3; HRMS (ESI) calcd. for $C_{20}H_{15}ClN_3[M+H]^+$: 332.0949, found:332.0944.

(*E*)-1-Pyrimidin-2-yl-2-(2-o-tolyl-vinyl)-1H-indole (3ao), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.51 (s, 3H), 7.08 (s, 1H), 7.18 (t, *J* = 4.8 Hz, 1H), 7.24~7.27 (m, 3H),

7.29~7.31 (m, 1H), 7.32~7.36 (m, 1H), 7.42 (d, *J* = 16.08 Hz, 1H), 7.63~7.69 (m, 3H), 8.36 (d, *J* = 8.12 Hz, 1H), 8.86 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 20.0, 105.3, 114.1, 117.3, 120.4, 121.8, 122.4, 123.6, 125.6, 126.2, 127.4, 127.6, 129.5, 130.5, 135.9, 136.4, 137.4, 139.2, 158.2, 158.3; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found:312.1491.

(*E*)-2-[2-(2,3-Dimethoxy-phenyl)-vinyl]-1-pyrimidin-2-yl-1H-indole (3ap), colorless solid, mp: 131.9 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.91(s, 6H), 6.86(dd, *J*=1.08, 8.08Hz, 1H), 7.08(t, *J*=8.04Hz, 1H), 7.12(s, 1H), 7.18(t, *J*=4.84Hz, 1H), 7.23~7.33 (m, 3H), 7.50 (d, *J* = 16.4 Hz, 1H), 7.65~7.67 (m, 1H), 7.81 (d, *J* = 16.4 Hz, 1H), 8.33 (d, *J* = 8.16 Hz, 1H), 8.85 (d, *J* = 4.84 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 55.9, 61.1, 105.4, 111.4, 114.0, 117.3, 118.3, 120.4, 121.9, 122.3, 123.5, 124.0, 124.1, 129.5, 131.7, 137.4, 139.2, 147.0, 153.2, 158.2, 158.3; HRMS (ESI) calcd. for $C_{22}H_{20}N_3O_2[M+H]^+$: 358.1550, found:358.1551.

(*E*)-2-(2-Naphthalen-2-yl-vinyl)-1-pyrimidin-2-yl-1H-indole (3aq), yellow solid, mp: 76.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.13~7.16 (m, 2H), 7.28~7.40 (m, 3H), 7.49~7.55 (m, 2H), 7.71 (d, *J* = 7.60 Hz, 1H), 7.76 (d, *J* = 8.68 Hz, 1H), 7.85~7.92(m, 5H), 8.41 (d, *J* = 8.20 Hz, 1H), 8.86 (d, *J* = 4.76 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.4, 114.2, 117.3, 120.5, 121.1, 122.5, 123.7, 123.7, 126.0, 126.4, 126.8, 127.8, 128.1, 128.3, 129.5, 129.8, 133.1, 133.8, 135.1, 137.5, 139.0, 158.2, 158.3; HRMS (ESI) calcd. for $C_{24}H_{17}N_3Na[M+Na]^+$: 370.1315, found: 370.1306.

(*E*)-1-Pyrimidin-2-yl-2-(2-thiophen-2-yl-vinyl)-1H-indole (3ar), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.02~7.05 (m, 2H), 7.11 (d, *J* = 3.36 Hz, 1H), 7.18~7.33 (m, 5H), 7.62 (dd, *J* = 7.48, 16.8 Hz, 2H), 8.34 (d, *J* = 8.16 Hz, 1H), 8.86 (d, *J* = 4.84 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.2, 114.1, 117.3, 120.3, 120.4, 122.4, 122.7, 123.6, 124.4, 126.2, 127.7, 129.4, 137.4, 138.4, 143.1, 158.1, 158.3; HRMS (ESI) calcd. for $C_{18}H_{14}N_3S[M+H]^+$: 304.0903, found:304.0899

(*E*)-2-(2-Furan-2-yl-vinyl)-1-pyrimidin-2-yl-1H-indole (3as), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.40~6.46 (m, 2H), 7.00~7.03 (m, 2H), 7.16 (t, *J* = 4.80 Hz, 1H), 7.26~7.34 (m, 2H), 7.43 (s, 1H), 7.65 (dd, *J* = 3.52, 11.24 Hz, 2H), 8.32 (d, *J* = 8.12 Hz, 1H), 8.85 (d, *J* = 4.76 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 104.9, 109.0, 111.8, 113.9, 117.4, 117.4, 118.8, 120.4, 122.4, 123.6, 129.4, 137.5, 138.5, 142.2, 153.4, 158.0, 158.4; HRMS (ESI) calcd. for $C_{18}H_{14}N_3O[M+H]^+$: 288.1131, found:288.1126.

(*E*)-2-(4-Phenyl-buta-1,3-dienyl)-1-pyrimidin-2-yl-1H-indole (3at), brown solid, mp: 126.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.73 (d, *J* = 14.48 Hz, 1H), 7.00~7.10 (m, 3H), 7.19 (t, *J* = 4.80 Hz, 1H), 7.25~7.32 (m, 3H), 7.34~7.39 (m, 3H), 7.49 (d, *J* = 7.64 Hz, 2H), 7.65 (d, *J* = 7.48 Hz, 1H), 8.31 (d, *J* = 8.12 Hz, 1H), 8.87 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.2, 113.9, 117.4, 120.4, 122.4, 123.6, 124.1, 126.7, 126.5, 127.6, 128.7, 129.5, 130.5, 132.8, 137.5, 138.6, 158.1, 158.4; HRMS (ESI) calcd. for $C_{22}H_{17}N_3Na[M+Na]^+$: 346.1315, found: 346.1318.

(*E*)-3-(1-Pyrimidin-2-yl-1H-indol-2-yl)-acrylic acid ethyl ester (3au), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.36(t, *J*=7.12Hz, 3H), 4.29(q, *J*=7.12Hz, 2H), 6.50(d, *J*=15.84Hz, 1H), 7.15(s, 1H), 7.23(t, *J*=4.92Hz, 1H), 7.27~7.28(m, 1H), 7.36(td, *J*=1.16, 7.24Hz, 1H), 7.66(d, *J*=7.80Hz, 1H), 8.27(d, *J*=15.88Hz, 1H), 8.37(d,

J=8.48Hz, 1H), 8.87(d, *J*=4.84Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 14.4, 60.5, 109.0, 114.4, 117.5, 117.9, 121.2, 122.7, 125.0, 128.8, 135.6, 136.4, 137.9, 157.7, 158.4, 167.1; HRMS (ESI) calcd. for $C_{17}H_{15}N_3NaO_2[M+Na]^+$: 316.1056, found: 316.1060.

(*E*/*Z*)-2-(prop-1-enyl)-1-(pyrimidin-2-yl)-1H-indole (3av), red oil; ^{1}H NMR (400 MHz, $CDCl_3$): **E isomer:** δ 1.96 (dd, *J* = 1.76, 6.76 Hz, 3H), 6.30~6.39 (m, 1H), 6.82 (s, 1H), 6.91~6.95 (m, 1H) , 7.17~7.19 (m, 1H), 7.22~7.28 (m, 2H), 7.58~7.61 (m, 1H), 8.24~8.26 (m, 1H), 8.85 (d, *J* = 4.84 Hz, 2H); **Z isomer**: δ 2.08 (dd, *J* = 1.8, 7.08 Hz, 3H), 5.90~5.98 (m, 1H), 6.77 (s, 1H), 6.77~6.79 (m, 1H), 7.17~7.19 (m, 1H), 7.22~7.28 (m, 2H), 7.63~7.65 (m, 1H), 8.26~8.27 (m, 1H), 8.84 (d, *J*=4.64Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) **E isomer:** δ 18.9, 104.2, 113.7, 117.2, 120.1, 122.1, 122.9, 123.0, 127.6 **,** 129.5, 136.9, 139.1, 158.1, 158.3; **Z isomer:** δ 15.5, 108.4, 113.7, 117.2, 120.3, 121.7, 122.0, 123.4, 127.1, 129.4, , 136.1, 136.3, 158.1, 158.3; HRMS (ESI) calcd. for $C_{15}H_{14}N_3[M+H]^+$:236.1182, found:236.1178.

(*E*)-2-(2-Methyl-propenyl)-1-pyrimidin-2-yl-1H-indole (3aw), colorless solid**,** mp: 68.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.00 (s, 3H), 2.06 (s, 3H), 6.60 (s, 1H), 6.67 (s, 1H), 7.15 (td, *J* = 0.72, 4.68 Hz, 1H), 7.23~7.31 (m, 2H), 7.64 (d, *J*=7.32Hz, 1H), 8.21 (d, *J* = 7.80 Hz, 1H), 8.83 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 20.5, 27.1, 107.5, 113.5, 117.2, 117.2, 120.1, 121.9, 123.0, 129.5, 136.3, 136.8, 137.4, 158.1, 158.2; HRMS (ESI) calcd. for $C_{16}H_{15}N_3Na[M+Na]^+$: 272.1158, found: 272.1163.

(*E*)-2-(2,2-Diphenyl-vinyl)-1-pyrimidin-2-yl-1H-indole (3ax), white solid, mp: 92.9 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.14 (s, 1H), 7.13 (t, *J* = 4.80 Hz, 1H), 7.17~7.21 (m, 1H), 7.26~7.30 (m, 1H), 7.33~7.45 (m, 12H), 8.25 (dd, *J* = 0.32, 8.32 Hz, 1H), 8.81 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 109.0, 113.5, 117.3, 119.6, 120.6, 122.1, 123.6, 127.5, 127.8, 128.3, 128.7, 129.3, 130.4, 130.6, 136.6, 137.4, 140.7, 142.0, 143.1, 158.0, 158.3; HRMS (ESI) calcd. for $C_{26}H_{19}N_3Na[M+Na]^+$: 396.1471, found: 396.1478.

2-Isopropenyl-1-pyrimidin-2-yl-1H-indole (5aa), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.00(s, 3H), 5.12~5.13 (m, 2H), 6.70 (s, 1H), 7.19 (t, *J* = 4.80 Hz, 1H), 7.23 (td, *J* = 1.16, 7.68 Hz, 1H), 7.26~7.30 (m, 1H), 7.61~7.63 (m, 1H), 8.16 (d, *J* = 8.12 Hz, 1H), 8.84 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 22.6, 107.4, 113.0, 114.9, 117.5, 120.6, 122.1, 123.5, 129.1, 137.8, 138.0, 142.3, 158.3; HRMS (ESI) calcd. for $C_{15}H_{14}N_3[M+H]^+$:236.1182, found:236.1185.

2-(1-Phenyl-vinyl)-1-pyrimidin-2-yl-1H-indole (5ab), colorless solid, mp: 135.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.68 (s, 1H), 5.77 (s, 1H), 6.84 (t, *J* = 4.80 Hz, 1H), 6.97 (d, *J* = 0.68 Hz, 1H), 7.10~7.17 (m, 3H), 7.27~7.40 (m, 4H), 7.74 (d, *J* = 7.52 Hz, 1H), 8.30~8.32 (m, 1H), 8.52 (d, *J* = 4.84 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 109.9, 113.6, 115.3, 116.8, 120.7, 122.2, 123.9, 126.8, 127.4, 128.0, 129.0, 137.3, 140.2, 140.5, 143.2, 157.3, 157.8; HRMS (ESI) calcd. for $C_{20}H_{16}N_3[M+H]^+$:298.1339, found:298.1335.

2-[1-(6-Methoxy-naphthalen-2-yl)-vinyl]-1-pyrimidin-2-yl-1H-indole (5ac), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.89 (s, 3H), 5.74 (d, *J* = 14.84 Hz, 2H), 6.73 (t, *J* = 4.80 Hz, 1H), 6.97 (s, 1H), 7.02 (s, 1H), 7.05 (dd, *J* = 2.28, 9.0 Hz, 1H), 7.31 (t, *J* =

7.44 Hz, 1H), 7.36 (t, *J* = 7.16 Hz, 1H), 7.47 (d, *J* = 8.56 Hz, 1H), 7.51~7.56 (m, 3H), 7.73 (d, *J* = 7.56 Hz, 1H), 8.29 (d, *J* = 8.16 Hz, 1H), 8.43 (d, *J* = 4.76 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 55.2, 105.5, 109.9, 113.7, 115.1, 116.8, 118.7, 120.7, 122.2, 123.8, 125.4, 125.7, 126.5, 128.4, 129.1, 129.7, 133.8, 135.8, 137.3, 140.4, 143.2, 157.4, 157.6; HRMS (ESI) calcd. for $C_{25}H_{20}N_3O[M+H]^+$:378.1601, found:37 8.1605.

2-(1-Benzyl-vinyl)-1-pyrimidin-2-yl-1H-indole (5ad), brown oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.63 (s, 2H), 5.09 (d, *J* = 1.44 Hz, 1H), 5.30 (t, *J* = 0.56 Hz, 1H), 6.62 (s, 1H), 7.17~7.34 (m, 8H), 7.60 (dd, *J* = 0.76, 7.24 Hz,1H), 8.28 (dd, *J* = 0.52, 8.16 Hz, 1H), 8.86 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 42.7, 108.4, 113.5, 116.2, 117.5, 120.6, 122.1, 123.6, 126.2, 127.9, 128.3, 129.2, 137.7, 139.2, 141.3, 142.3, 157.8, 158.3; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$:312.1495, found: 312.1488.

(*E*)-3-(1-Pyrimidin-2-yl-1H-indol-2-yl)-but-2-enoic acid methyl ester (5ae), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.33 (d, *J* = 1.20 Hz, 3H), 3.77 (s, 3H), 6.16 (d, *J* = 1.20Hz, 1H), 6.80 (s, 1H), 7.16 (td, *J* = 0.76, 4.84 Hz, 1H), 7.28 (d, *J* = 7.44 Hz, 1H), 7.33~7.37 (m, 1H), 7.64 (d, *J* = 7.52 Hz, 1H), 8.38 (dd, *J* = 0.36, 8.24 Hz, 1H), 8.79 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 20.0, 51.0, 109.6, 114.0, 116.9, 117.4, 121.1, 122.6, 124.6, 128.8, 138.3, 142.3, 150.4, 157.9, 158.3, 167.2; HRMS (ESI) calcd. for $C_{17}H_{15}N_3NaO_2[M+Na]^+$:316.1056, found: 316.1049.

(*E*)-2-(1-Methyl-propenyl)-1-pyrimidin-2-yl-1H-indole (5af), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.78~1.79 (m, 6H), 5.81~5.87 (m, 1H), 6.57 (s, 1H), 7.16 (t, *J* = 4.84 Hz, 1H), 7.21~7.27 (m, 2H), 7.57~7.59 (m, 1H), 8.17 (d, *J* = 8.24 Hz, 1H), 8.82 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 14.1, 16.9, 106.4, 113.1, 117.3, 120.3, 121.9, 123.1, 124.7, 129.3, 129.7, 137.5, 139.8, 144.5, 158.3; HRMS (ESI) calcd. for $C_{16}H_{16}N_3[M+H]^+$: 250.1339, found: 250.1341.

(*E*)-2-(1-Methyl-2-phenyl-vinyl)-1-pyrimidin-2-yl-1H-indole (5ag),[5] red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.22 (d, *J* = 0.96 Hz, 3H), 6.78 (s, 1H), 6.85 (s, 1H), 7.12 (t, *J* = 4.84 Hz, 1H), 7.31~7.40 (m, 3H), 7.44~7.46 (m, 4H), 7.71 (d, *J* = 7.76 Hz, 1H), 8.34 (d, *J* = 8.20 Hz, 1H), 8.82 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 19.3, 107.4, 113.4, 117.5, 120.7, 122.3, 123.6, 126.7, 128.3, 129.2, 129.3, 129.4, 131.4, 138.0, 144.6, 158.2, 158.4; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found: 312.1489.

(*E*)-2-[1-(3-Nitro-benzylidene)-propyl]-1-pyrimidin-2-yl-1H-indole (5ah), red oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.09 (t, *J* = 7.48 Hz, 3H), 2.55 (q, *J* = 7.48 Hz, 2H), 6.66 (s, 1H), 6.80 (s, 1H), 7.14 (t, *J* = 4.80 Hz, 1H), 7.27~7.38 (m, 2H), 7.52 (t, *J* = 7.96 Hz, 1H), 7.64 (d, *J* = 7.68 Hz, 1H), 7.68 (d, *J* = 7.24 Hz, 1H), 8.12 (dd, *J* = 1.36, 8.16 Hz, 1H), 8.23 (s, 1H), 8.37 (d, *J* = 8.32 Hz, 1H), 8.80 (d, *J* = 4.84 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 13.1, 25.1, 108.6, 113.8, 117.4, 120.6, 121.4, 122.3, 123.4, 123.8, 126.2, 129.2, 134.8, 137.8, 139.4, 141.3, 141.7, 148.3, 157.9, 158.2; HRMS (ESI) calcd. for $C_{22}H_{18}N_4NaO_2[M+Na]^+$: 393.1322, found: 393.1326.

(*E*)-3-Phenyl-2-(1-pyrimidin-2-yl-1H-indol-2-yl)-acrylonitrile (5ai), colorless solid, mp: 177.4 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.95 (s, 1H), 7.20 (t, *J* = 4.68 Hz, 1H), 7.28~7.34 (m, 1H), 7.40~7.51 (m, 5H), 7.69 (d, *J* = 7.72 Hz, 1H), 7.93 (d, *J* = 6.52 Hz,

2H), 8.51 (d, *J* = 8.40 Hz, 1H), 8.83 (d, *J* = 4.76 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 106.1, 110.6, 114.6, 117.3, 117.8, 121.1, 122.8, 125.0, 128.6, 129.0, 129.3, 130.6, 133.8, 134.9, 137.7, 142.6, 157.5, 158.3; HRMS (ESI) calcd. for $C_{21}H_{15}N_4[M+H]^+$: 323.1291, found: 323.1288.

2-(2-Methyl-1-phenyl-propenyl)-1-pyrimidin-2-yl-1H-indole (5aj), yellow solid, mp: 131.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.89 (s, 3H), 1.94 (s, 3H), 6.66 (s, 1H), 7.02 (t, *J* = 4.80 Hz, 1H), 7.05~7.09 (m, 1H), 7.13~7.15 (m, 4H), 7.21~7.27 (m, 2H), 7.63~7.65 (m, 1H), 8.11 (d, *J* = 7.60 Hz, 1H), 8.66 (d, *J* = 4.80 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 22.2, 23.4, 108.8, 113.2, 117.0, 120.2, 121.7, 123.0, 126.0, 127.3, 129.1, 129.3, 130.1, 134.3, 136.5, 140.7, 141.1, 157.6, 157.9; HRMS (ESI) calcd. for $C_{22}H_{20}N_3[M+H]^+$: 326.1652, found: 326.1654.

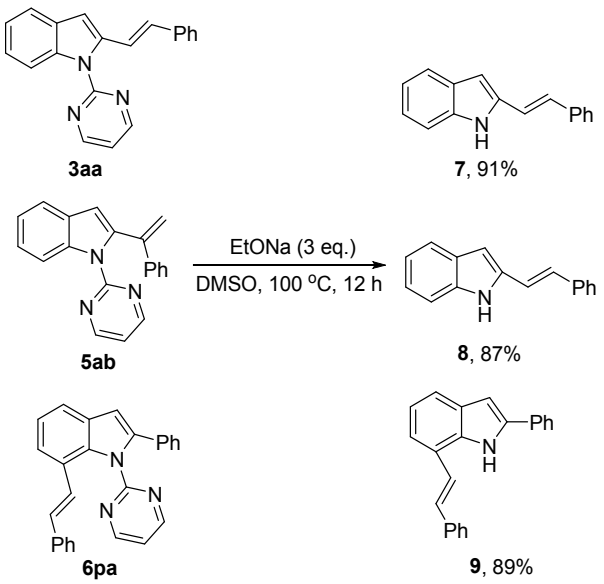
4. The general procedure for the direct C7-olefination of indoles

To an oven-dried pressure tube were sequentially added indole **1** (0.5 mmol), acrylic acid **2** (0.5 mmol), $[Rh(COD)_2]OTf$ (11.71 mg, 5.0 mol%), $(t$BuCO$)_2$O (140.0 mg，0.5 mmol) and anhydrous toluene (3.0 mL). After being degassed three times, the tube was heated and stirred vigorously at 140 °C for 2 h in an oil bath under nitrogen atmosphere. Then the tube was removed from the oil bath and cooled to room temperature. The solvent was removed by vacuum evaporation, and the residue was purified by column chromatography on silica gel using a mixture of ethyl acetate and hexane to give the pure product.

(*E*)-2-Phenyl-1-pyrimidin-2-yl-7-styryl-1H-indole (6pa), yellow solid, mp: 118.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.77 (s, 1H), 6.81 (d, *J* = 24.96 Hz, 2H), 7.15~7.17 (m, 3H), 7.27~7.30 (m, 6H), 7.37~7.43 (m, 4H), 7.69 (dd, *J* = 0.96, 7.80 Hz, 1H), 8.71 (d, *J* = 4.88 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 105.6, 119.7, 120.5, 121.7, 122.3, 123.6, 126.0, 126.2, 127.3, 127.6, 128.2, 128.5, 129.0, 129.7, 129.8, 132.8, 136.4, 137.5, 142.3, 158.4, 159.9; HRMS (ESI) calcd. for $C_{26}H_{20}N_3[M+H]^+$: 374.1652, found: 374.1655.

(*E*)-2-Methyl-1-pyrimidin-2-yl-7-styryl-1H-indole (6qa), colorless solid, mp: 159.8 °C ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.46 (s, 3H), 6.48 (s, 1H), 6.57 (d, *J* = 16.12 Hz, 1H), 6.80 (d, *J* = 16.12 Hz, 1H), 7.10 (d, *J* = 7.76 Hz, 2H), 7.19~7.29 (m, 5H), 7.38 (d, *J* = 7.40 Hz, 1H), 7.53 (d, *J* = 7.68 Hz, 1H), 8.80 (d, *J* = 4.84 Hz, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 14.2, 104.4, 118.8, 119.5, 121.4, 121.6, 122.9, 126.1, 126.5, 127.2, 128.5, 130.3, 135.1, 137.6, 138.3, 158.5, 159.0; HRMS (ESI) calcd. for $C_{21}H_{18}N_3[M+H]^+$: 312.1495, found: 312.1497.

5. The general procedure for the deprotection of olefinated indoles



To an oven-dried pressure tube was added the olefinated indole (0.5 mmol), freshly prepared EtONa (1.5 mmol) and dry DMSO (3.0 mL). After being degassed by nitrogen for three times, the tube was heated and stirred vigorously at 100 °C for 12 h in an oil bath. Then the tube was removed from the oil bath and cooled to room temperature. The mixture was poured into 25 mL water and extracted with CH_2Cl_2 (20 mL × 3). The organic phase was dried by Na_2SO_4 and filtered. The filtrate was concentrated and the residue was purified by column chromatography on silica gel using a mixture of ethyl acetate and hexane to give the unprotected indoles.

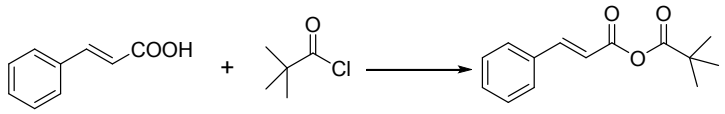
(*E*)-2-Styryl-1H-indole (7),[11] white solid, mp: 217.5 °C; ^{1}H NMR (400 MHz, d^6-DMSO) δ 6.59 (s, 1H), 6.98 (t, *J* = 7.28 Hz, 1H), 7.11 (t, *J* = 7.44 Hz, 1H), 7.18~7.29 (m, 3H), 7.35~7.42 (m, 3H), 7.50 (d, *J* = 7.80 Hz, 1H), 7.57 (d, *J* = 7.56 Hz, 2H), 11.39 (s, 1H); ^{13}C NMR (100.6 MHz, d^6-DMSO) δ 103.5, 111.4, 119.7, 120.0, 120.5, 122.5, 126.6, 127.6, 128.0, 128.9, 129.3, 137.2, 137.4, 137.8; HRMS (ESI) calcd. for $C_{16}H_{14}N[M+H]^+$: 220.1121, found: 220.1123.

2-(1-Phenyl-vinyl)-1H-indole (8),[12] yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.37 (s, 1H), 5.61 (s, 1H), 6.51 (s, 1H), 7.07~7.12 (m, 1H), 7.16~7.18 (m, 1H), 7.38~7.40 (m, 4H), 7.47~7.49 (m, 3H), 8.11 (br, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 103.4, 110.8, 112.8, 120.2, 120.9, 122.8, 128.3, 128.4, 128.6, 128.7, 136.5, 137.9, 140.1, 141.7; HRMS (ESI) calcd. for $C_{16}H_{14}N[M+H]^+$: 220.1121, found: 220.1124.

(*E*)-2-Phenyl-7-styryl-1H-indole (9), yellow solid, mp: 164.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.91 (d, *J* = 1.92 Hz, 1H), 7.18~7.25 (m, 2H), 7.35~7.52 (m, 8H), 7.63 (t, *J* = 7.76 Hz, 3H), 7.75 (d, *J* = 7.44 Hz, 2H), 8.60 (br, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 100.6, 120.3, 120.5, 120.7, 121.4, 124.8, 125.3, 126.5, 127.8, 127.9, 128.8, 129.1, 129.9, 130.0, 132.3, 134.9, 137.5, 138.2; HRMS (ESI) calcd. for $C_{22}H_{18}N[M+H]^+$: 296.1434, found: 296.1438.

6. The mechanistic study

a)

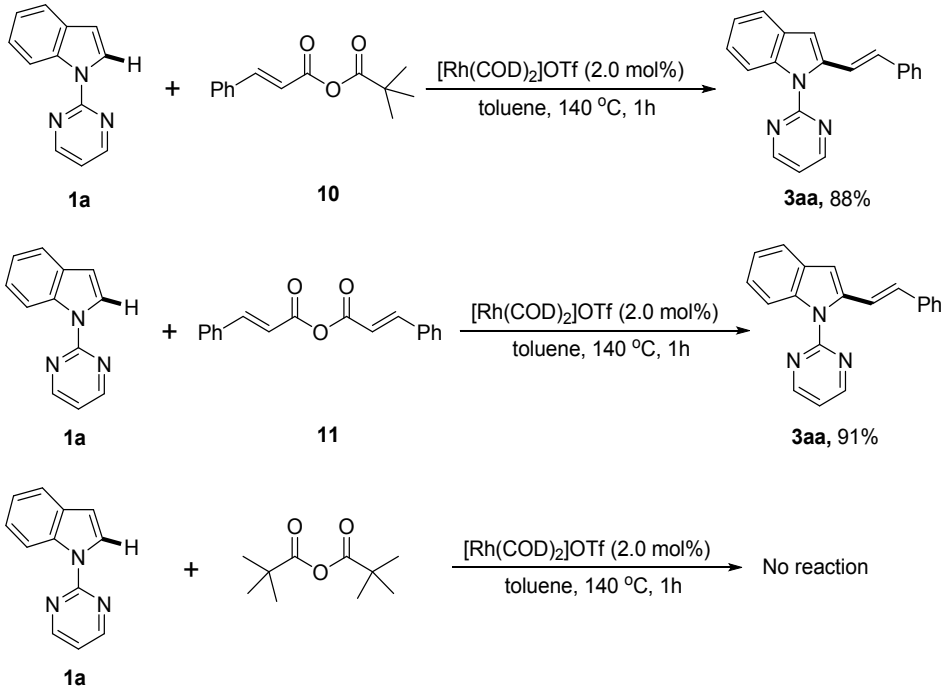


cinnamic pivalic anhydride (**10**)

Preparation of cinnamic pivalic anhydride (**10**): A solution of cinnamic acid (1.48 g, 10 mmol) was added dropwise distilled NEt_3 (1.01g, 10 mmol) in 20 mL of dry THF at -15 °C, and then added trimethyacetyl chloride (1.21 g, 10 mmol) in 10 mL THF at -15 °C. The reaction was monitored by TLC. When the acid disappeared, the reaction was poured into ice-cold saturated $NaHCO_3$ aqueous solution (20 mL). The organic layer was separated and the aqueous solution was extracted with CH_2Cl_2 (20 mL × 3). The combined organic layer was dried over Na_2SO_4, filtered, and concentrated under vacuum to give cinnamic pivalic anhydride (2.11 g, 91%).

Cinnamic pivalic anhydride (10), colorless liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.34 (s, 9H), 6.46 (d, J = 15.92 Hz, 1H), 7.41~7.45 (m, 3H), 7.55~7.58 (m, 2H), 7.77 (d, J = 15.96 Hz, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 26.6, 40.0, 116.9, 128.6, 129.1, 131.3, 133.7, 148.4, 162.7, 174.1; HRMS (ESI) calcd. for $C_{14}H_{17}O_3[M+H]^+$: 233.1172, found: 233.1175.

b) the coupling reaction of anhydrides with **1a**:



General procedure for the reaction of anhydrides with 1a: To an oven-dried pressure tube were sequentially added **1a** (97.6 mg, 0.5 mmol), anhydride (0.5 mmol), $[Rh(COD)_2]OTf$ (4.68 mg, 2.0 mol%) and anhydrous toluene (3.0 mL). The reaction mixture was degassed three times with nitrogen, and then heated and stirred vigorously at 140 °C in an oil bath. After an appropriate reaction time, the tube was removed from the oil bath, and cooled to room temperature. The solvent was removed

and the residue was purified by column chromatography on silica gel using a mixture of ethyl acetate and hexane to give the pure product **3aa**.

c) Procedure for the analysis of the gaseous products by GC-TCD:

To an oven-dried pressure tube were sequentially added indole **1a** (97.6 mg, 0.5 mmol), **2a** (74.1 mg, 0. 5 mmol), $[Rh(COD)_2]OTf$ (4.68 mg, 2.0 mol%), $(t\text{BuCO})_2O$ (93.1 mg, 0.5 mmol) and toluene (3.0 mL). After being degassed three times, the tube was heated and stirred vigorously at 140 °C for 1 h in an oil bath under argon atmosphere. After cooling, the reaction gas was analyzed by GC-TDC with argon as the carrier gas.

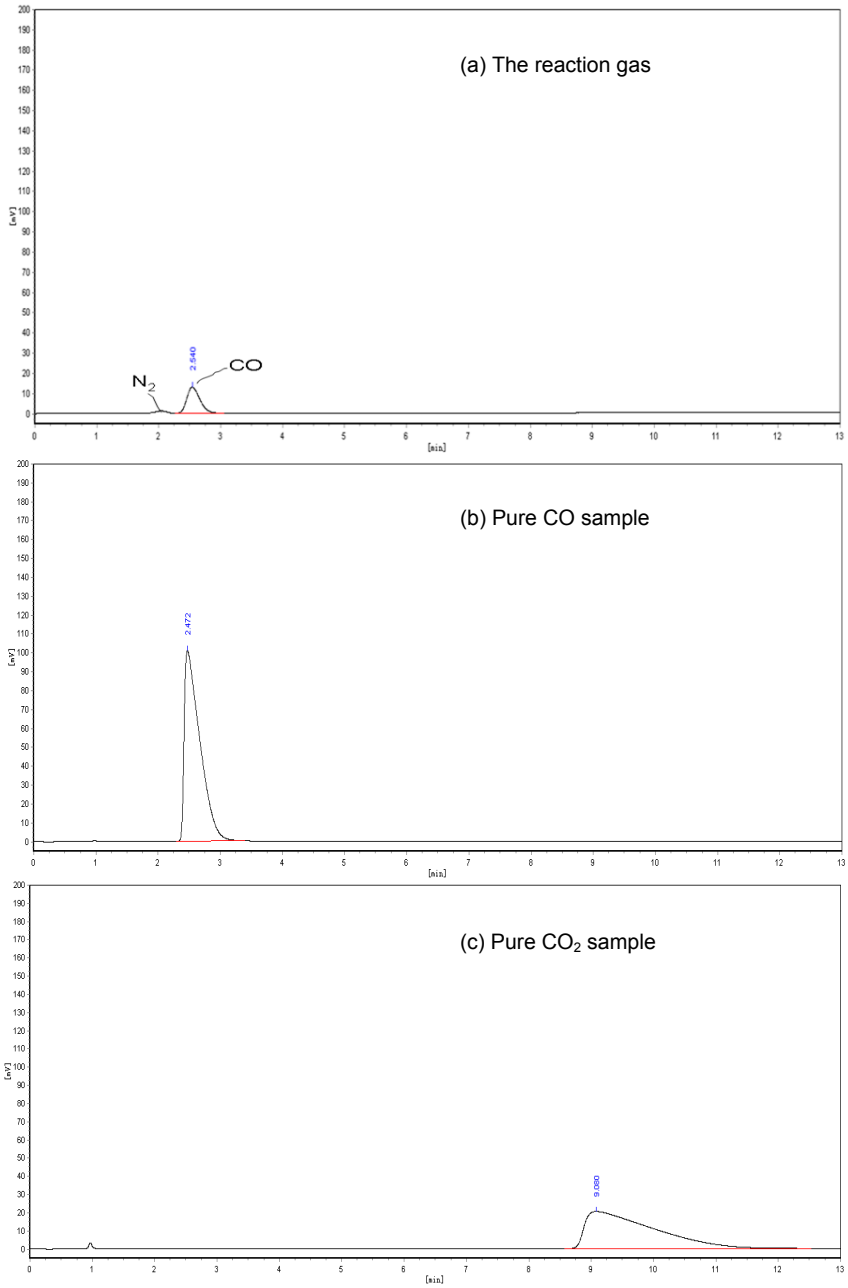


Figure S1. GC analysis indicated the existenc CO, and no CO_2 was produced.

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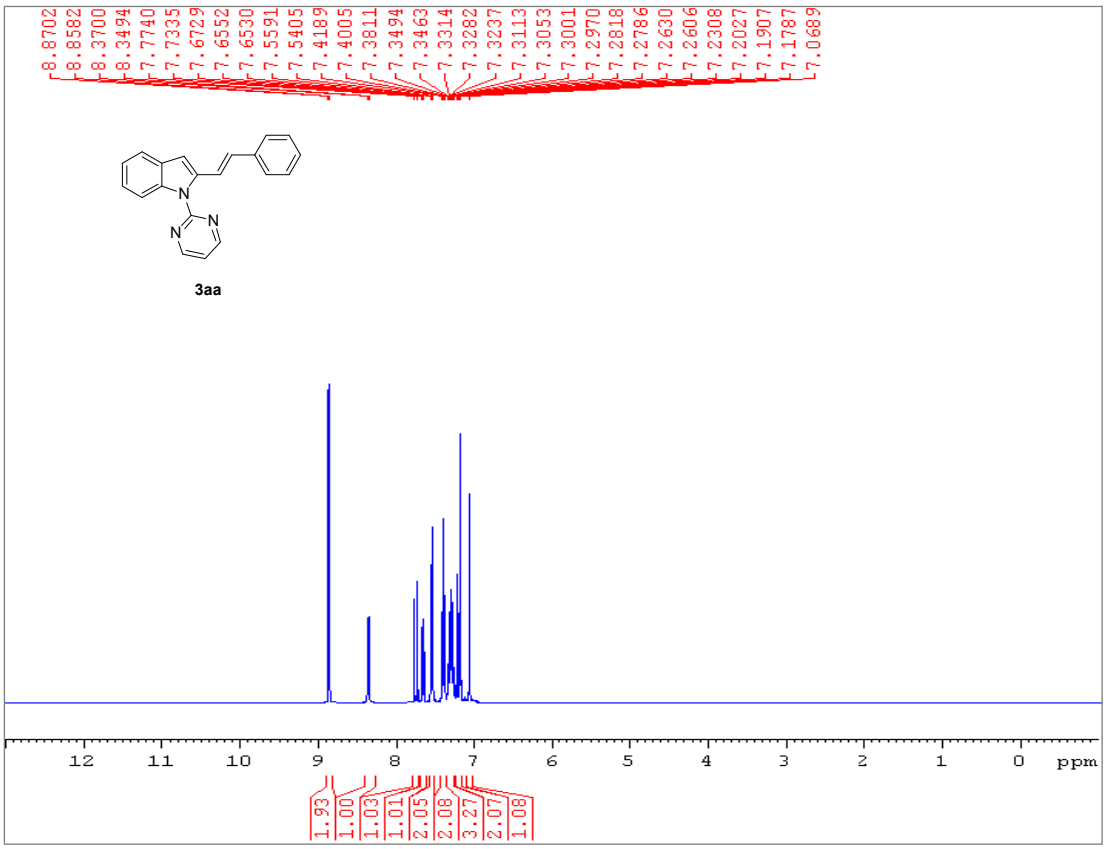
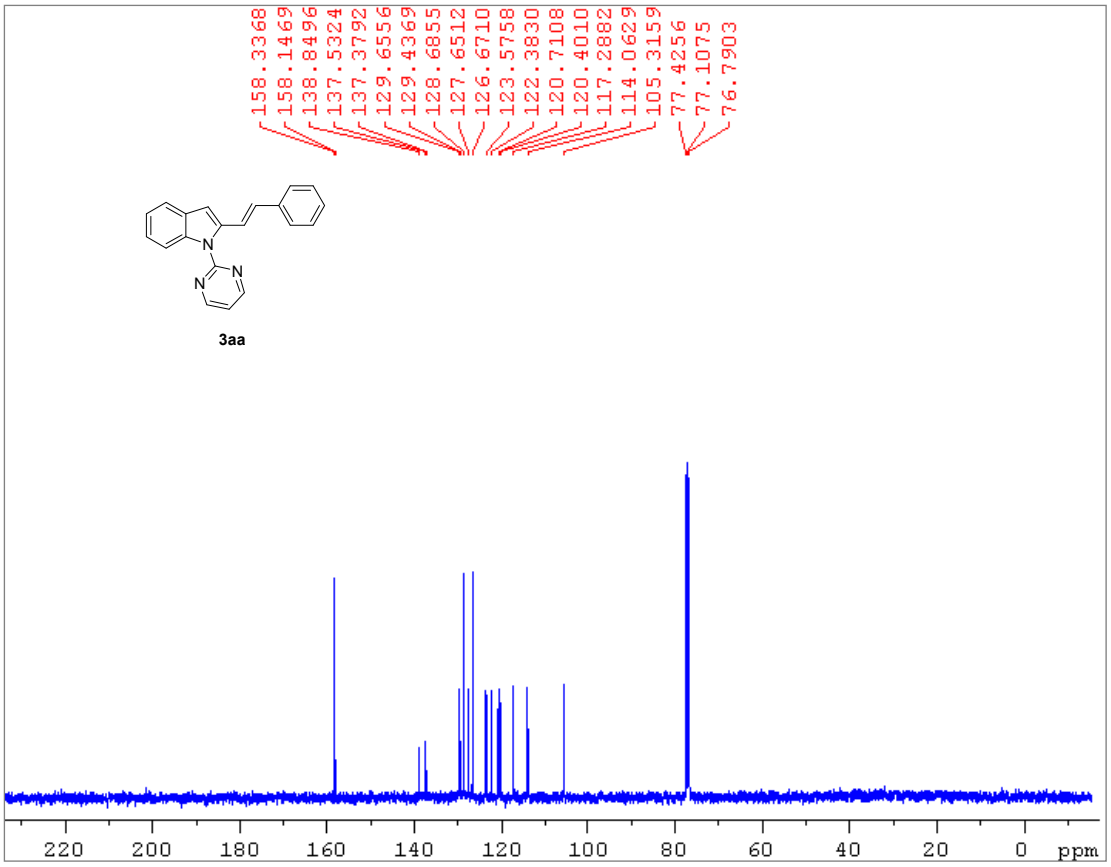
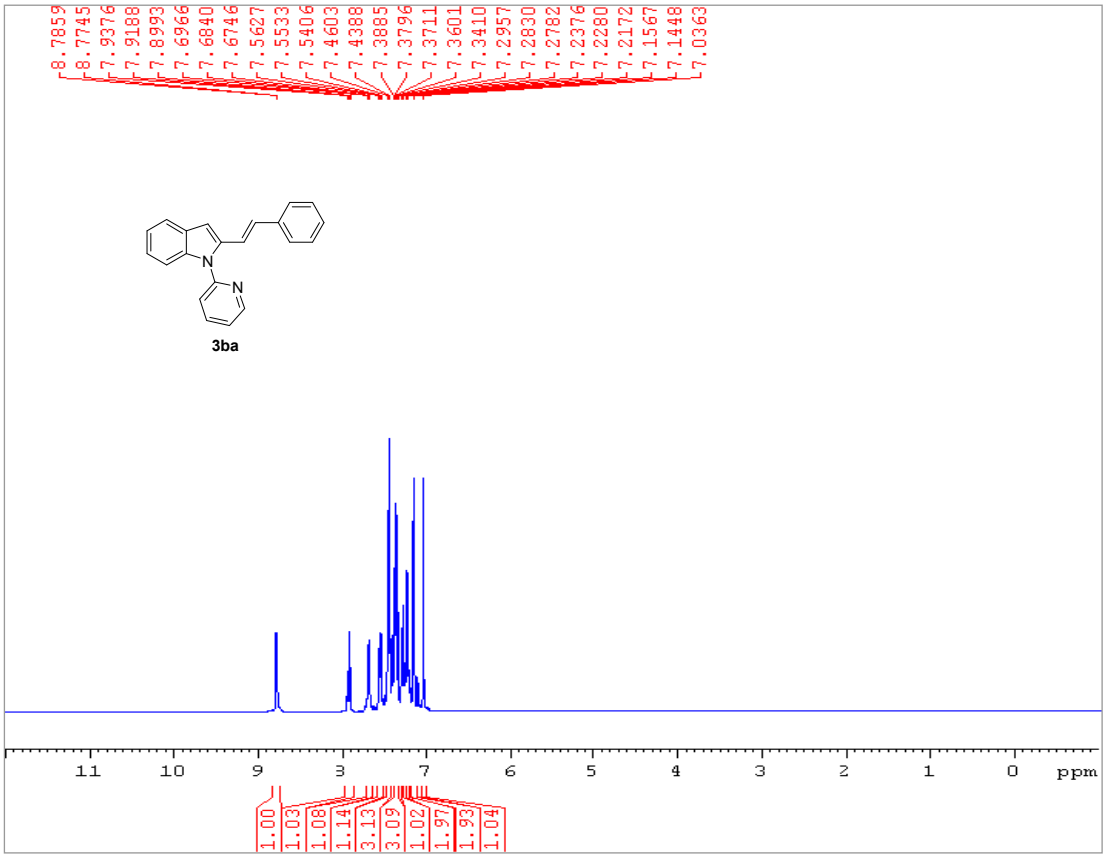
8. ^{1}H and ^{13}C NMR spectra of the olefinated indoles



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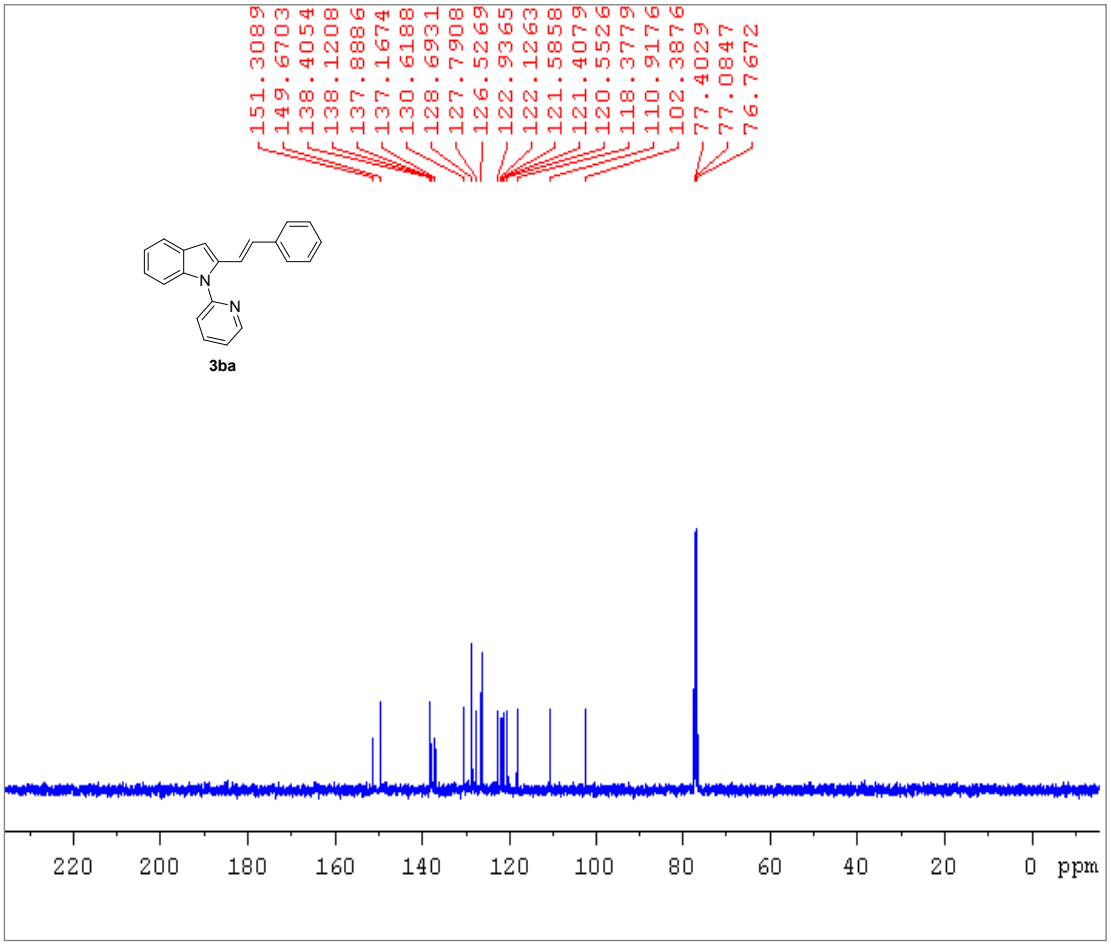
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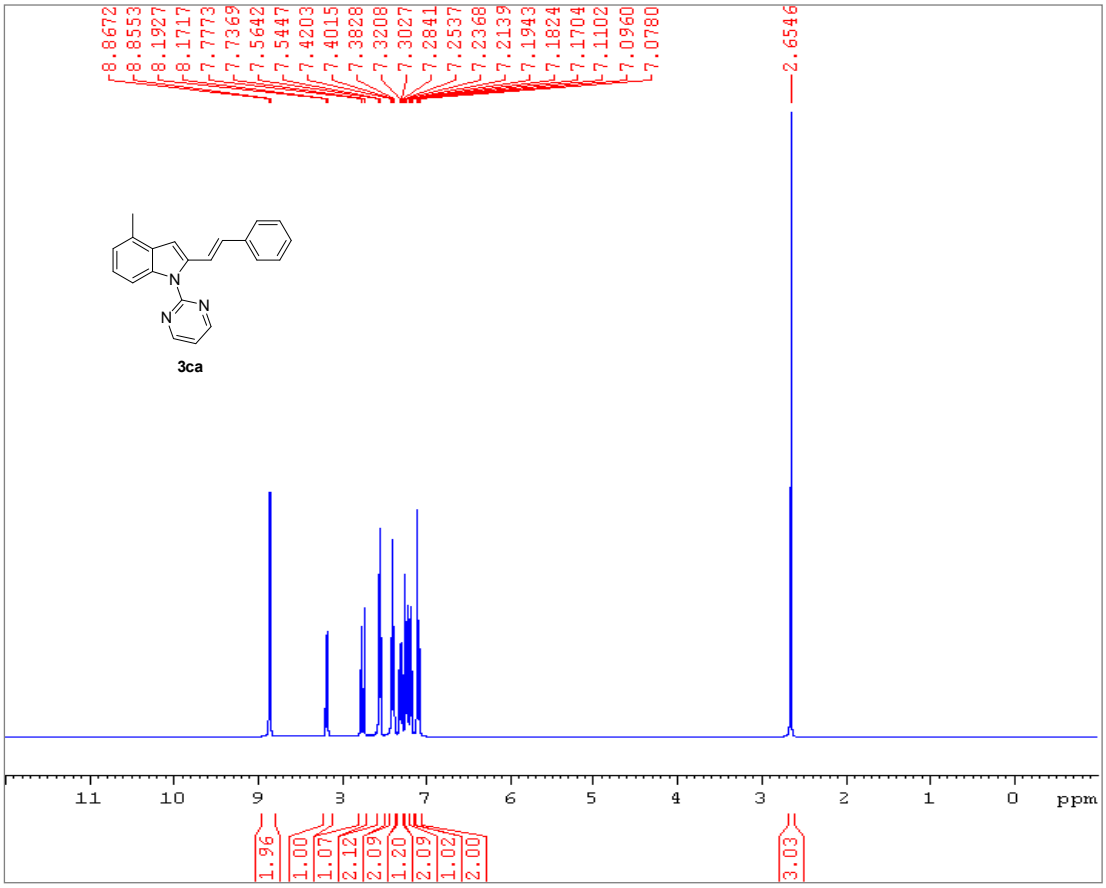
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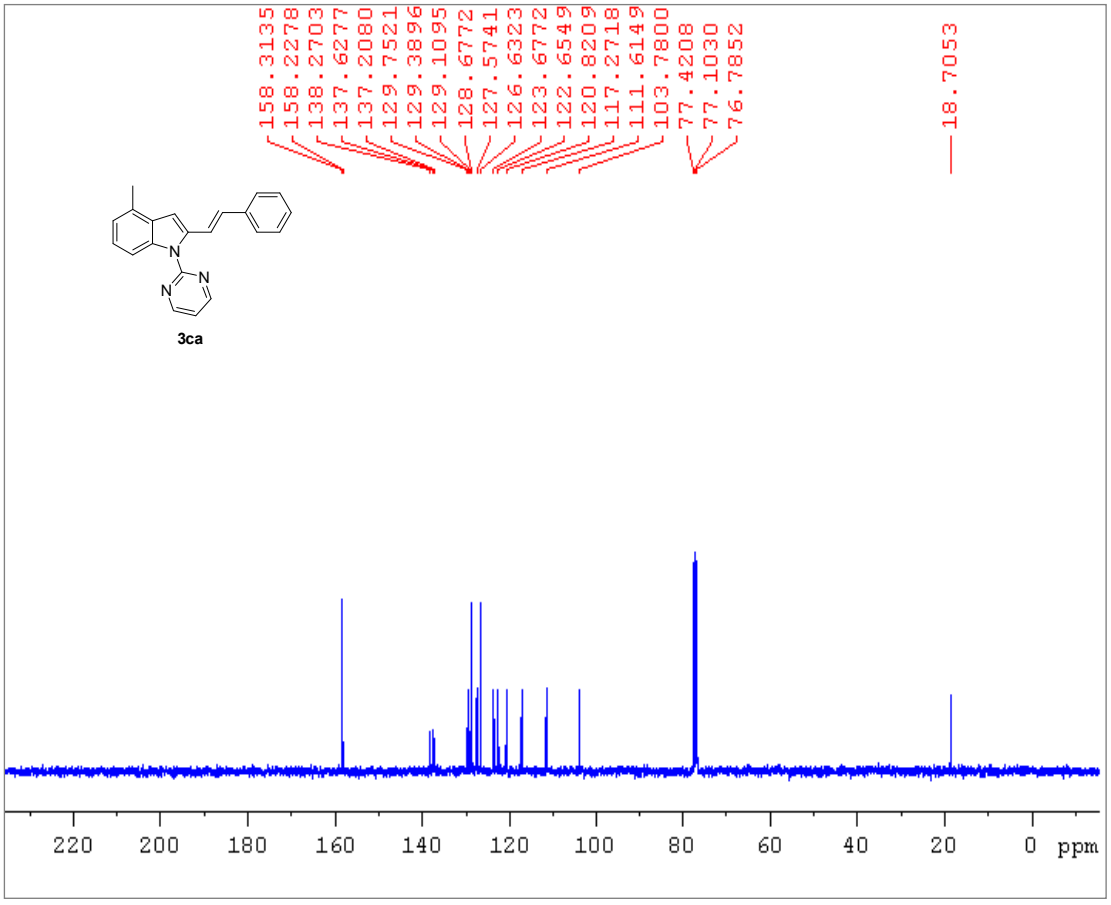
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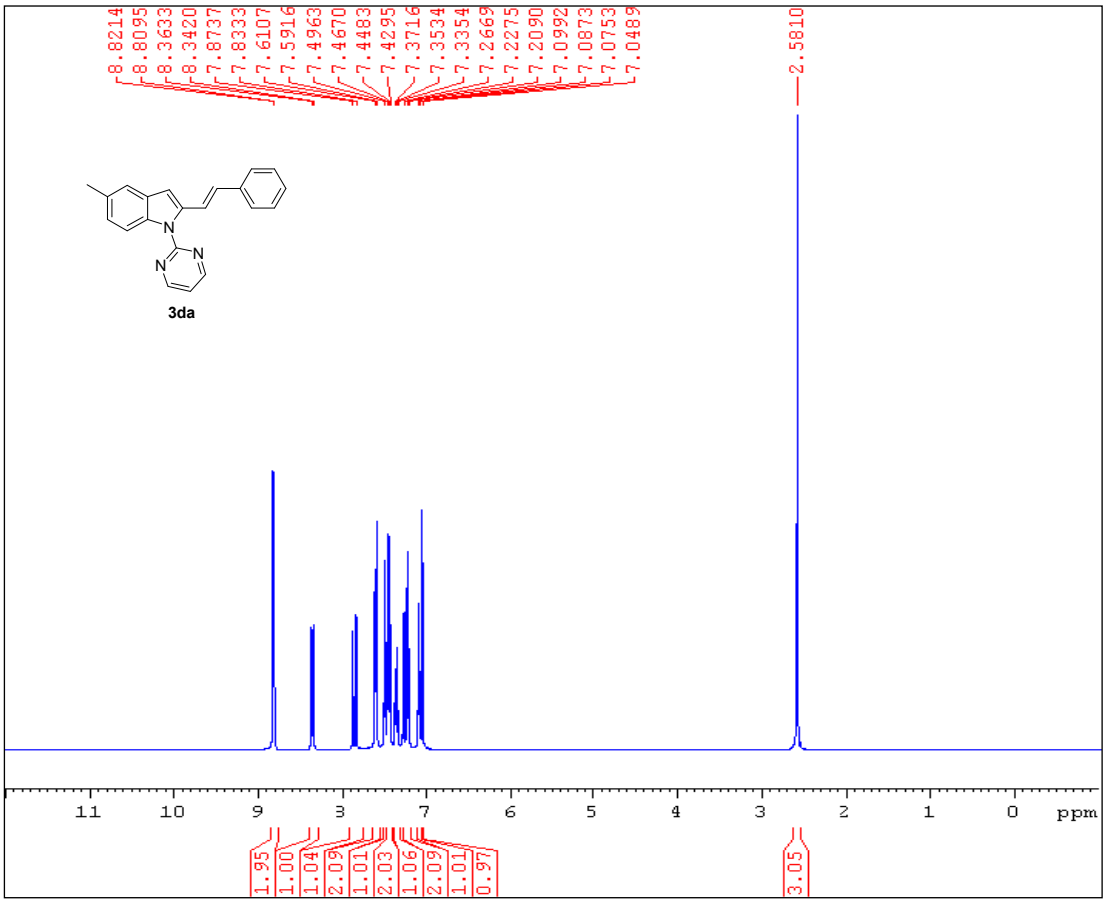
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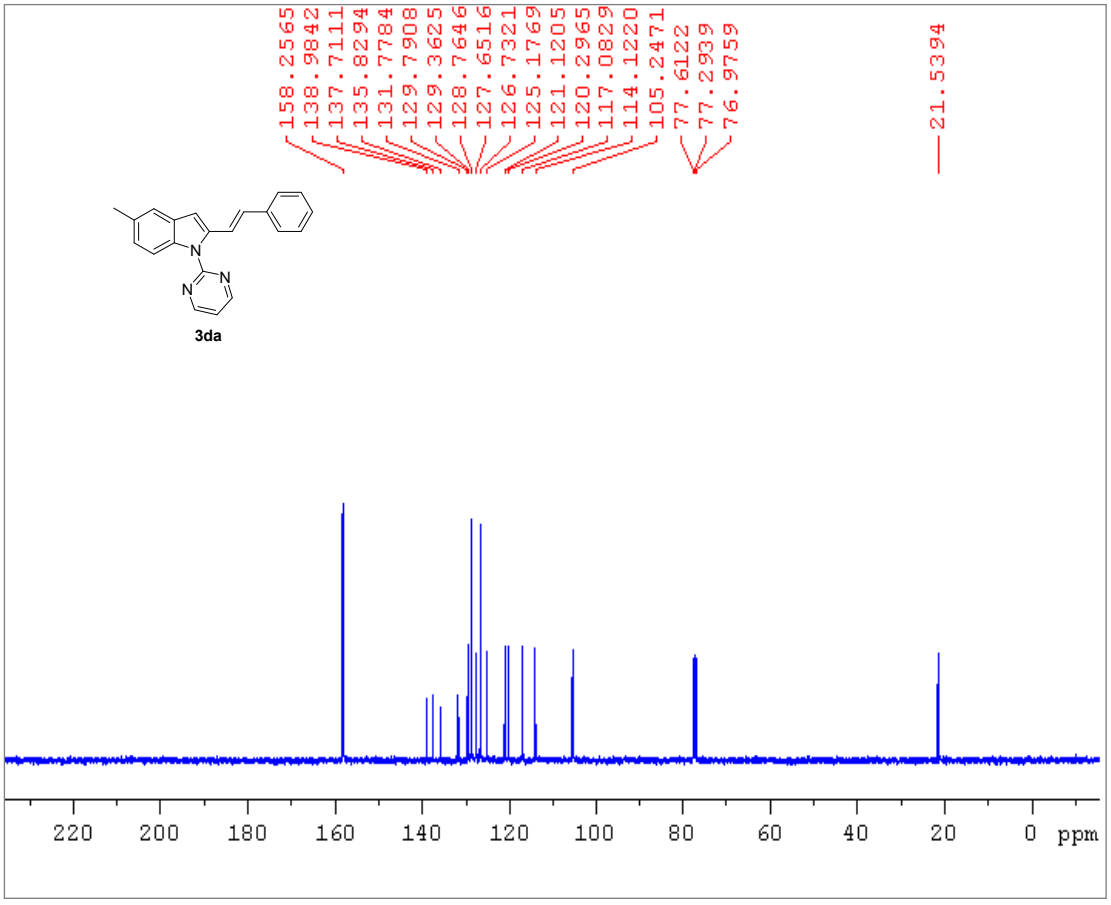
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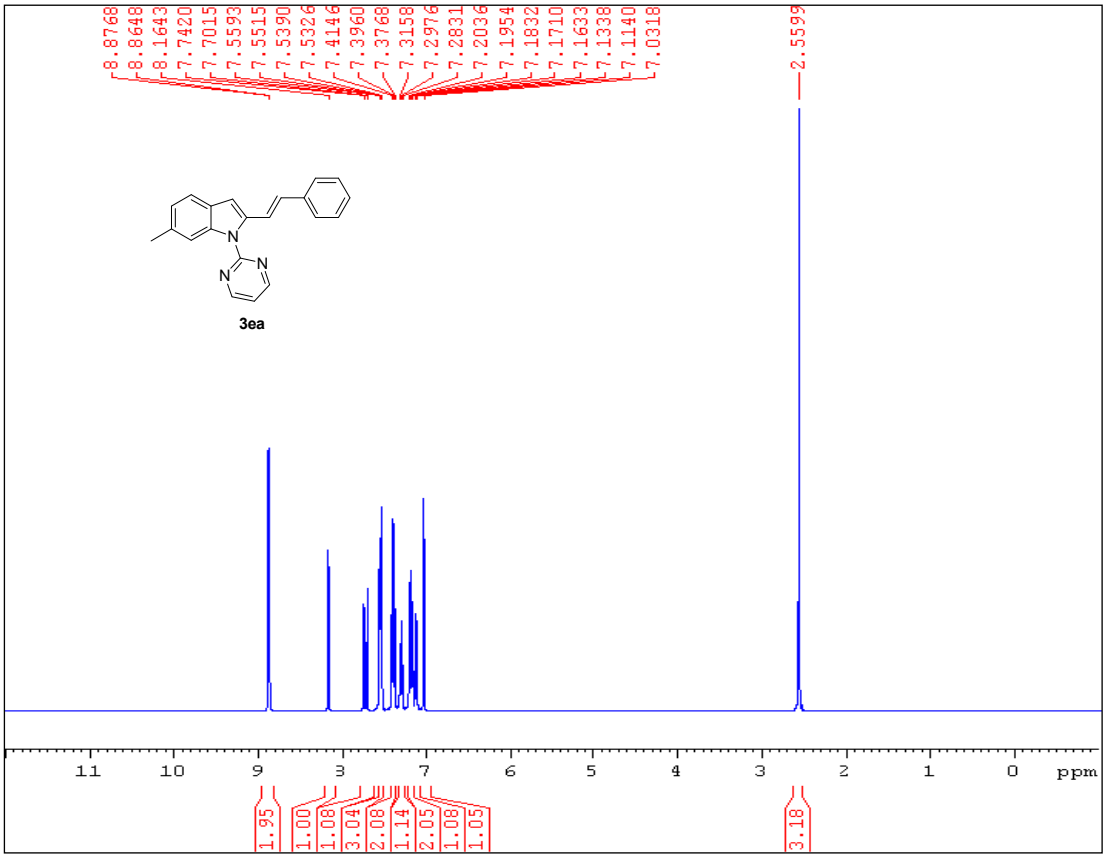
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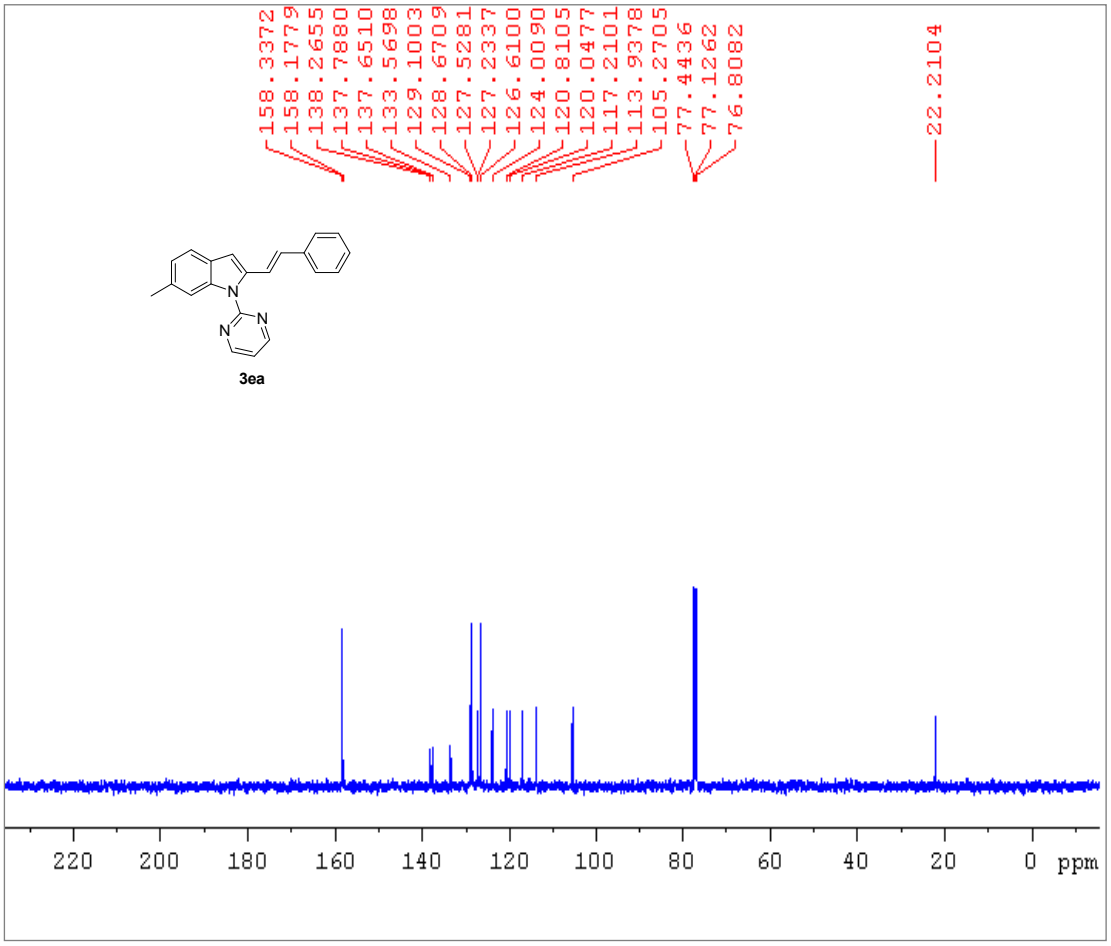
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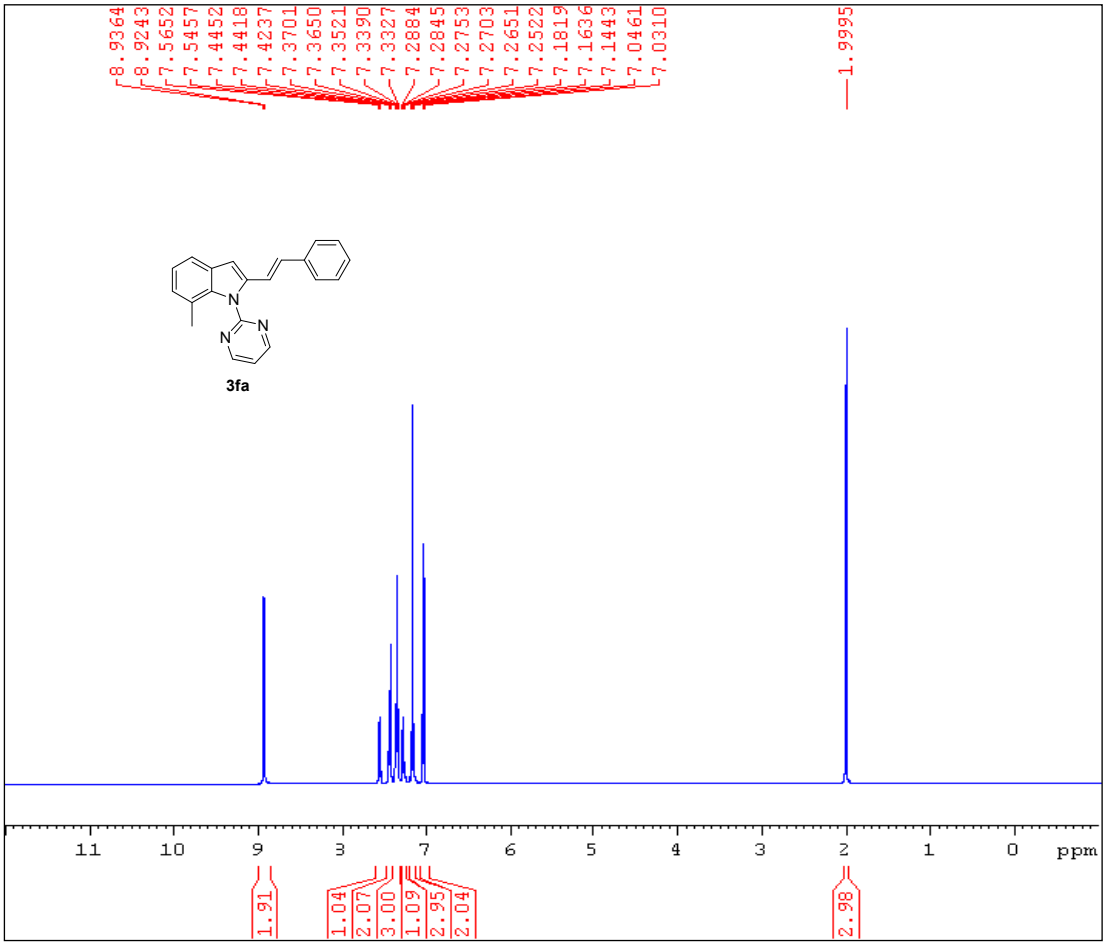
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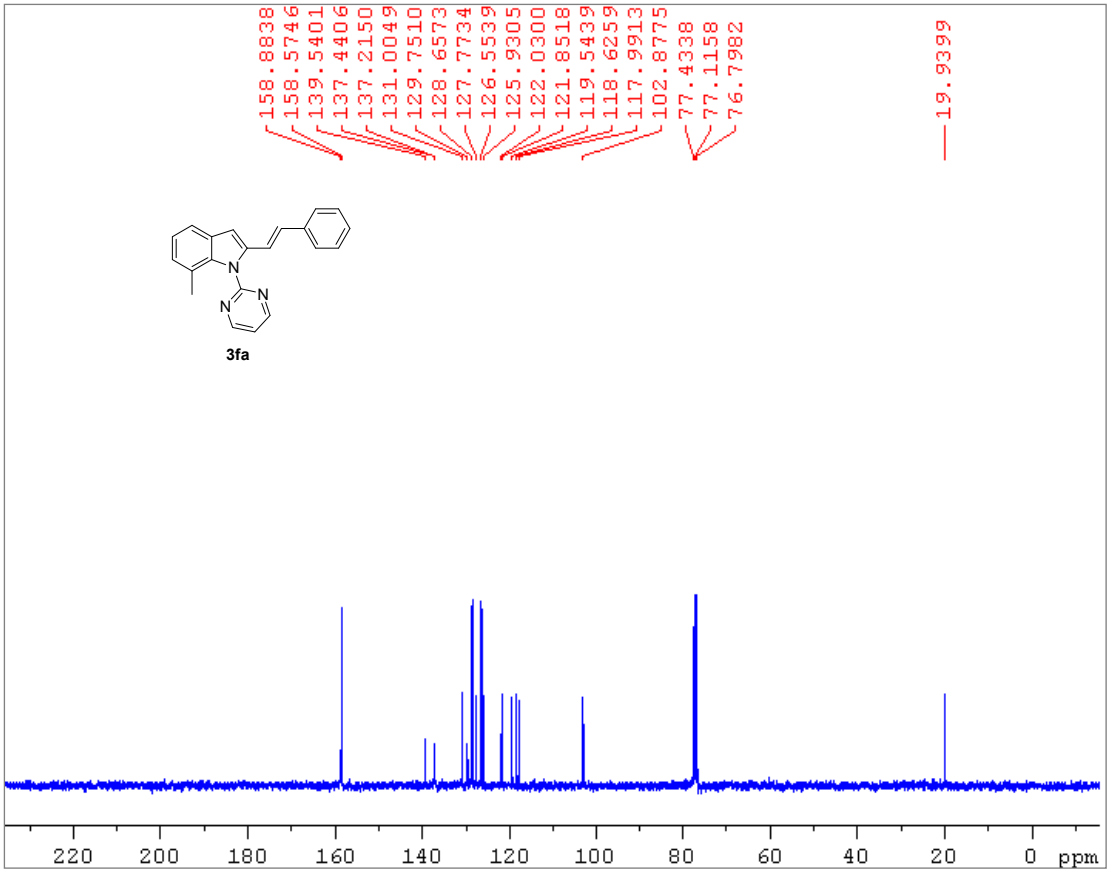
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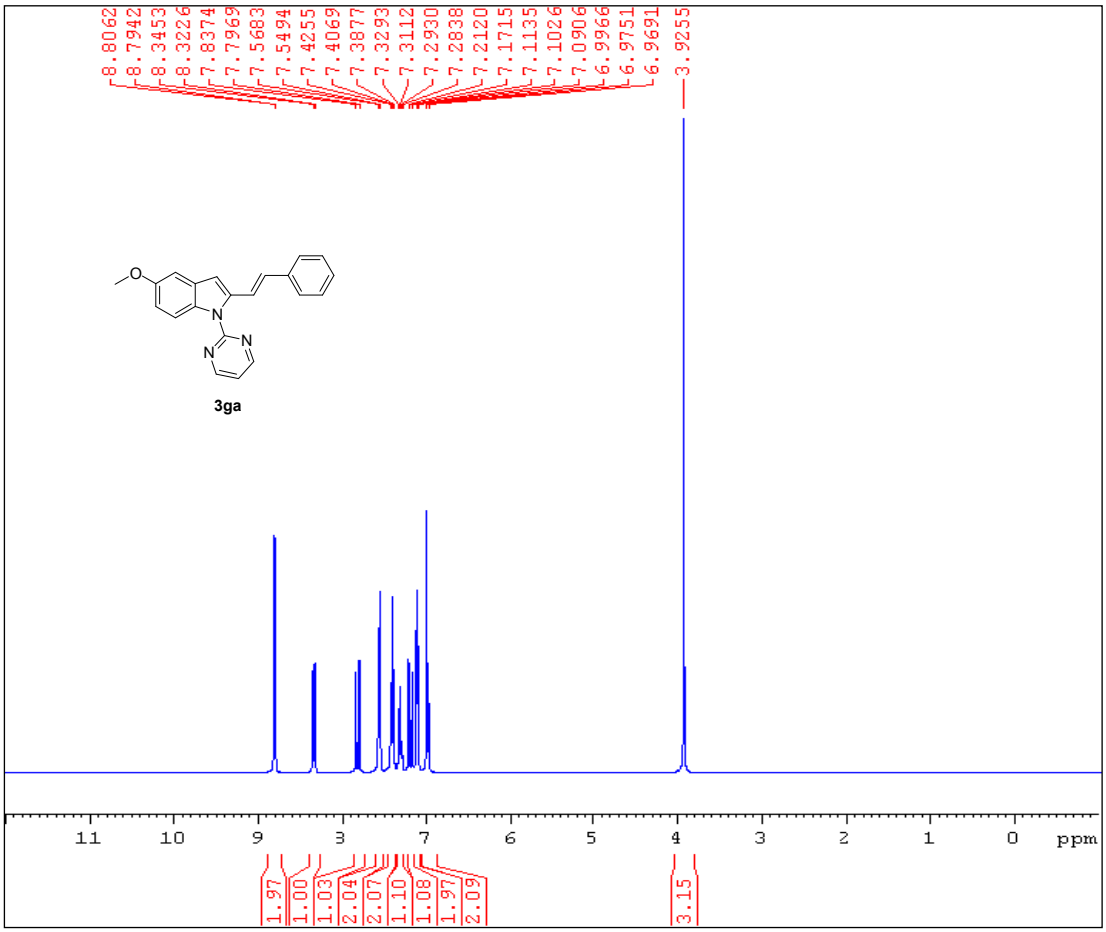
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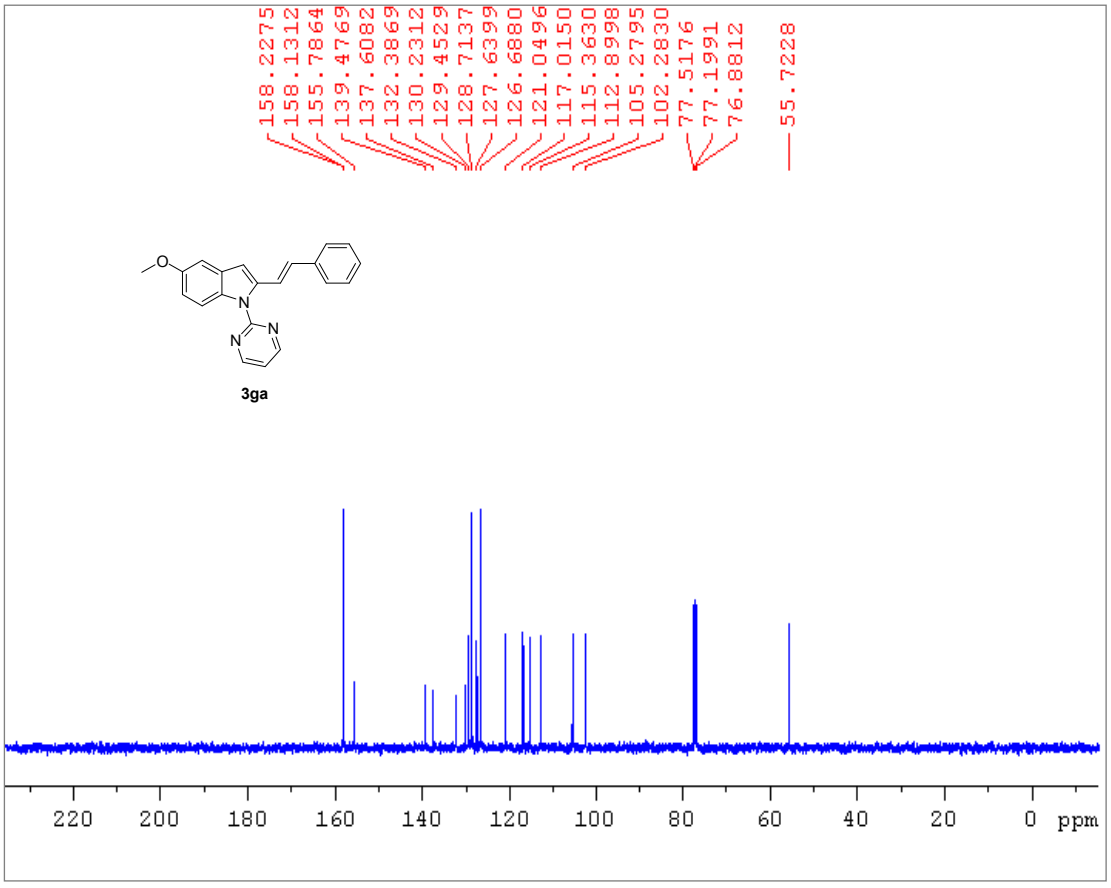
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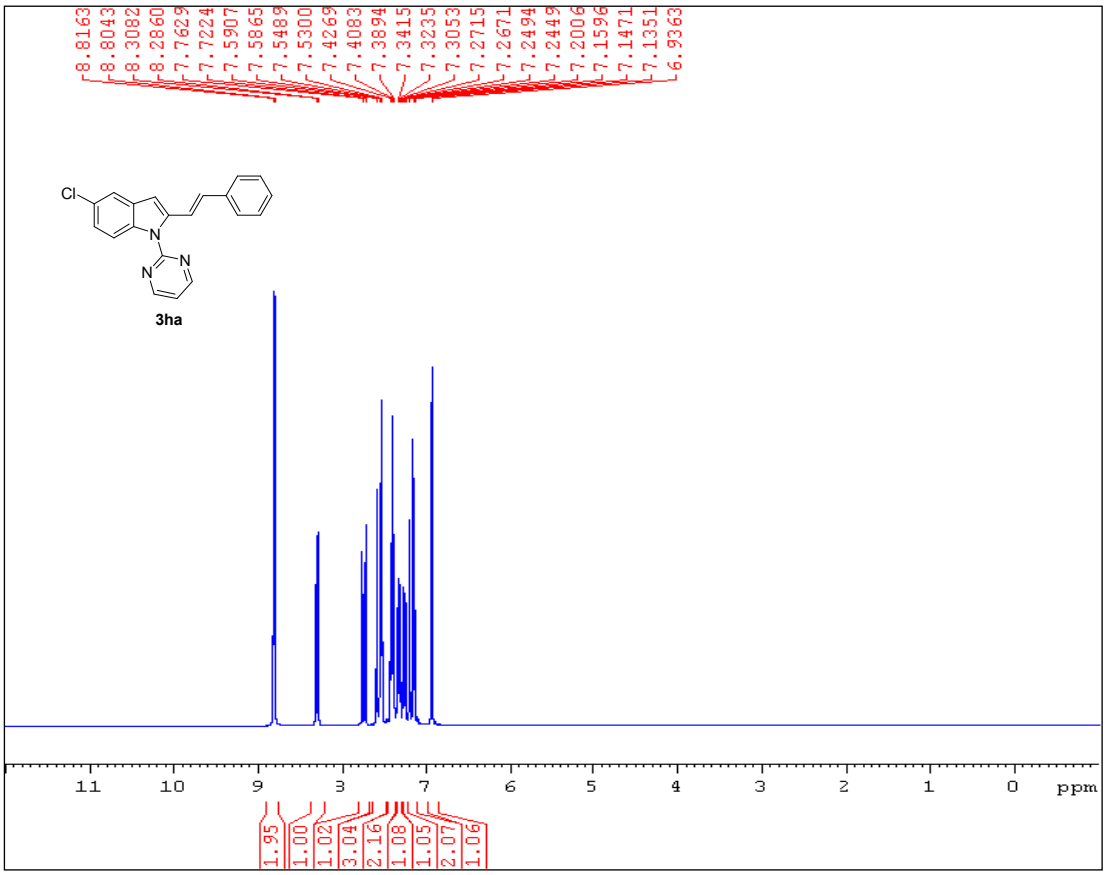
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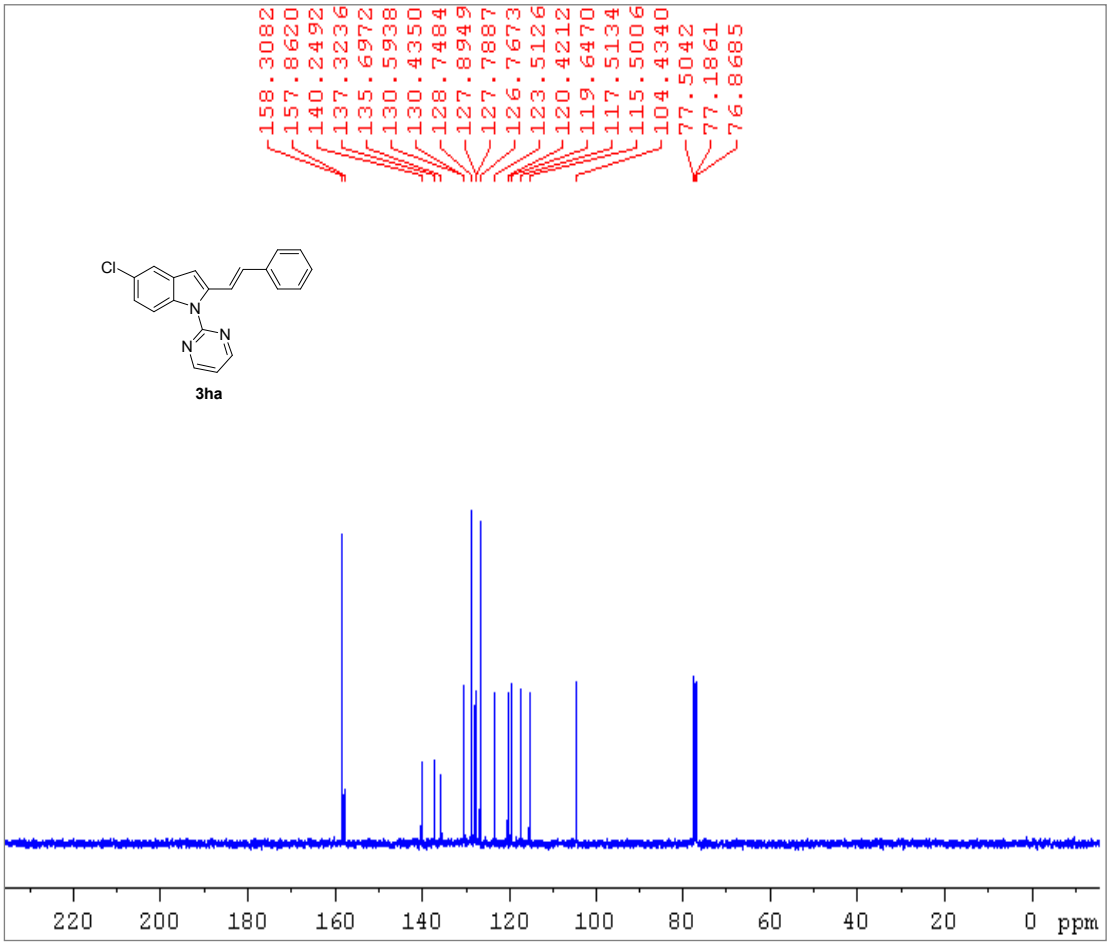
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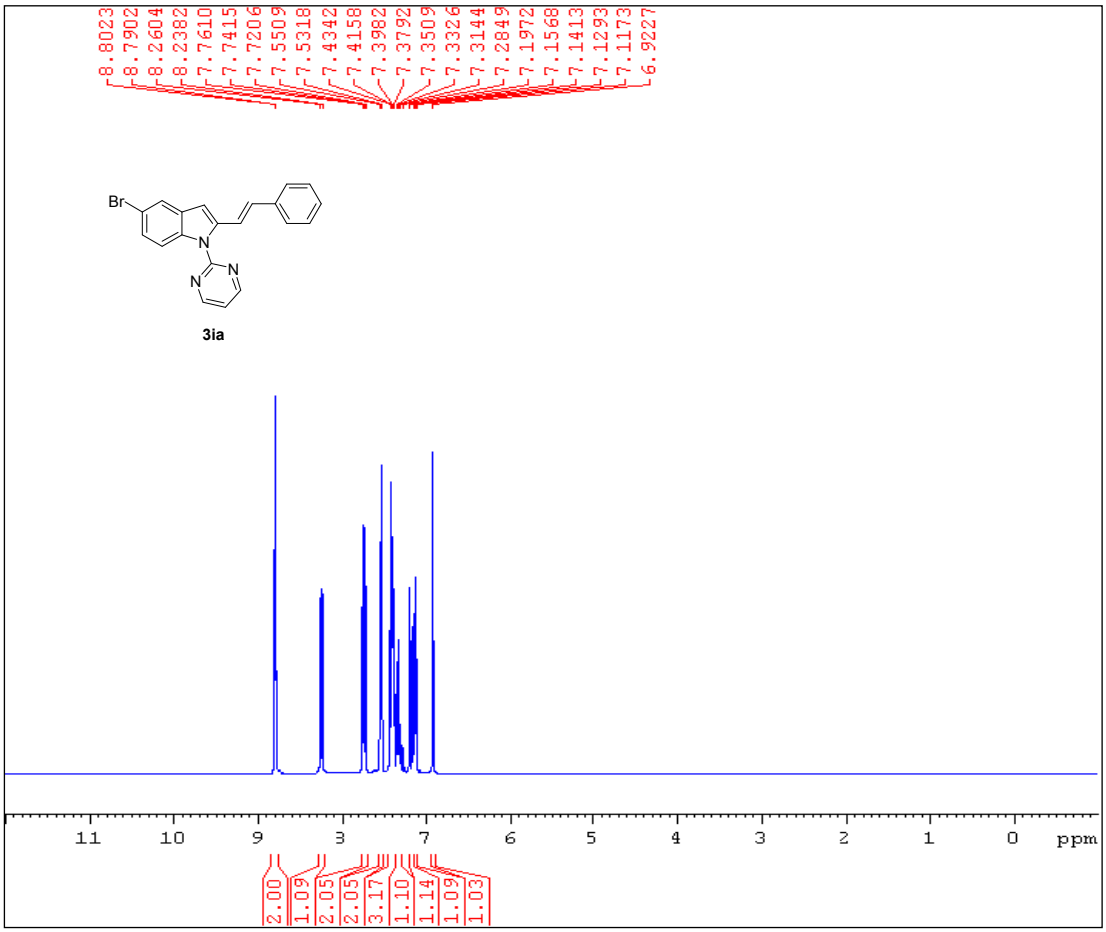
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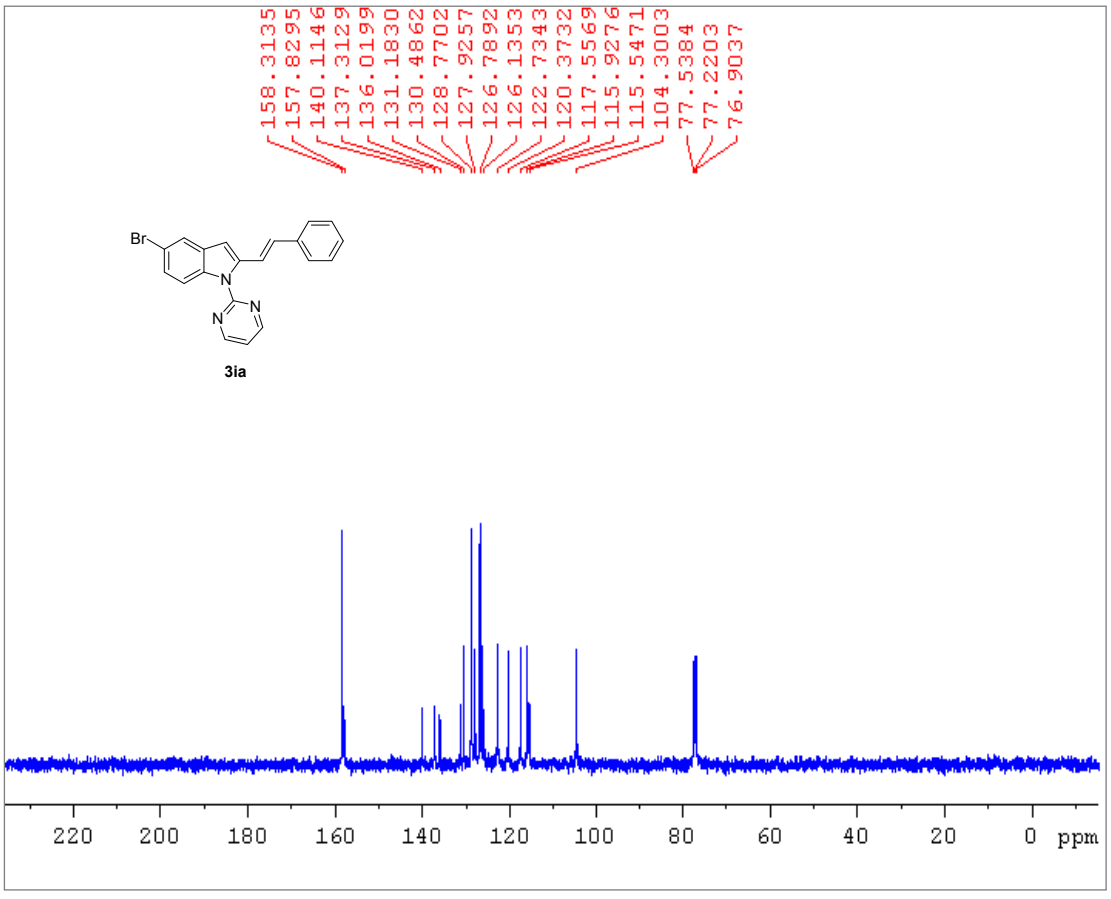
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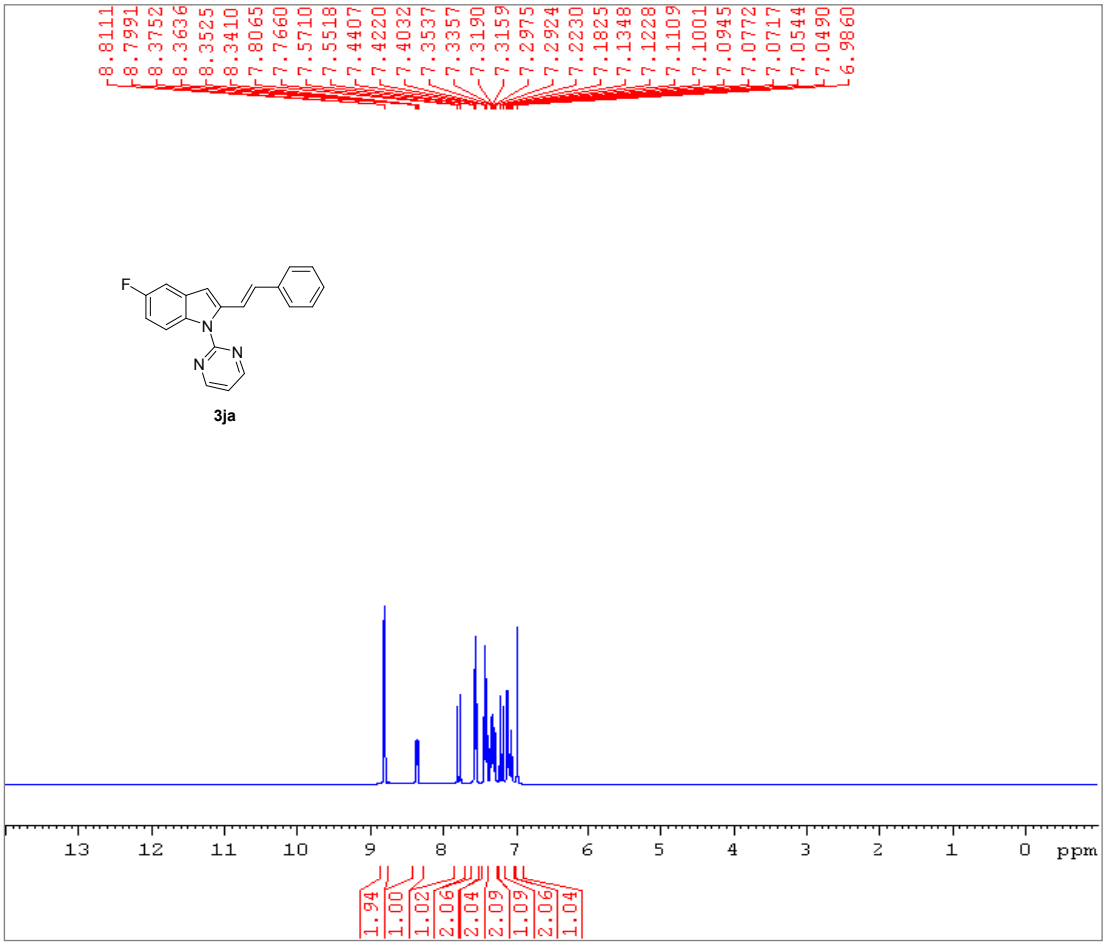
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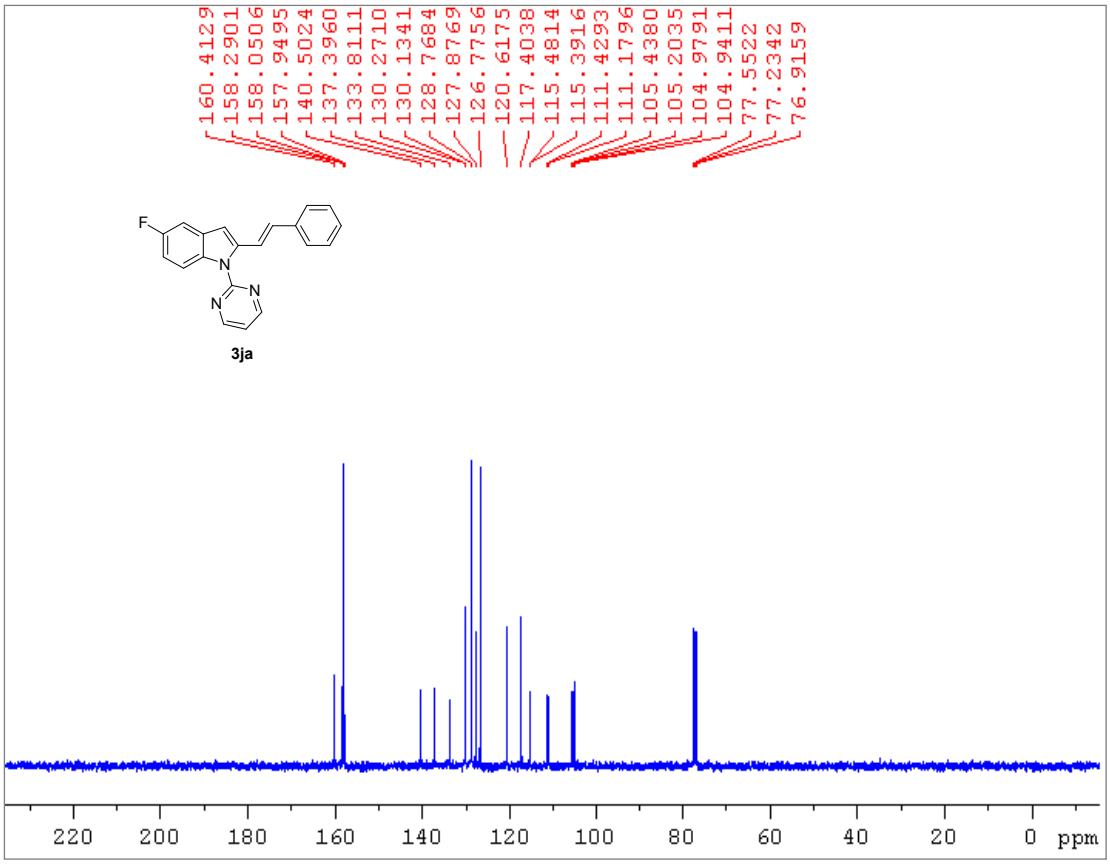
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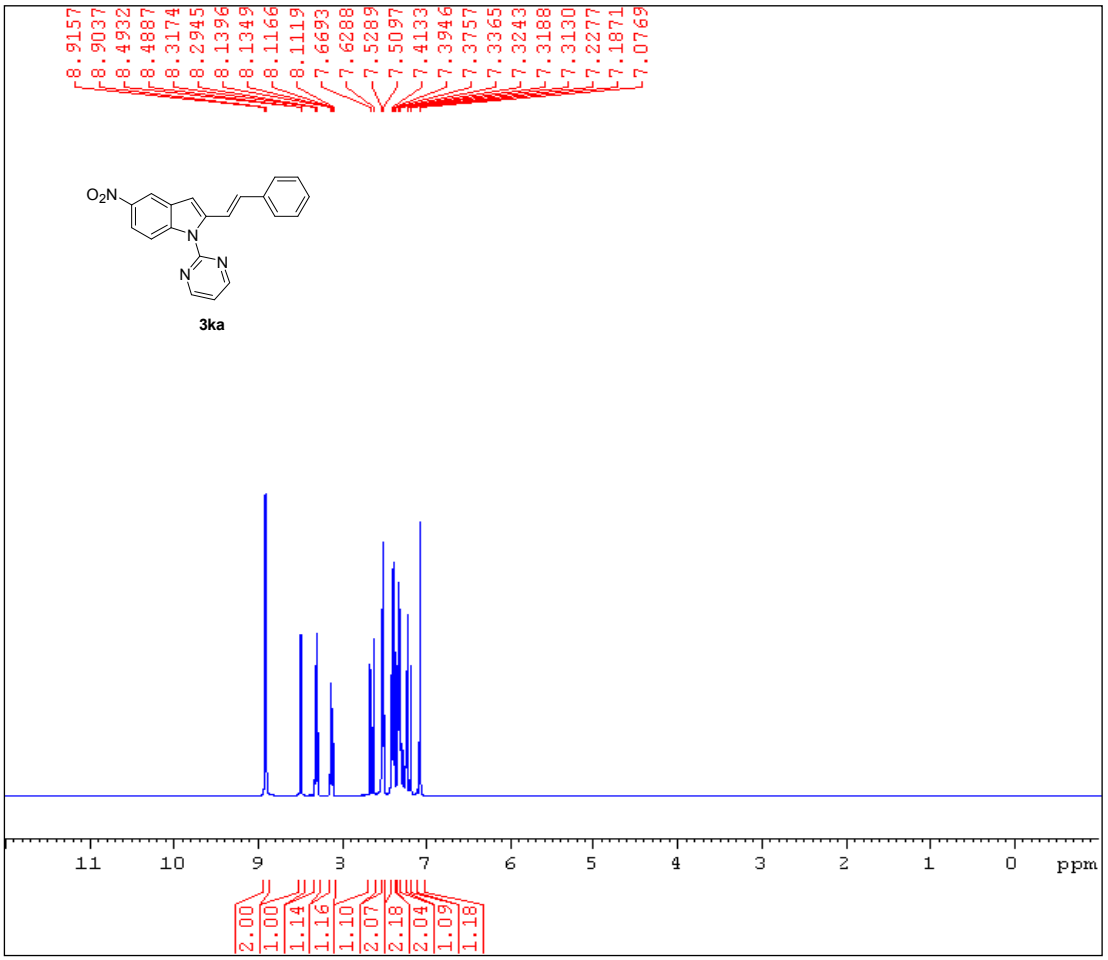
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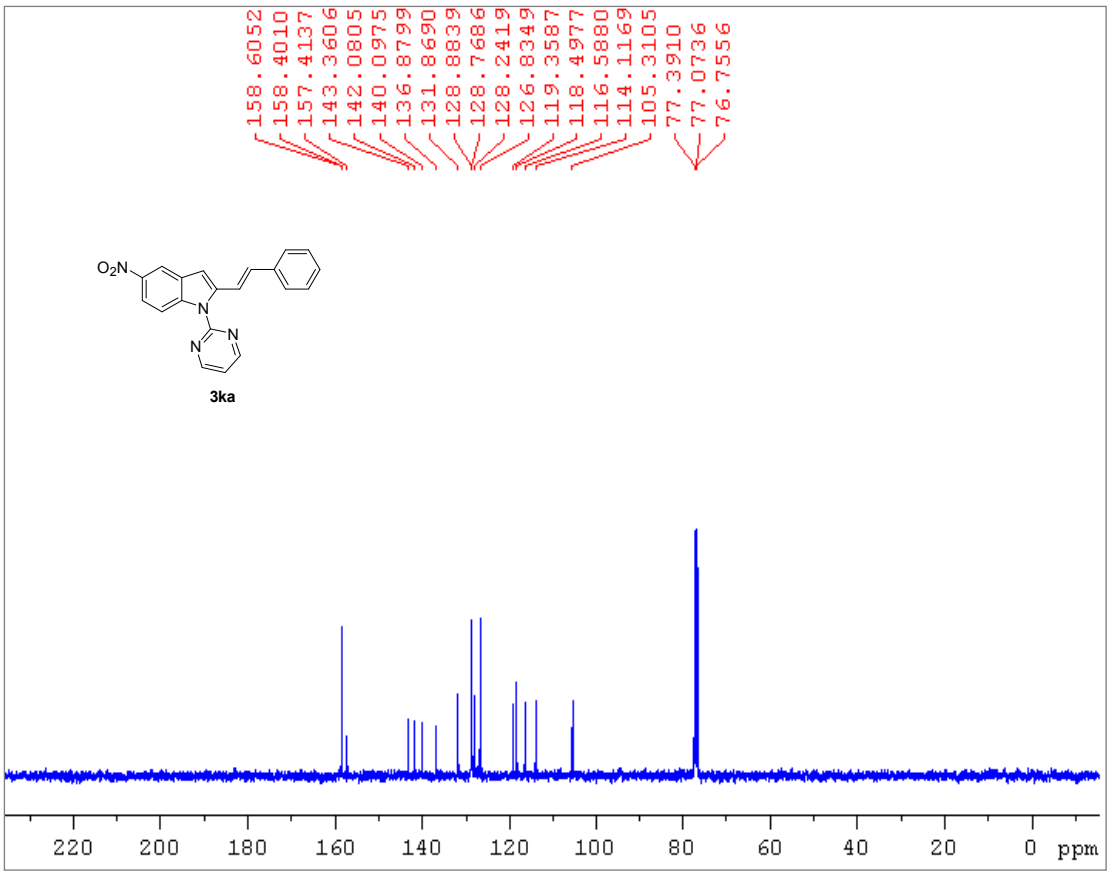
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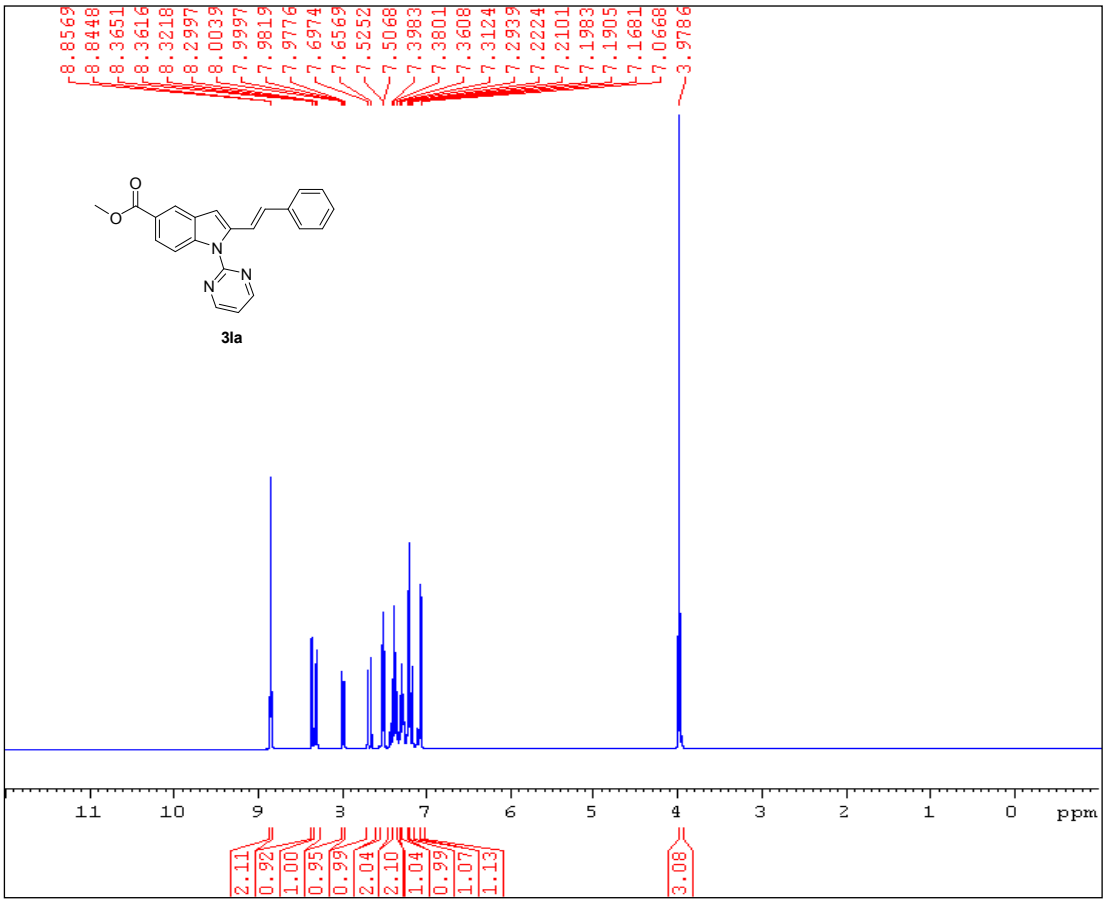
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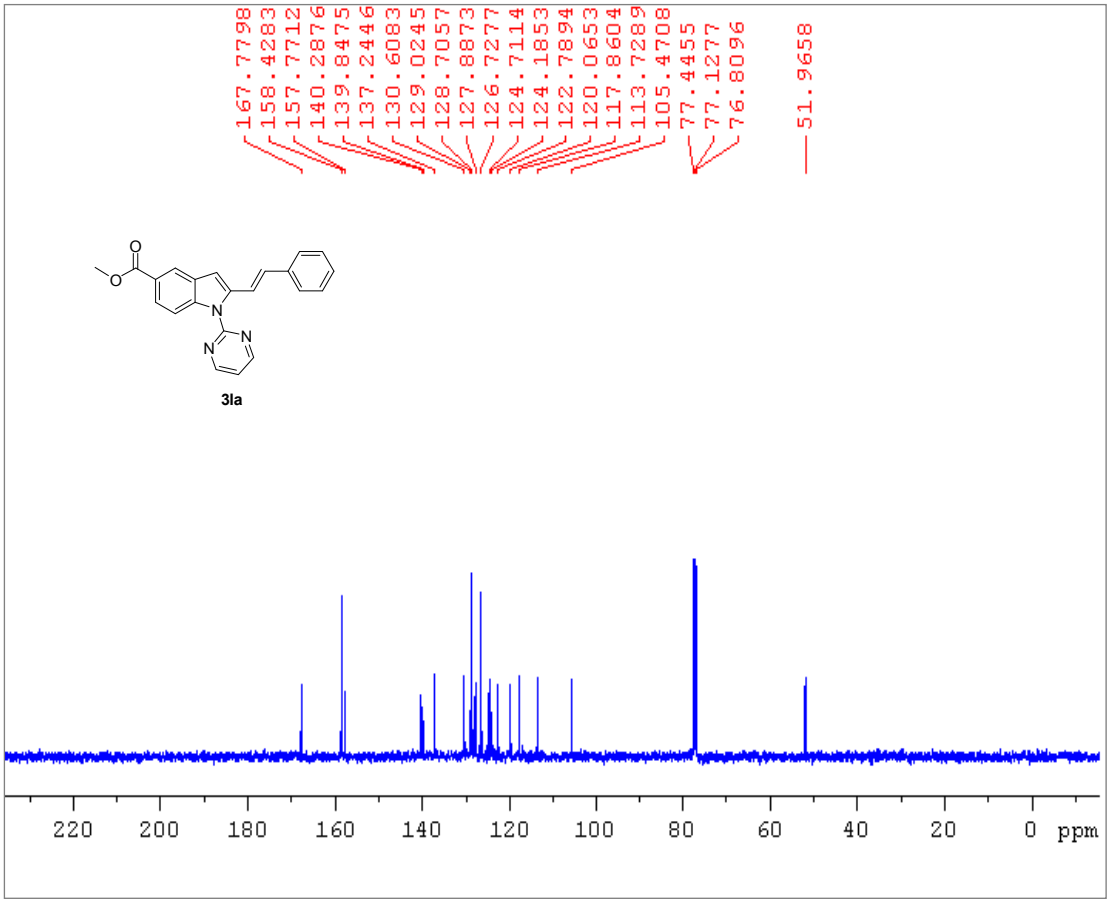
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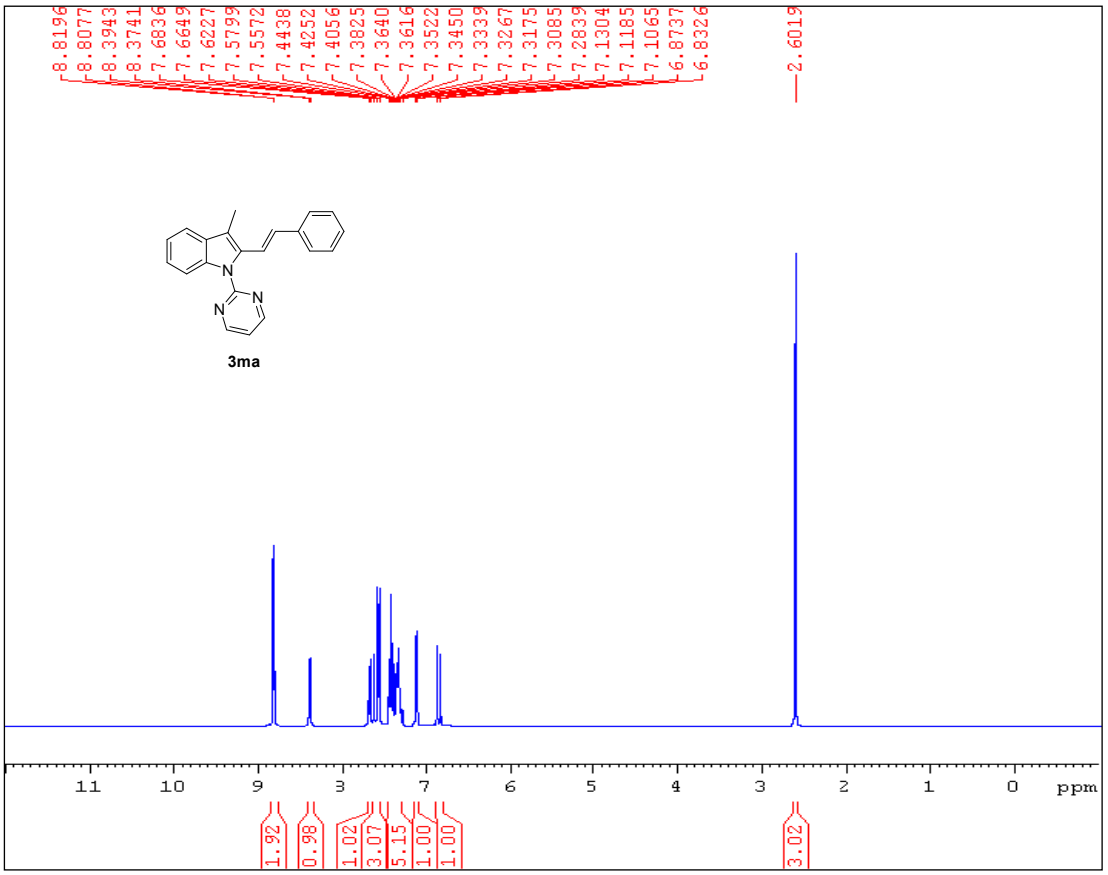
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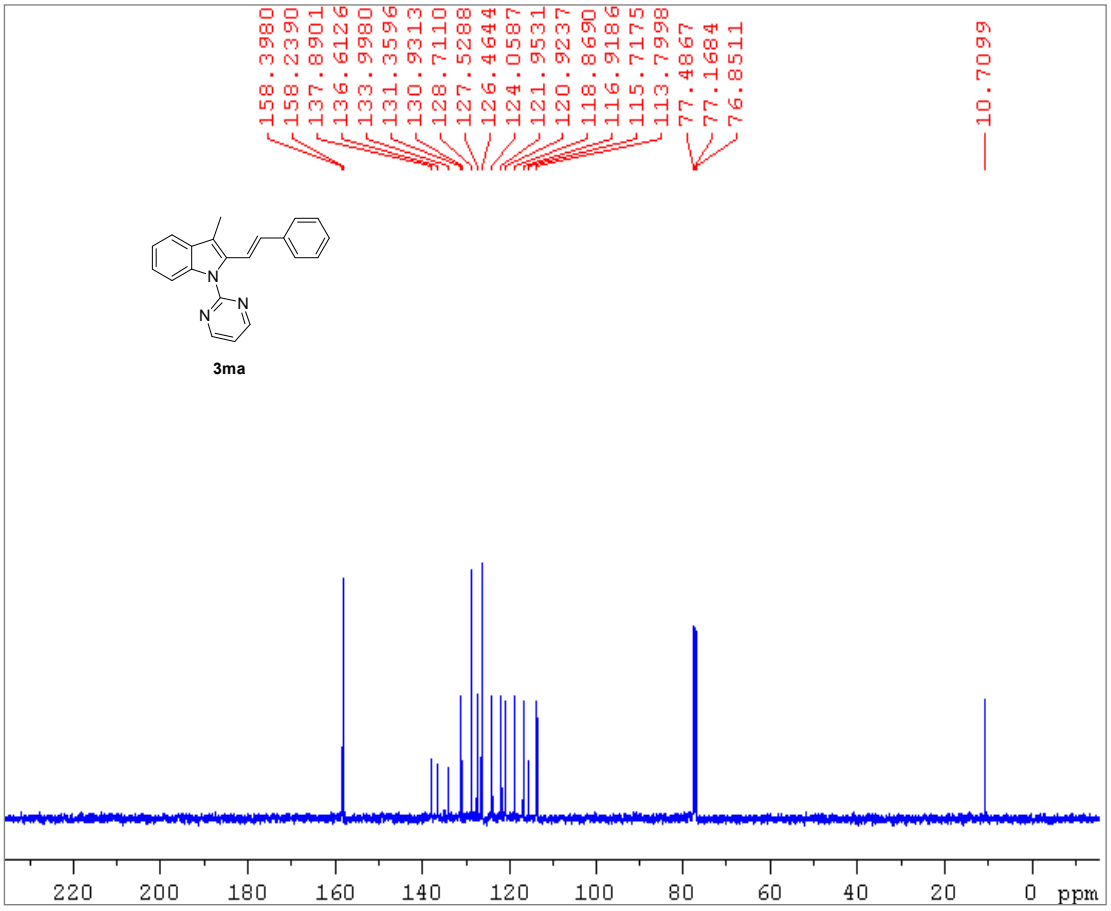
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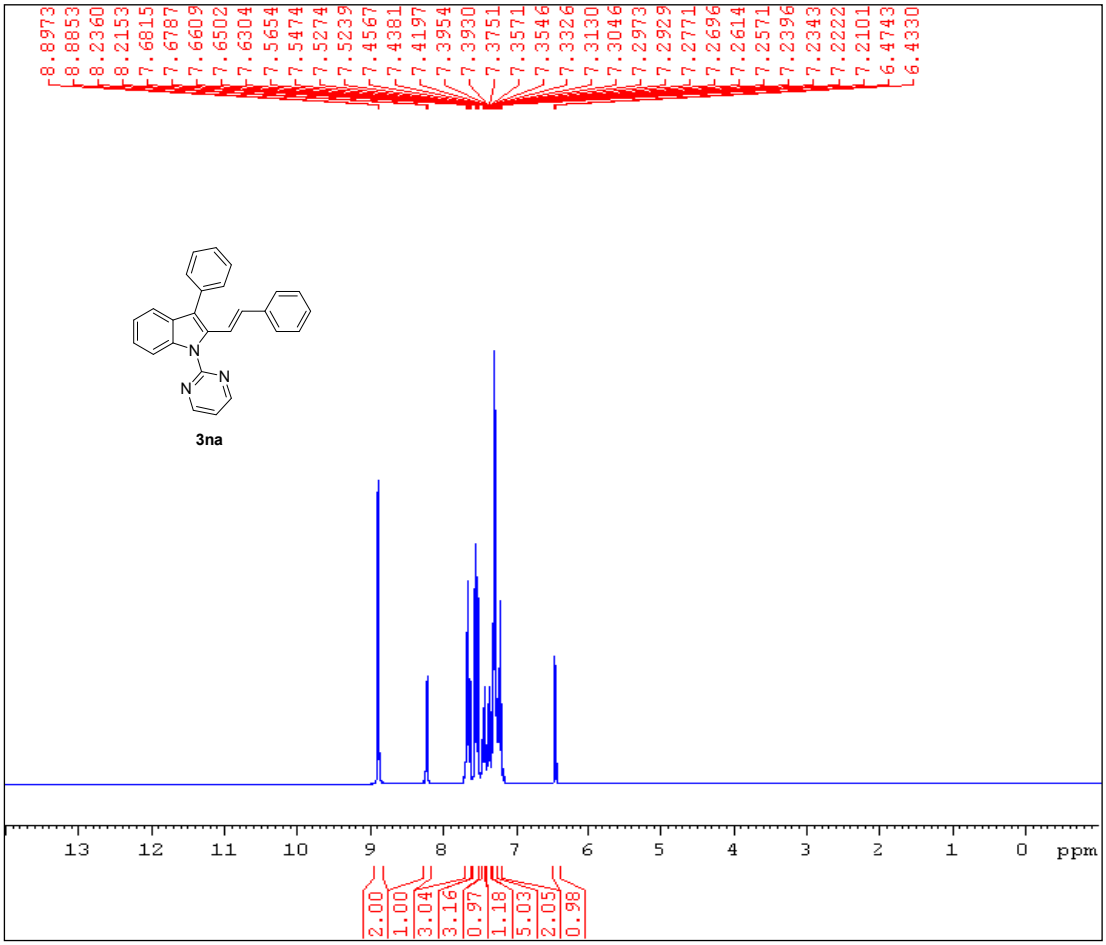
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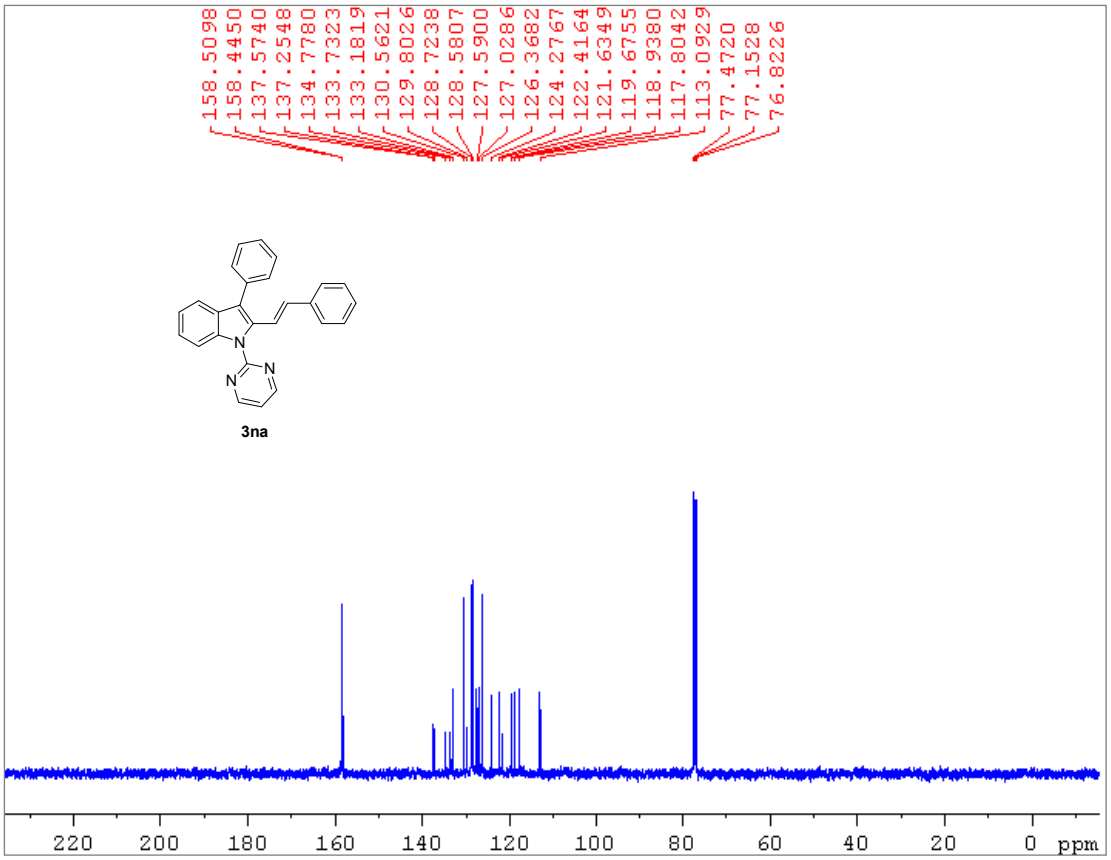
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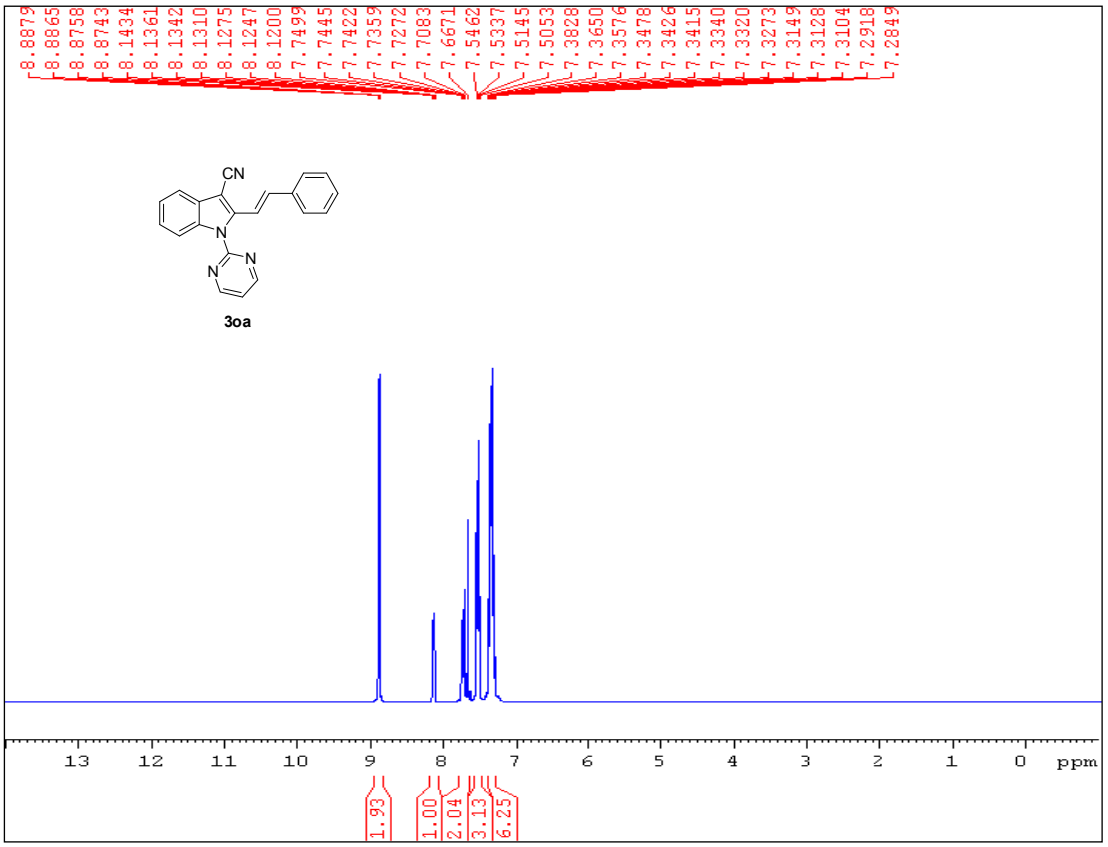
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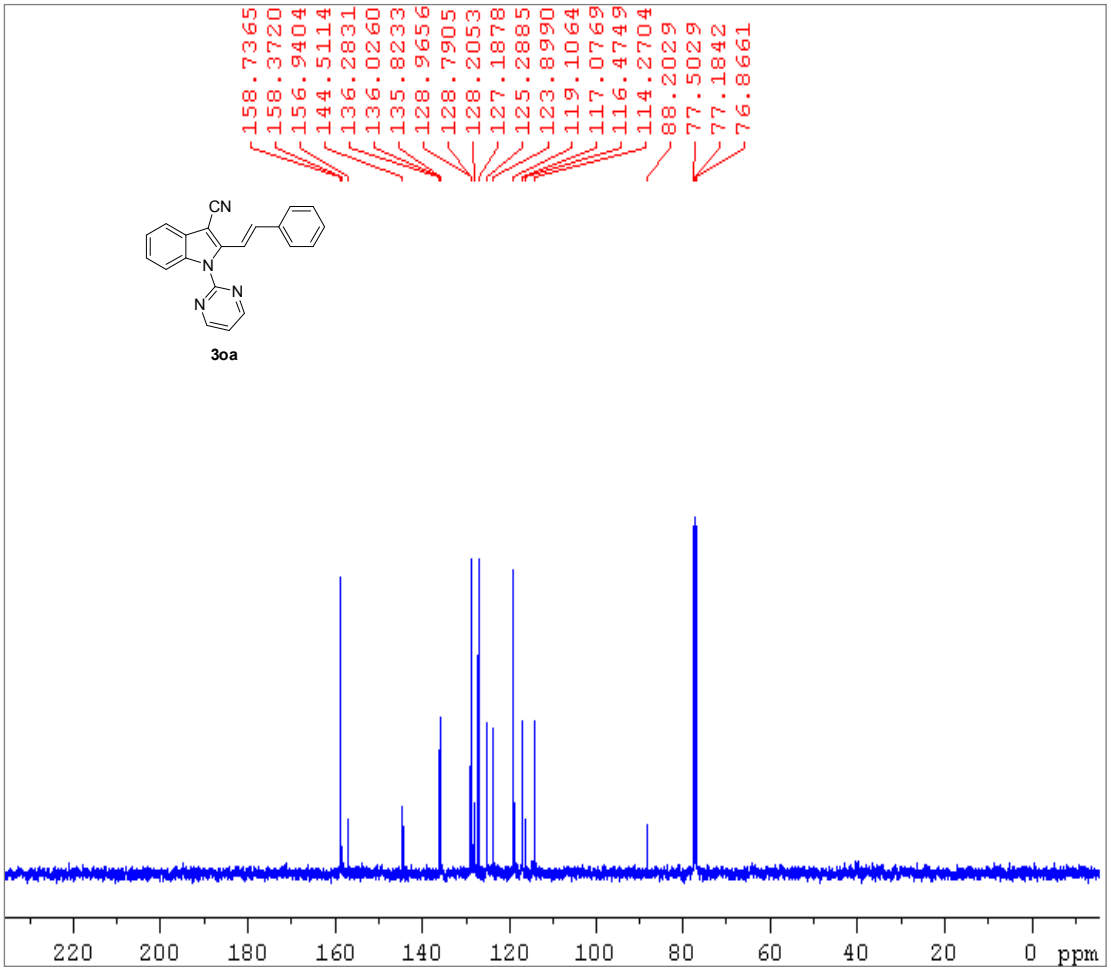
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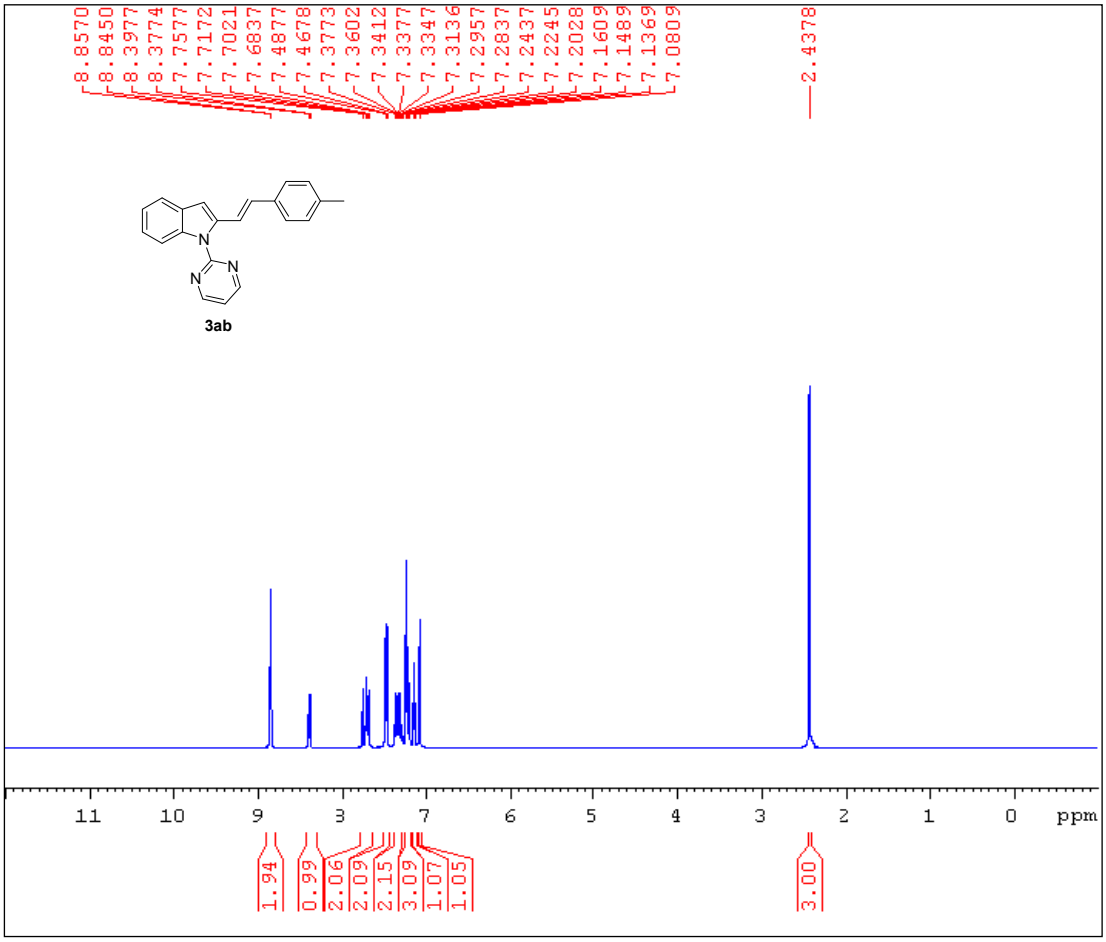
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3
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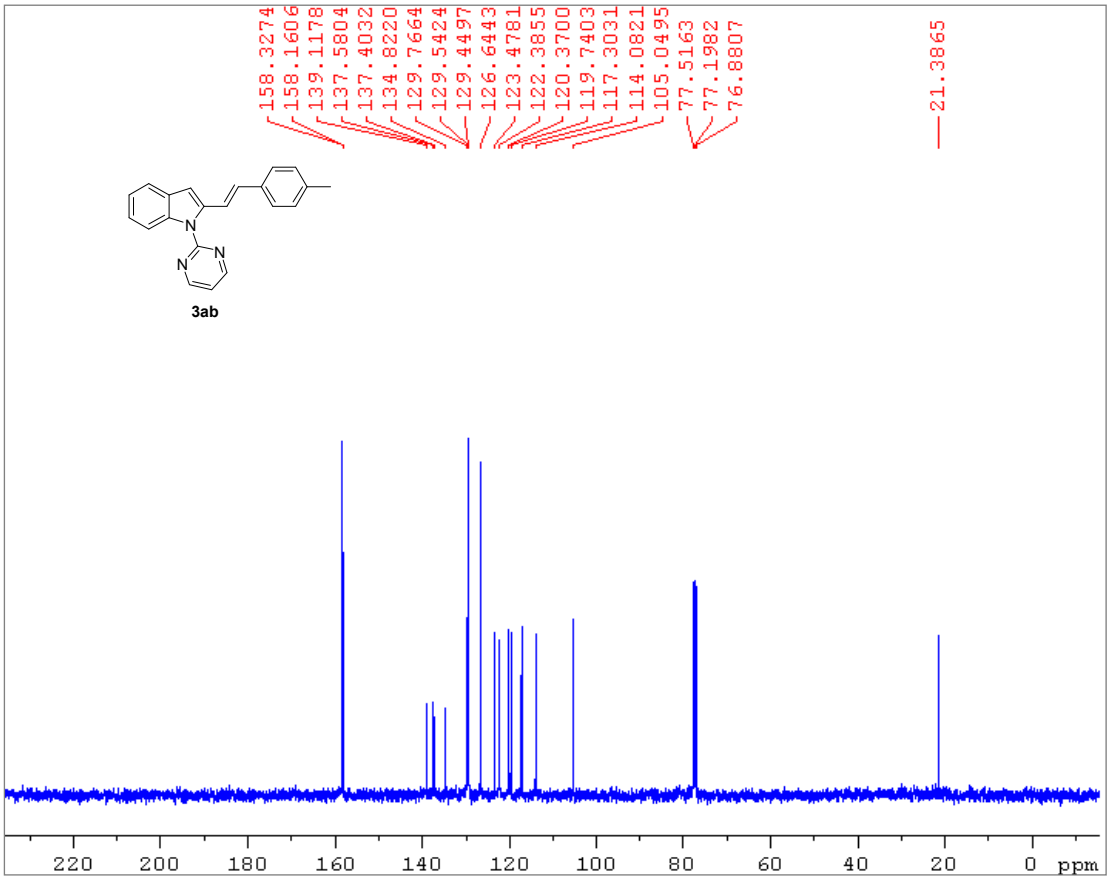
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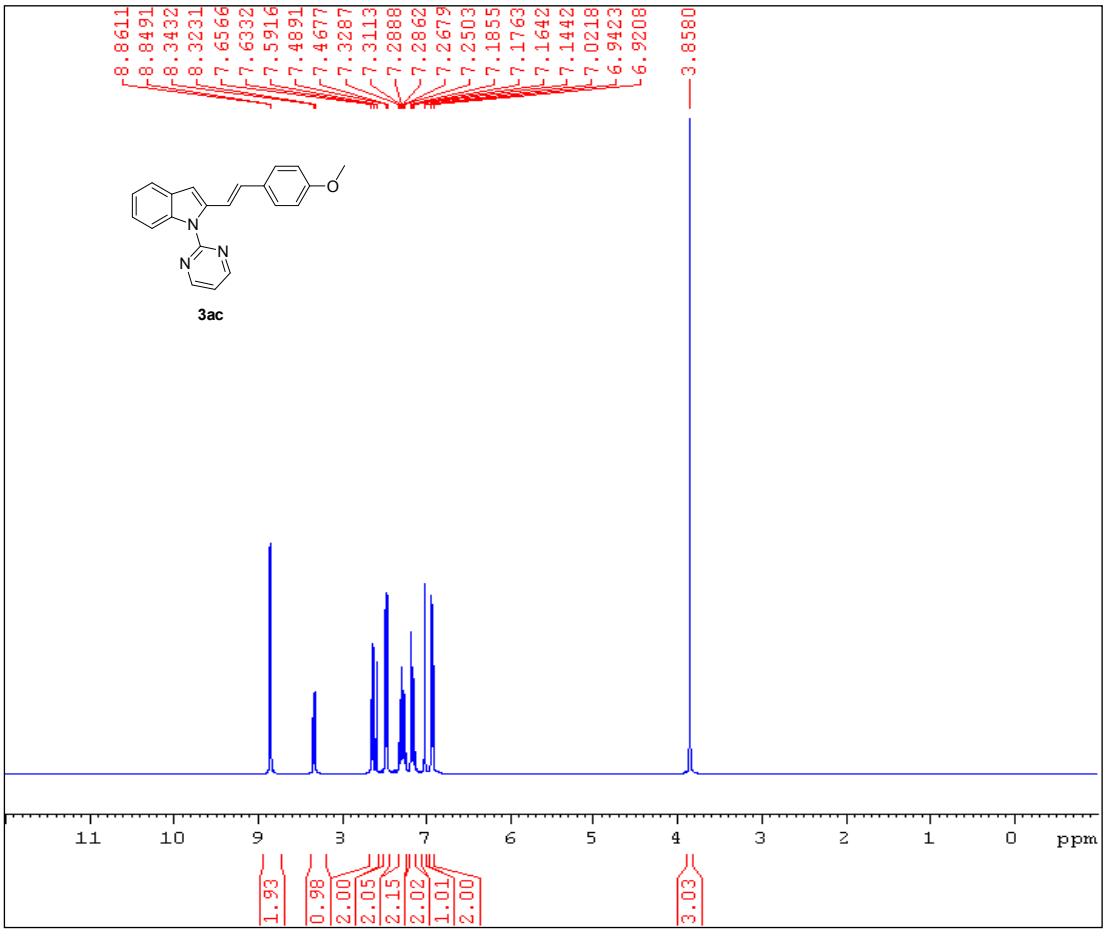
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7.2679
7.2503
7.1855
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7.1442
7.0218
6.9423
6.9208
3.8580
O
N
N
N
3ac
11
10
9
3
7
6
5
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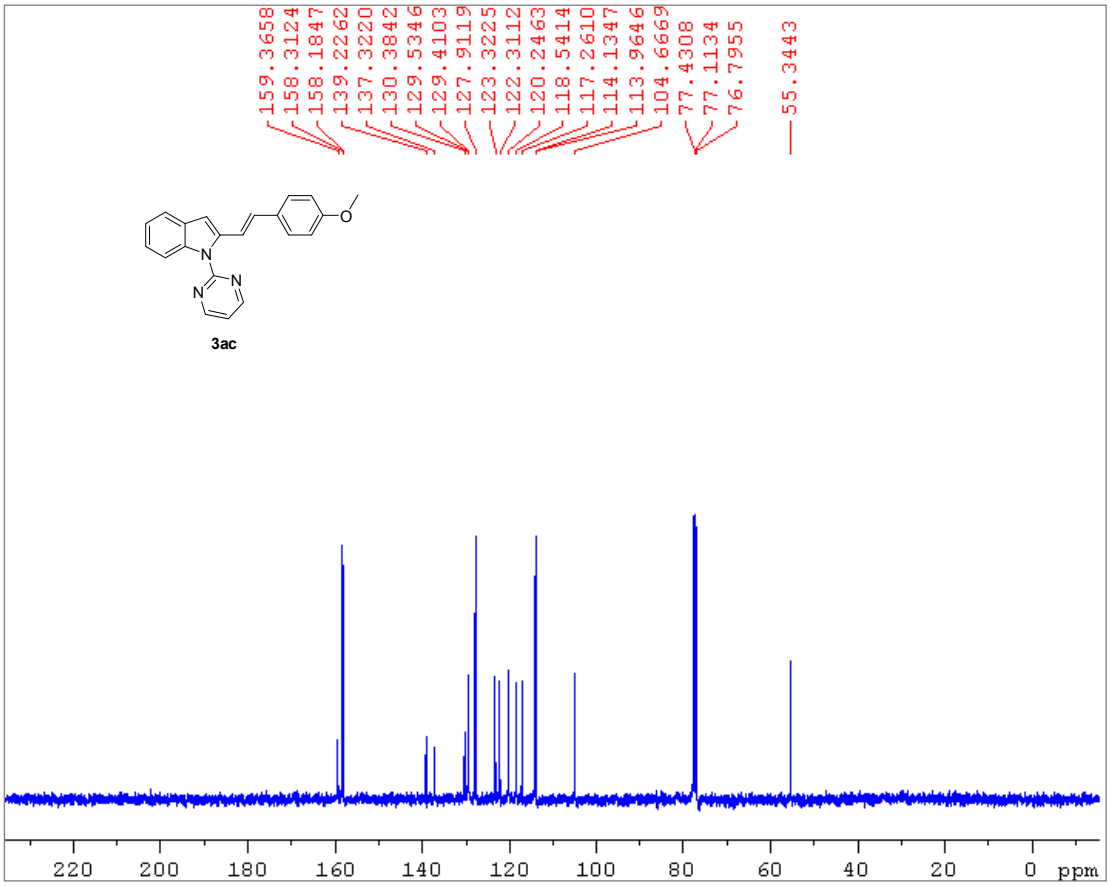
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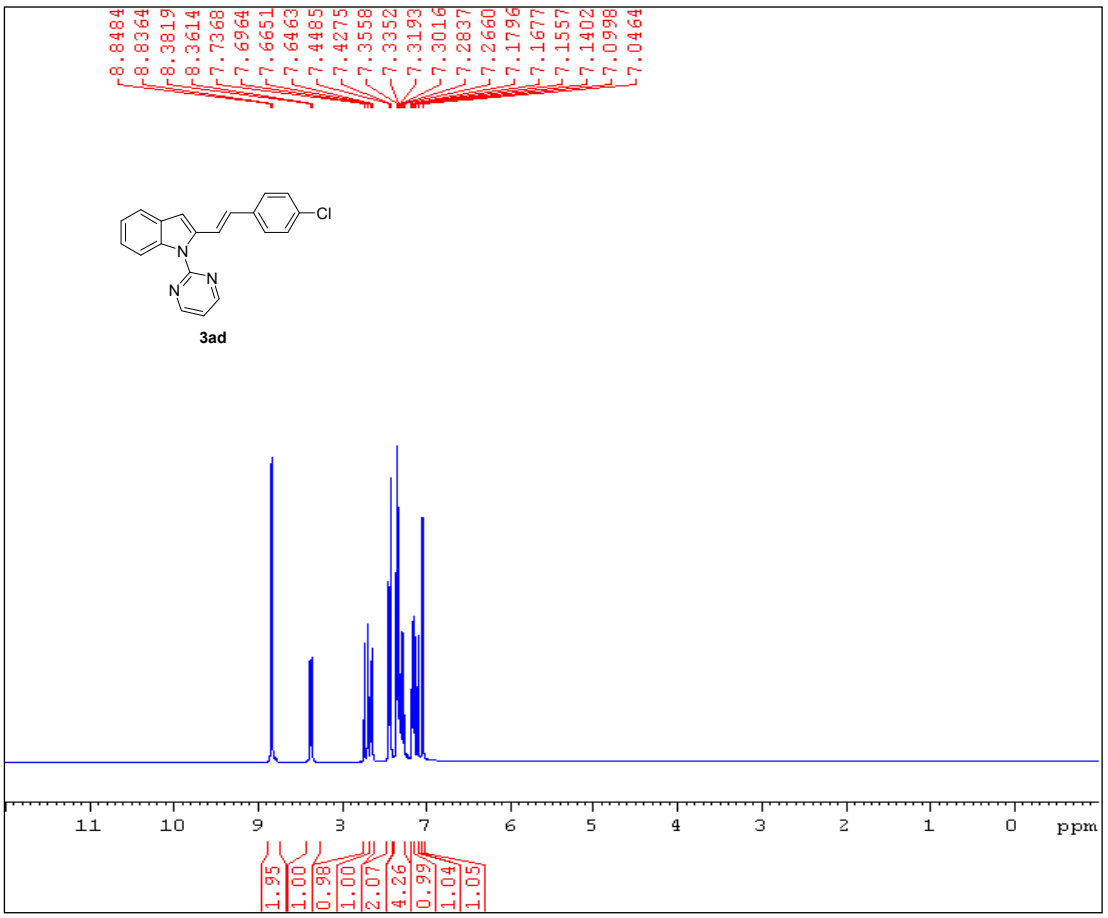
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7.1796
7.1677
7.1557
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Cl
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N
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11
10
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3
7
6
5
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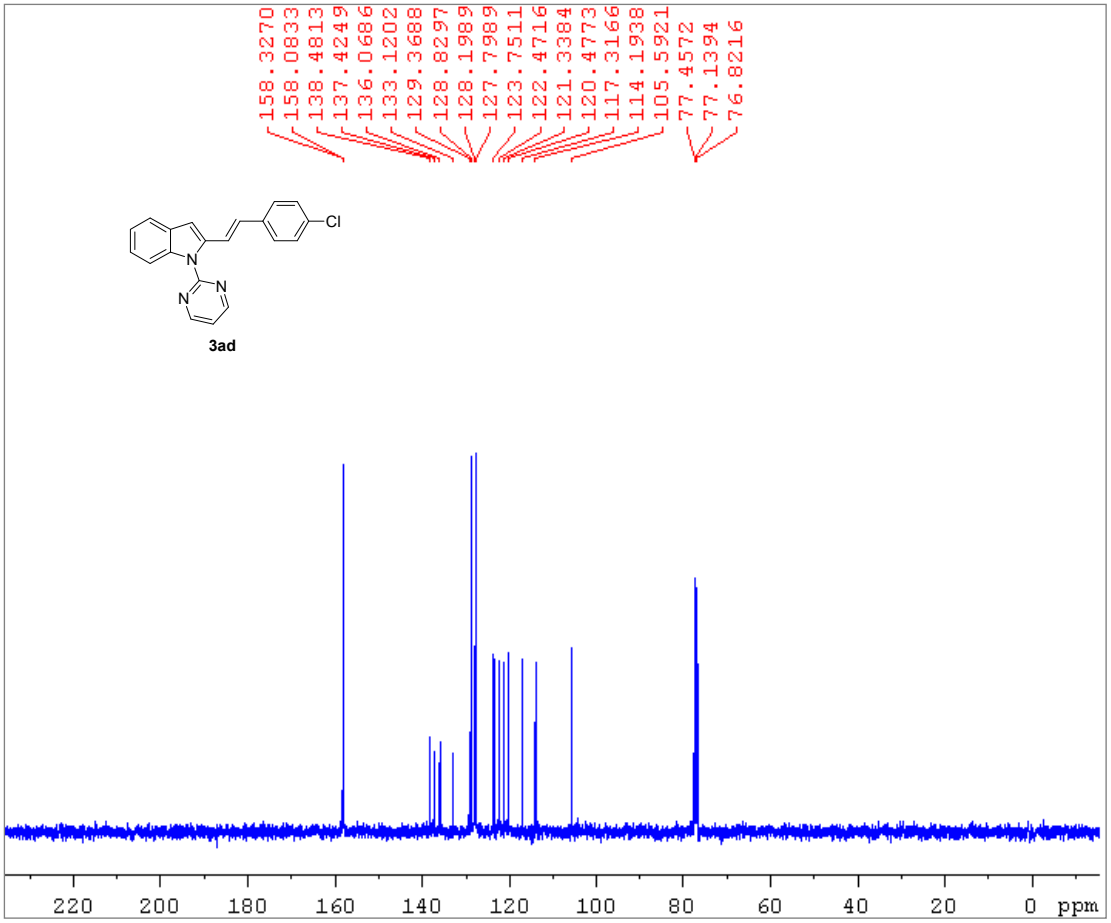
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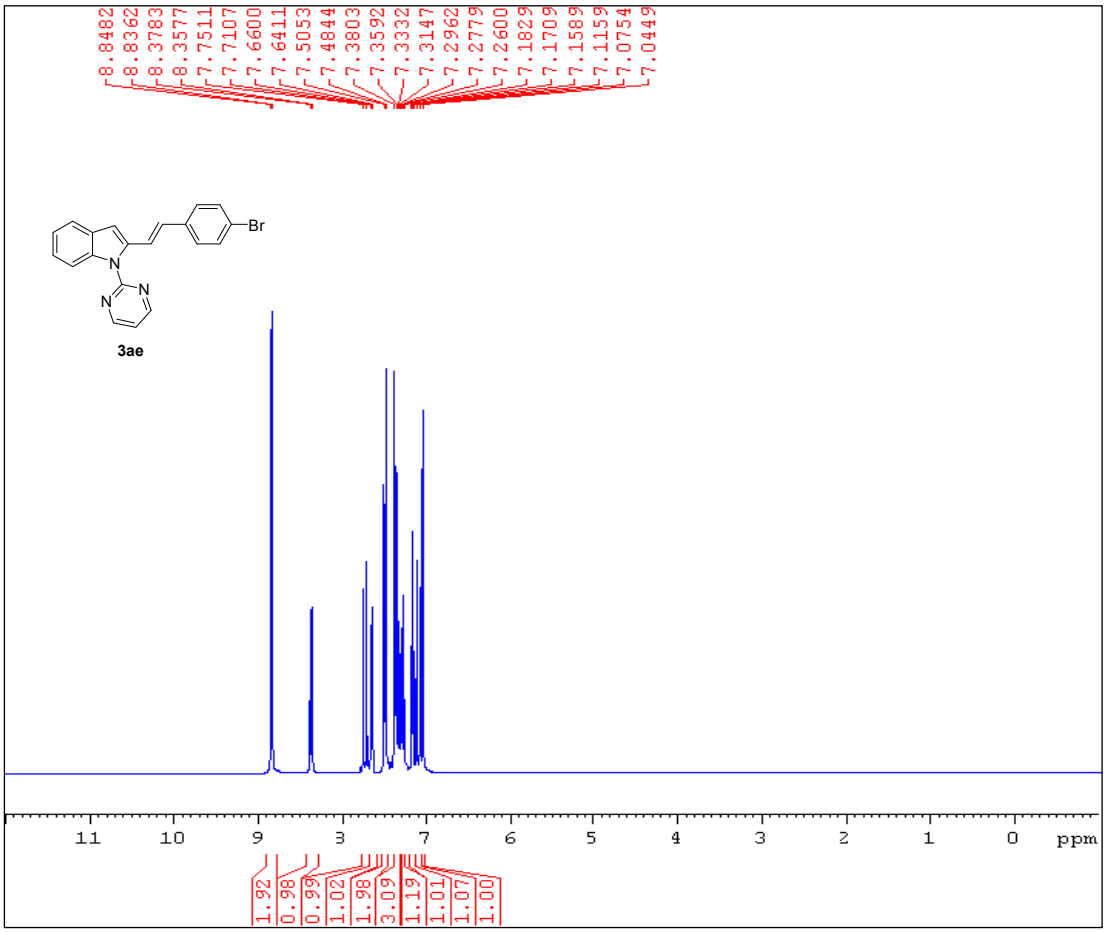
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Br
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N
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10
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3
7
6
5
4
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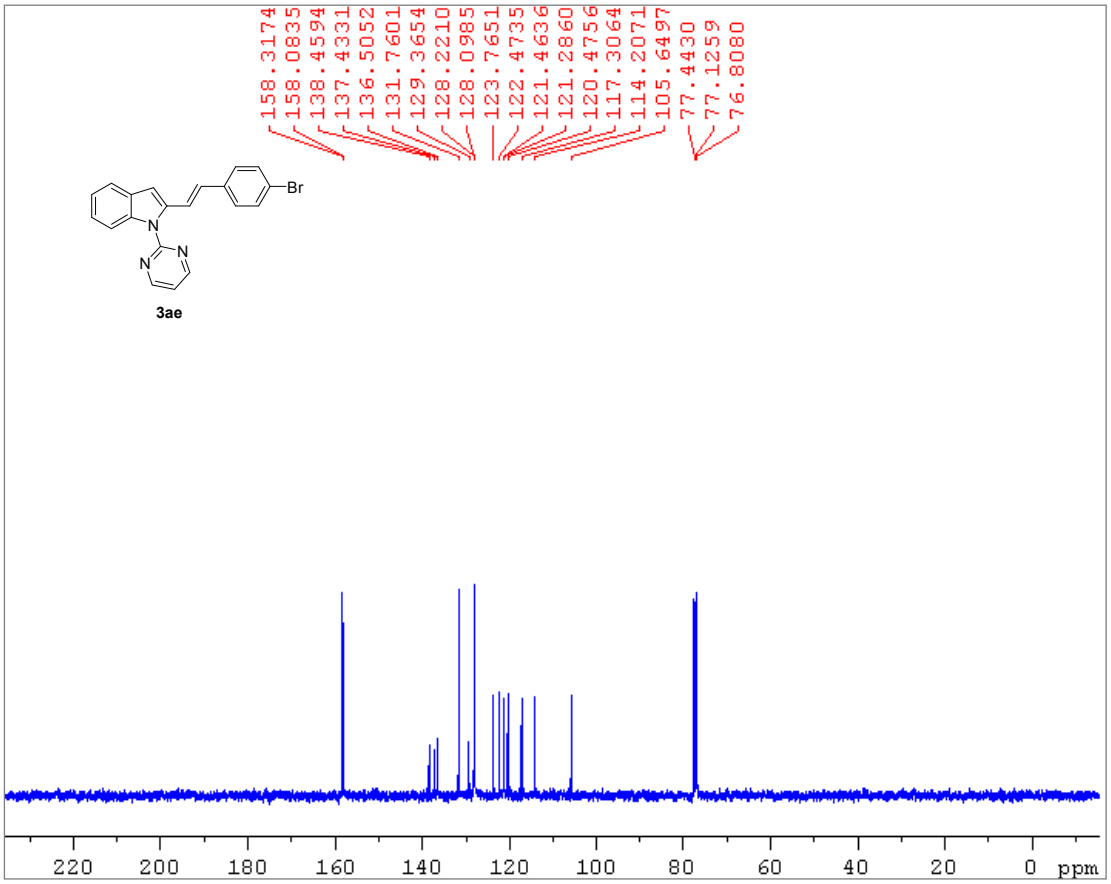
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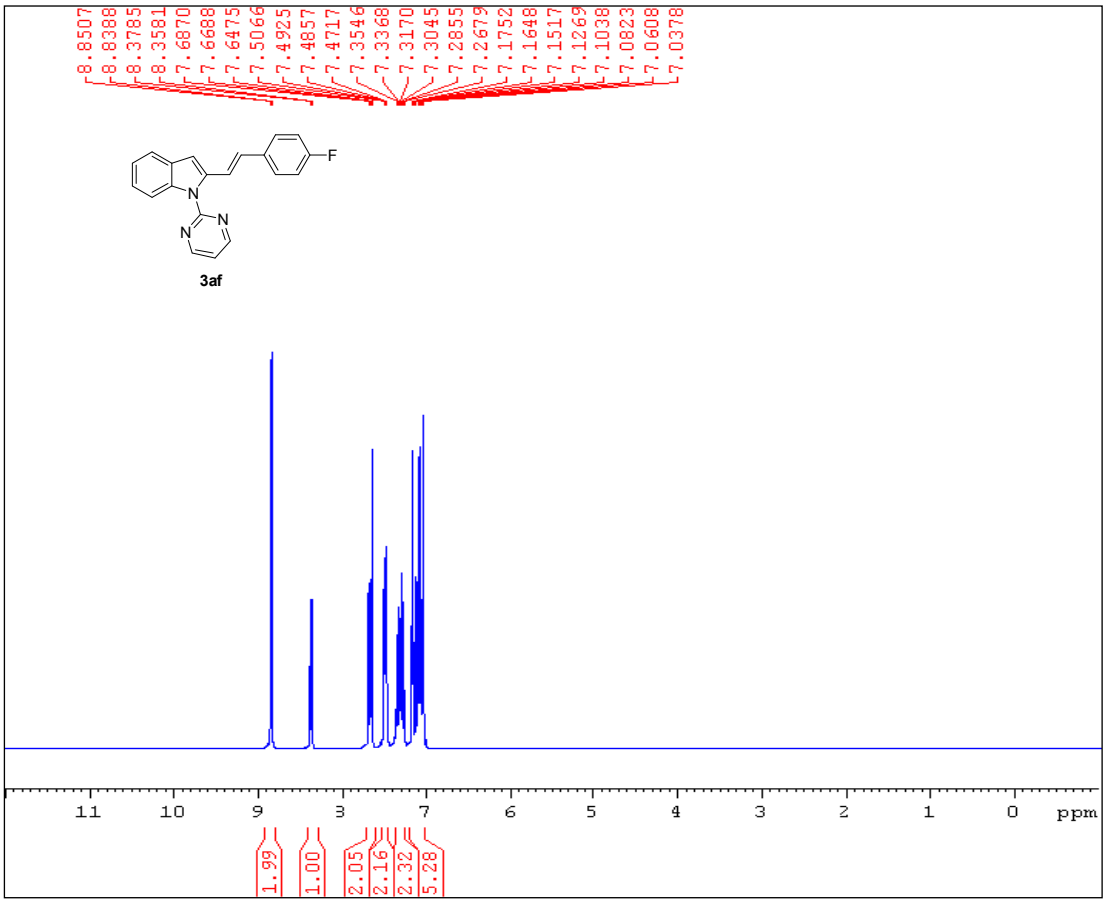
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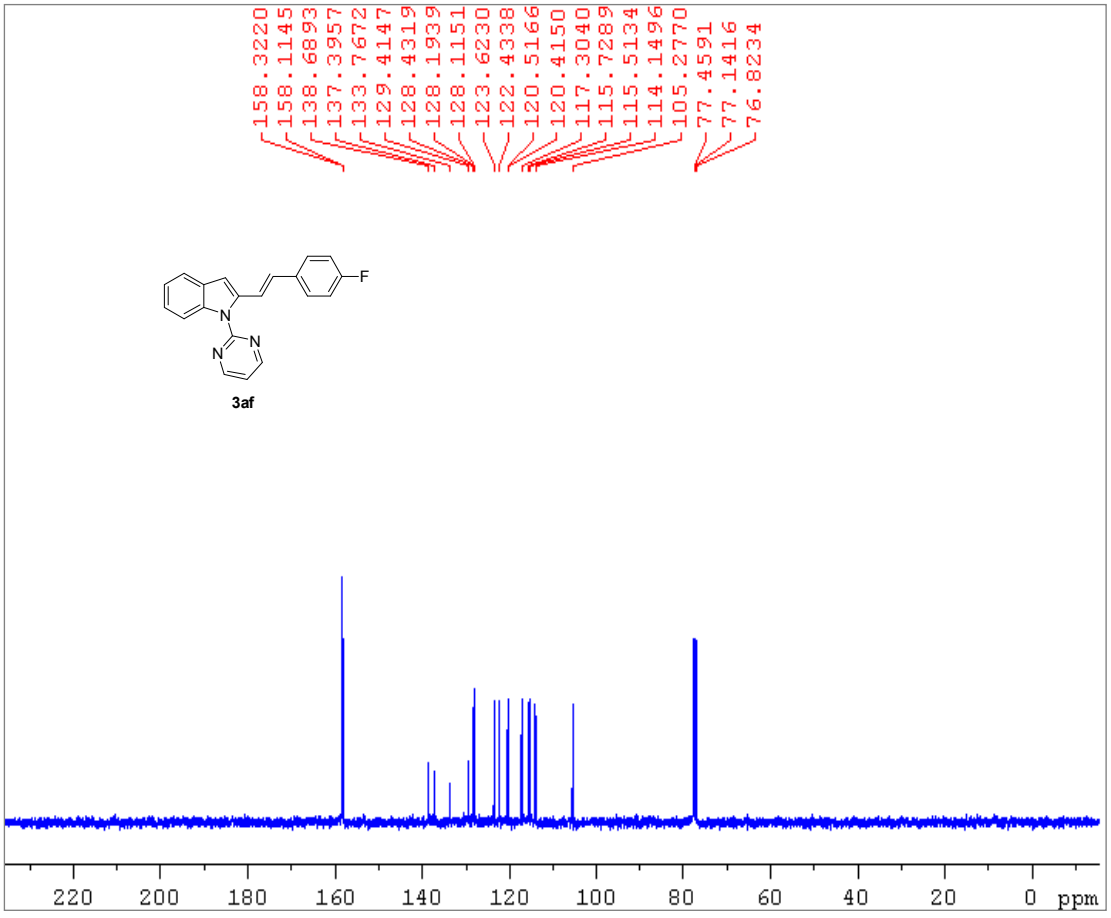
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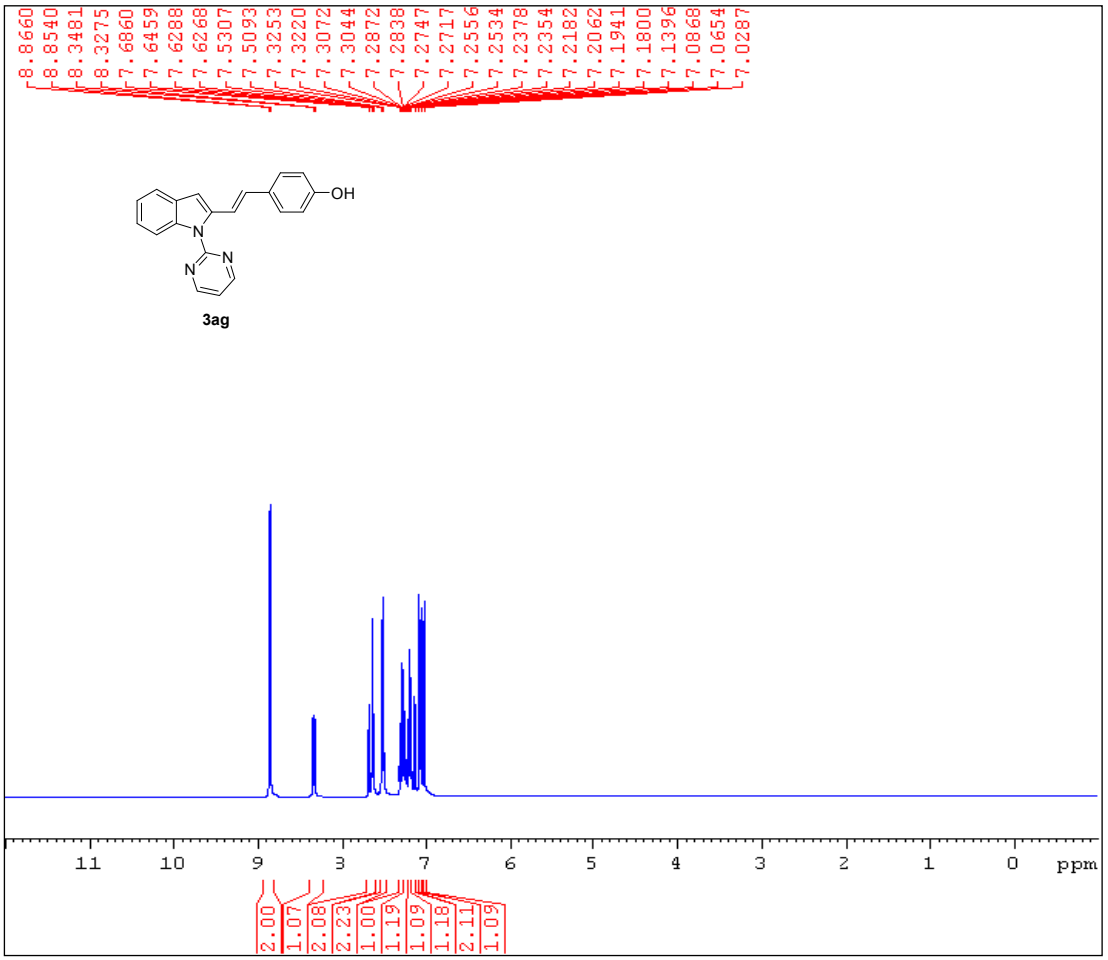
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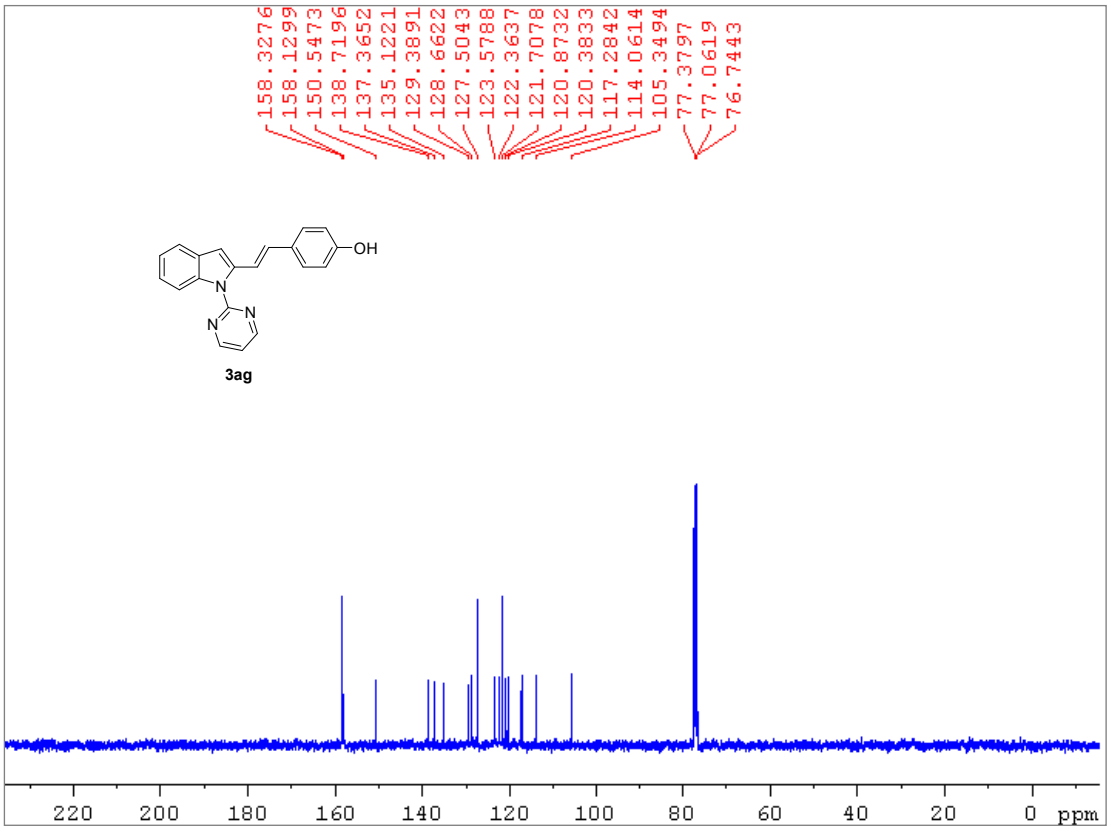
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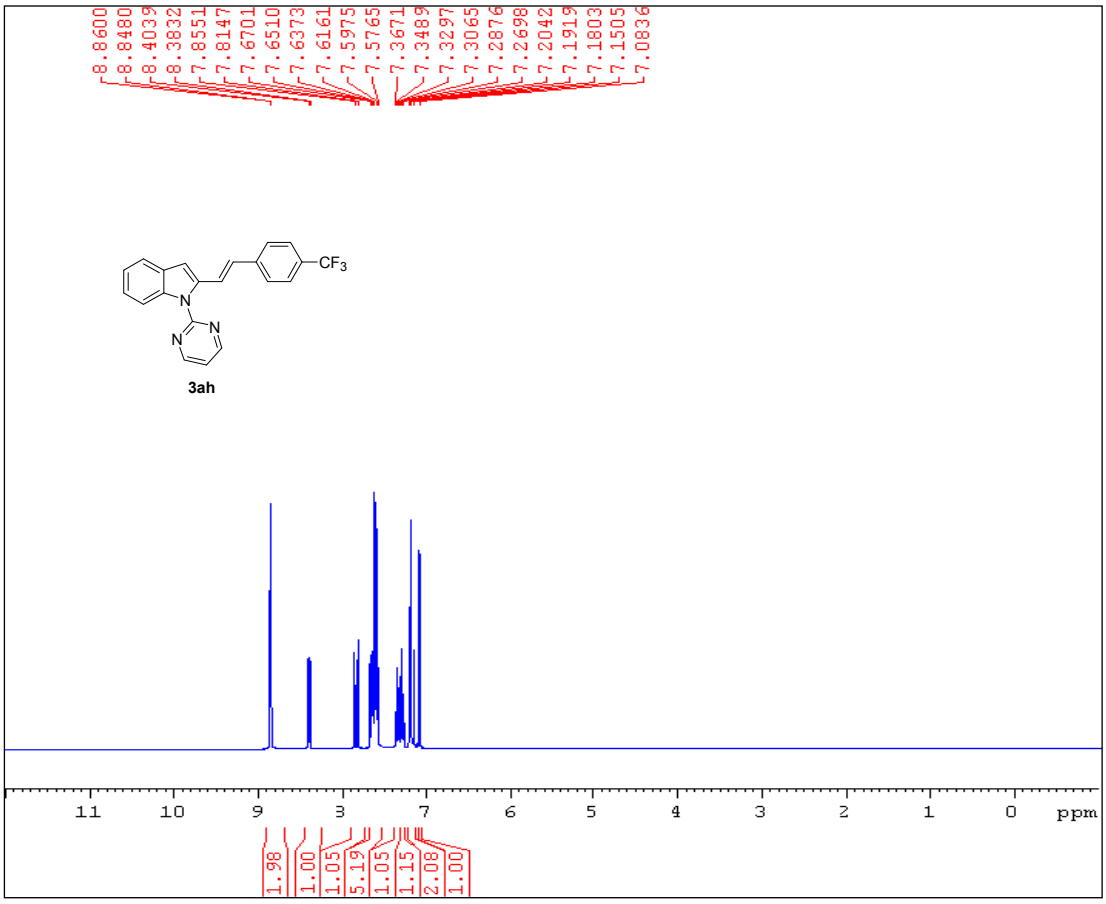
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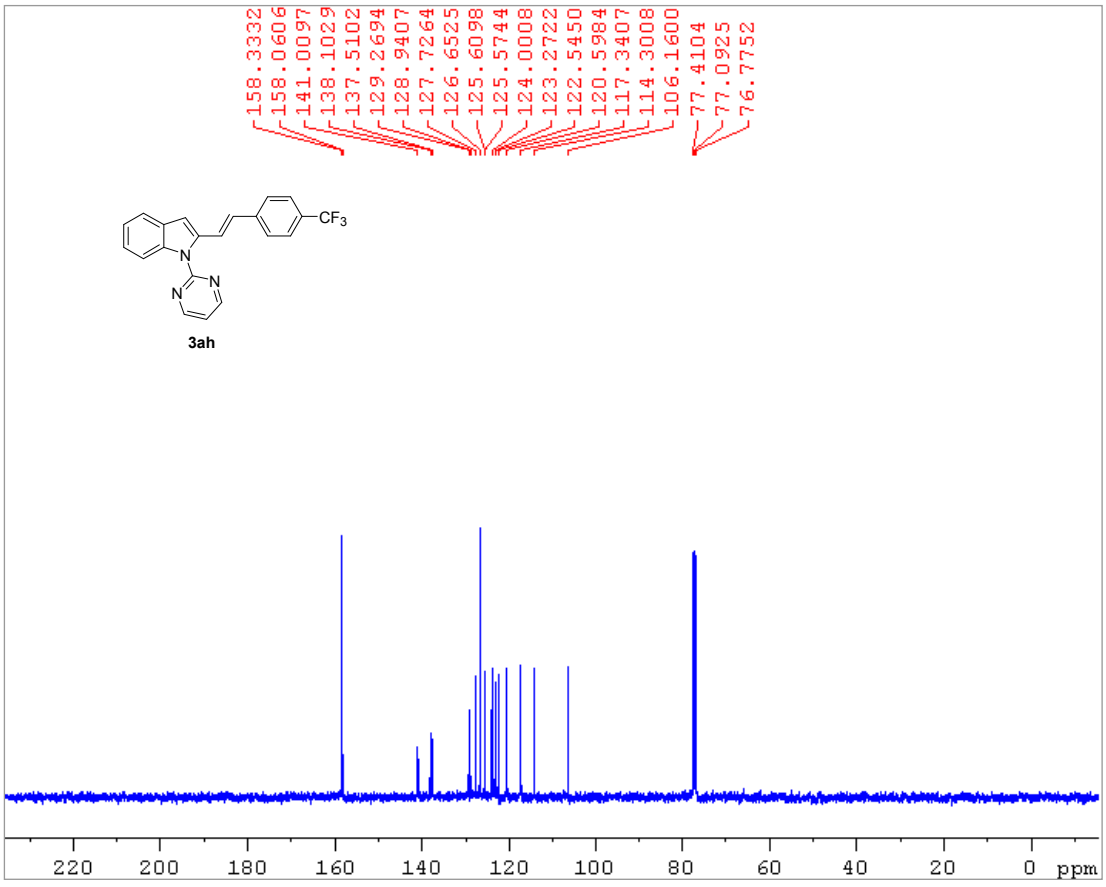
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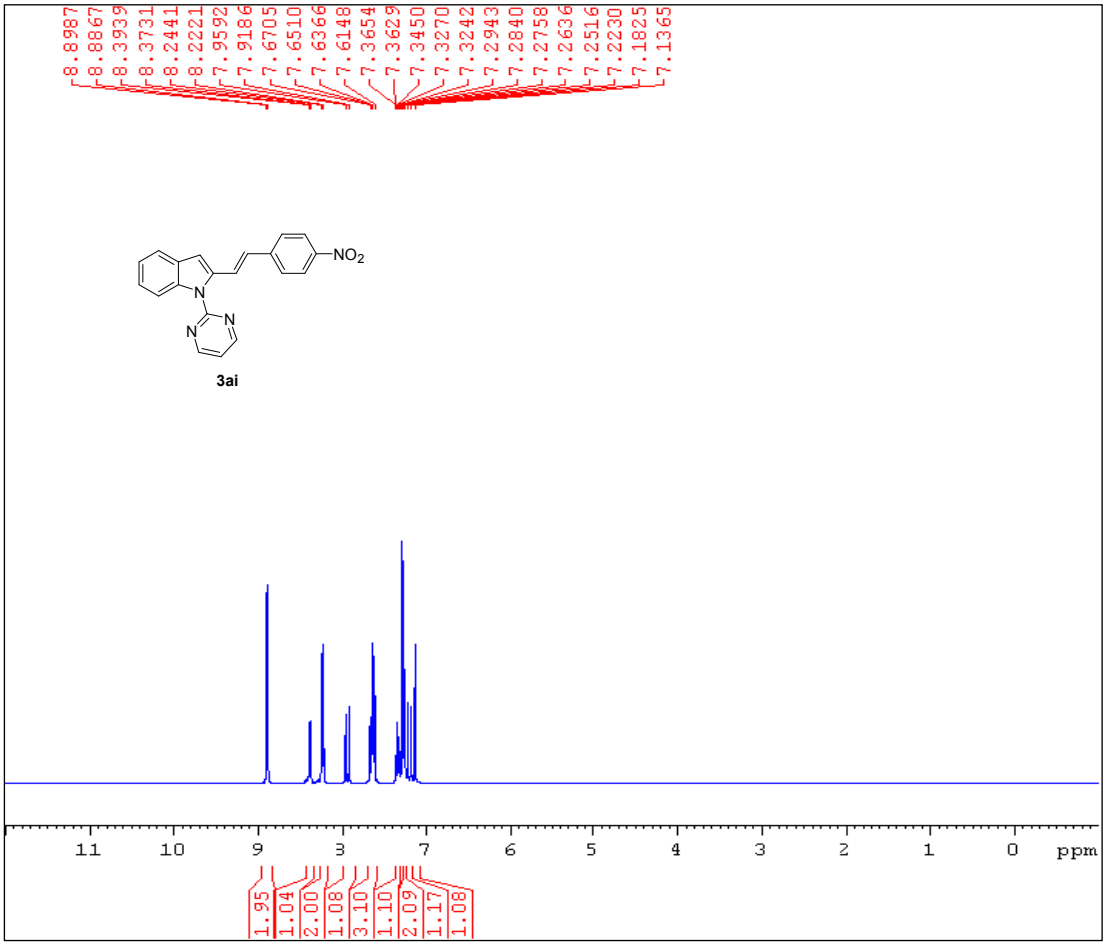
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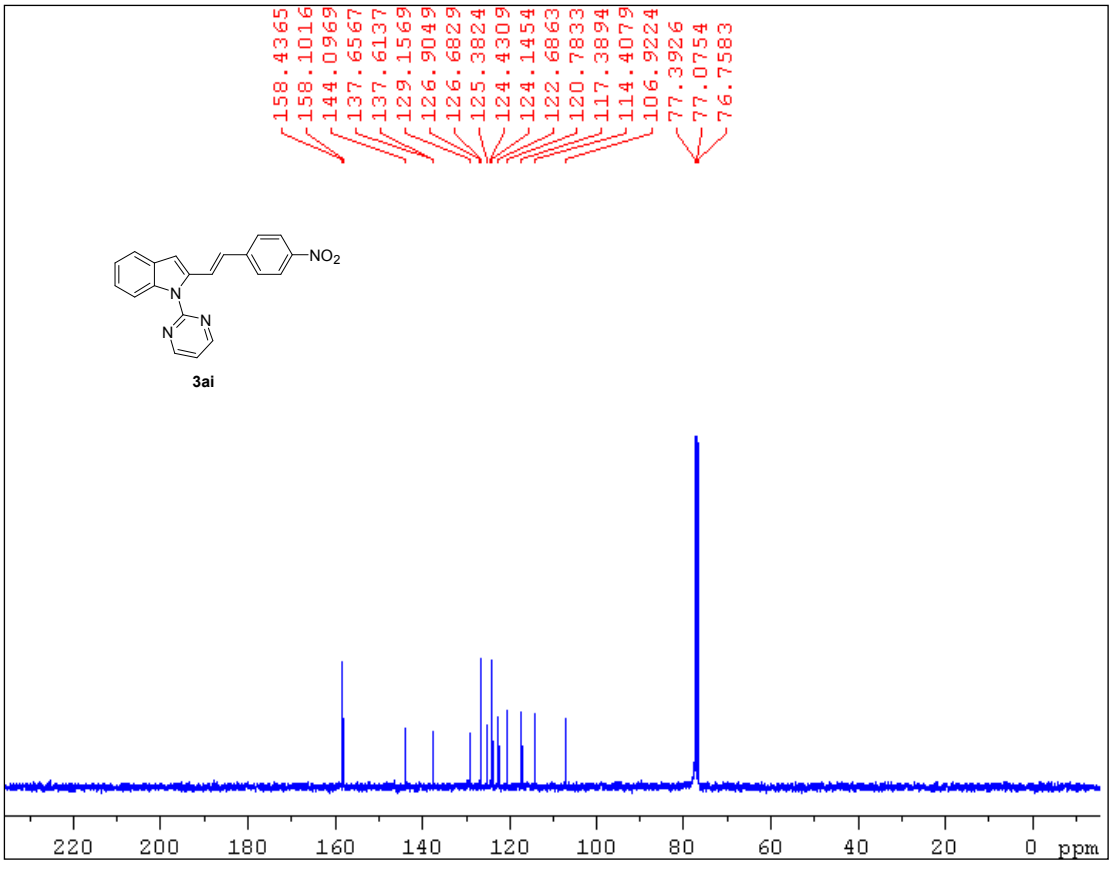
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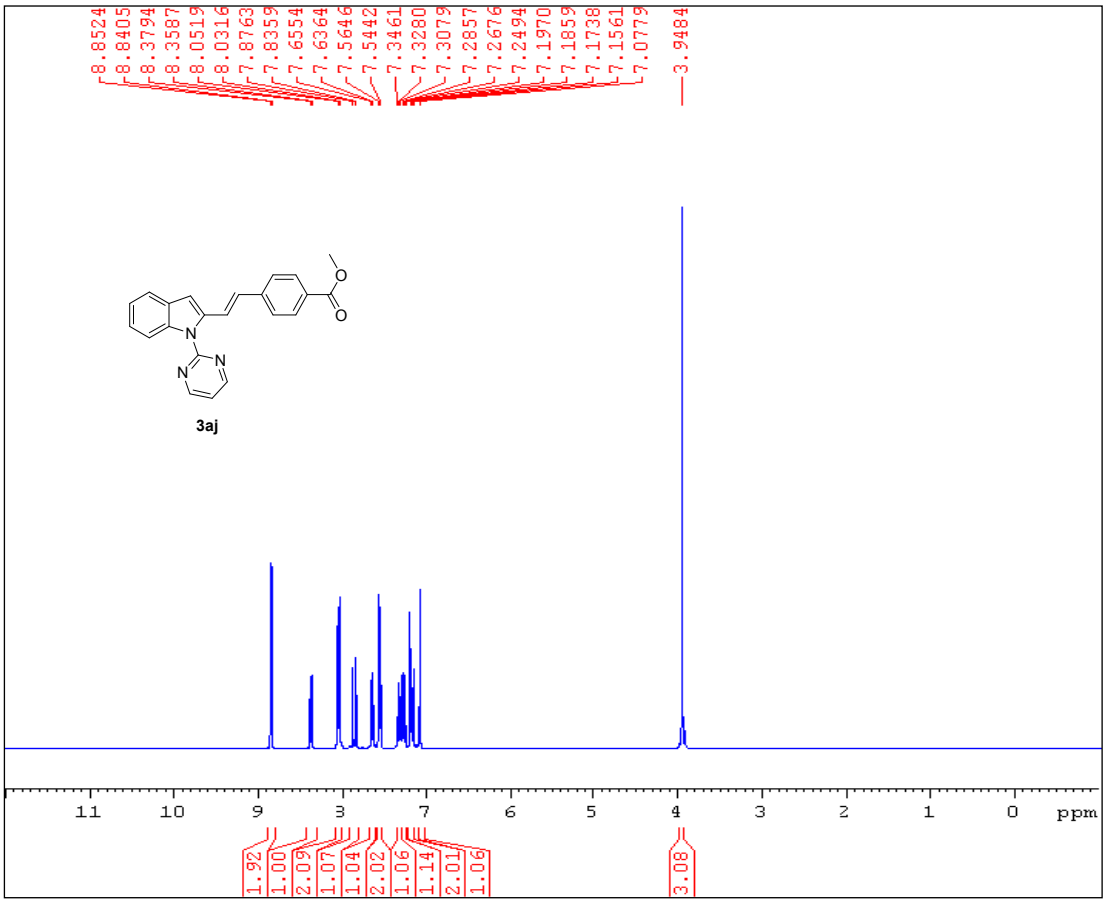
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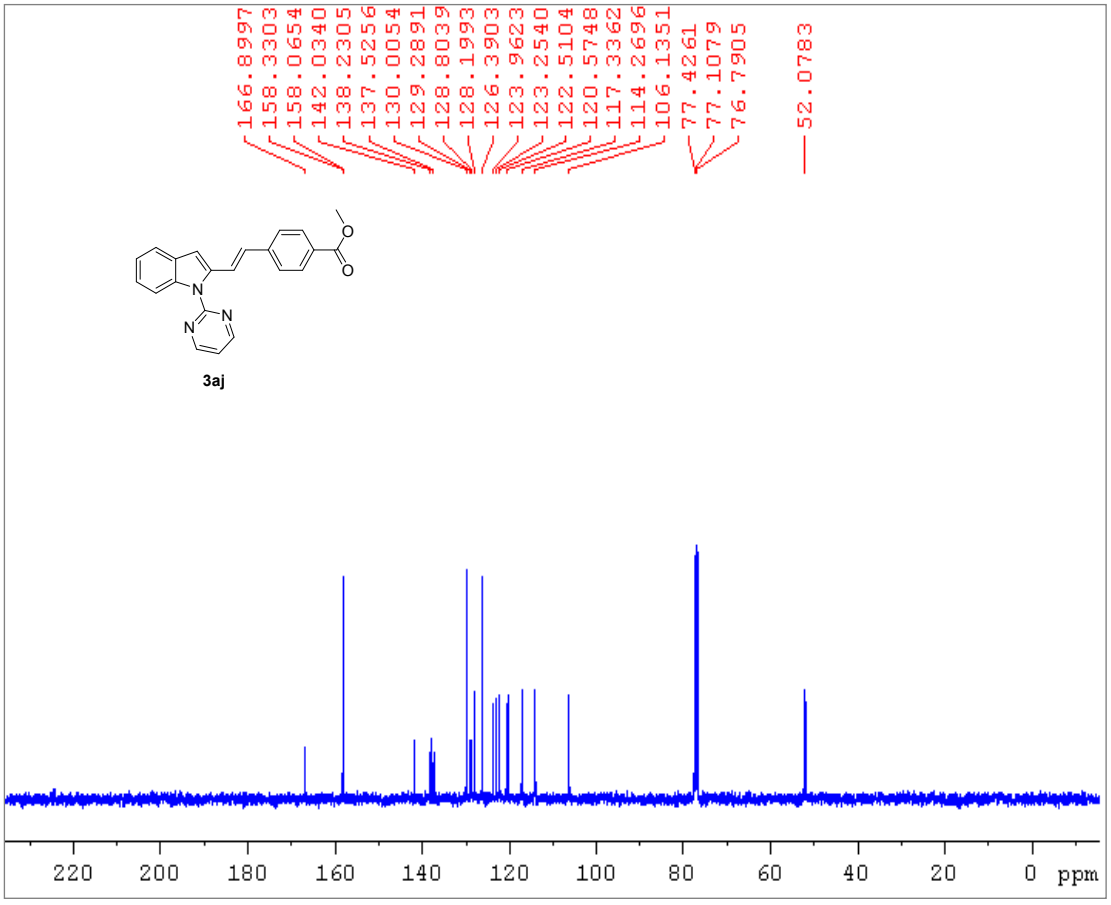
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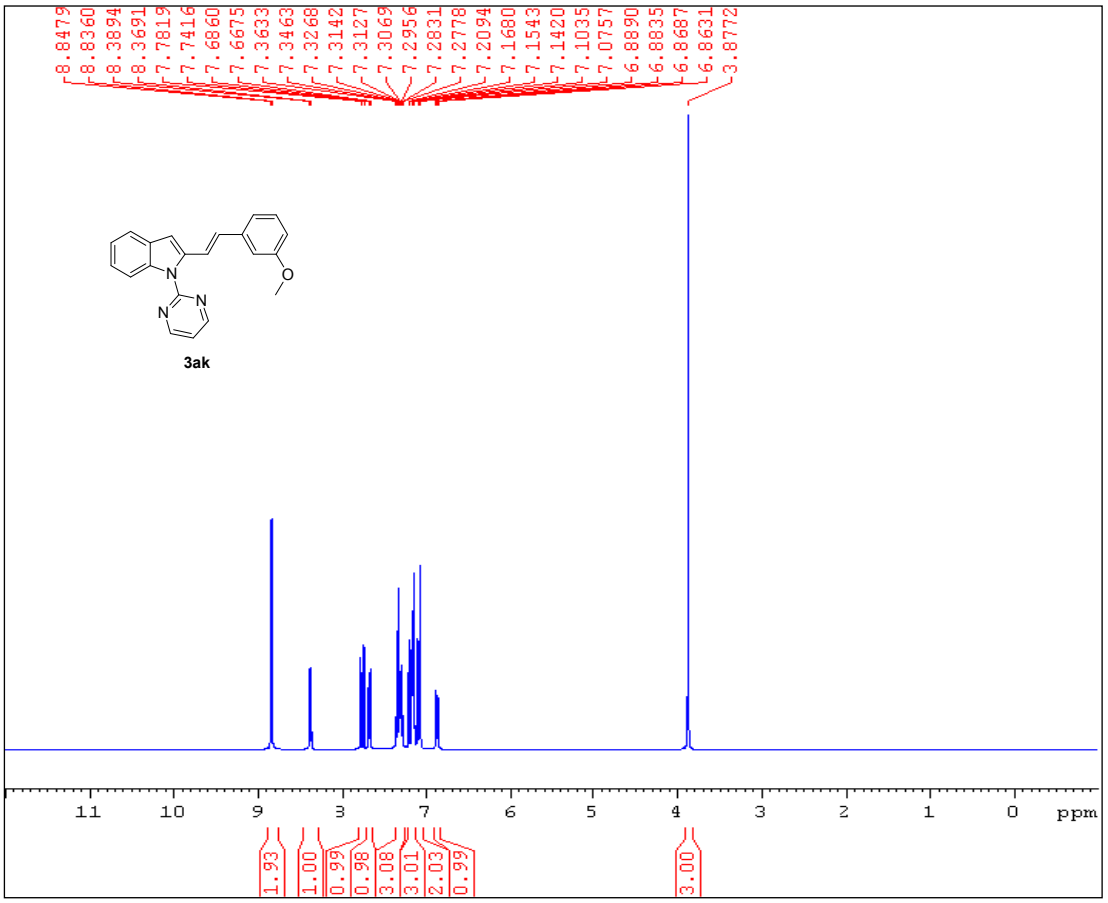
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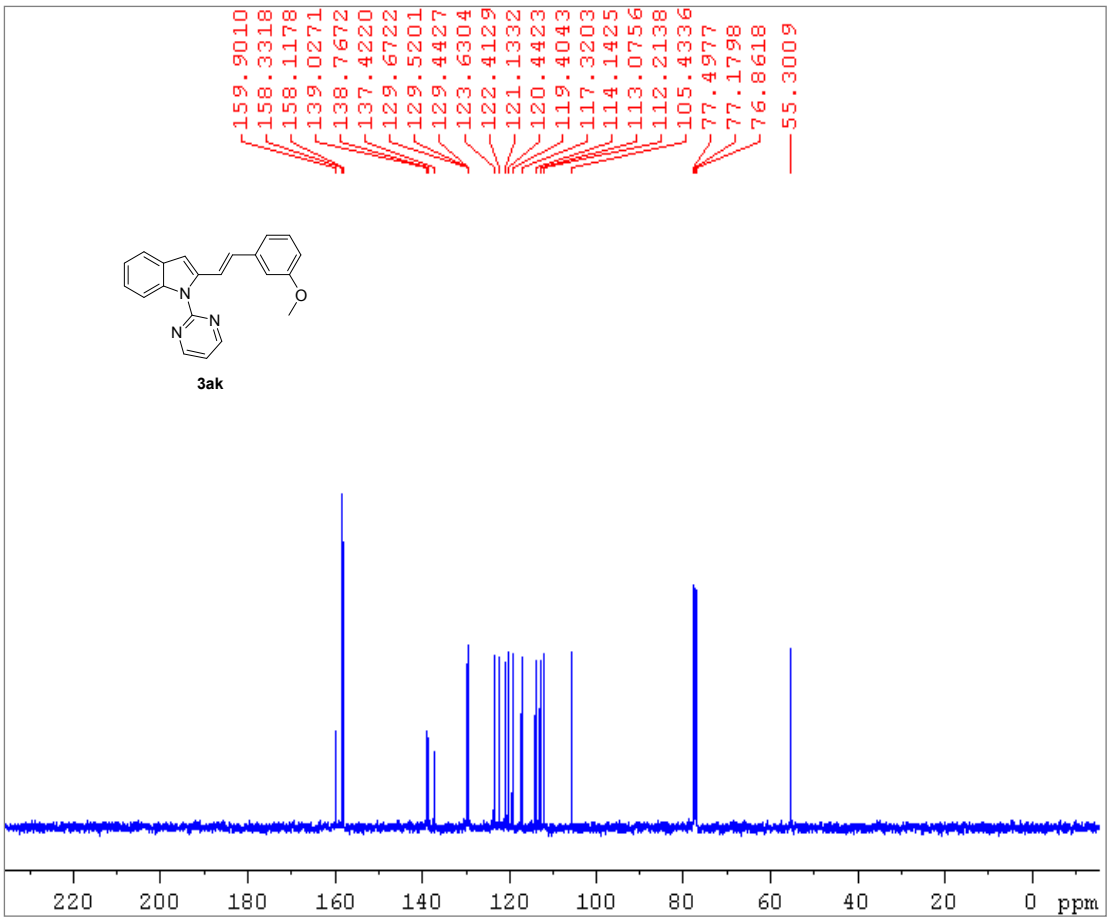
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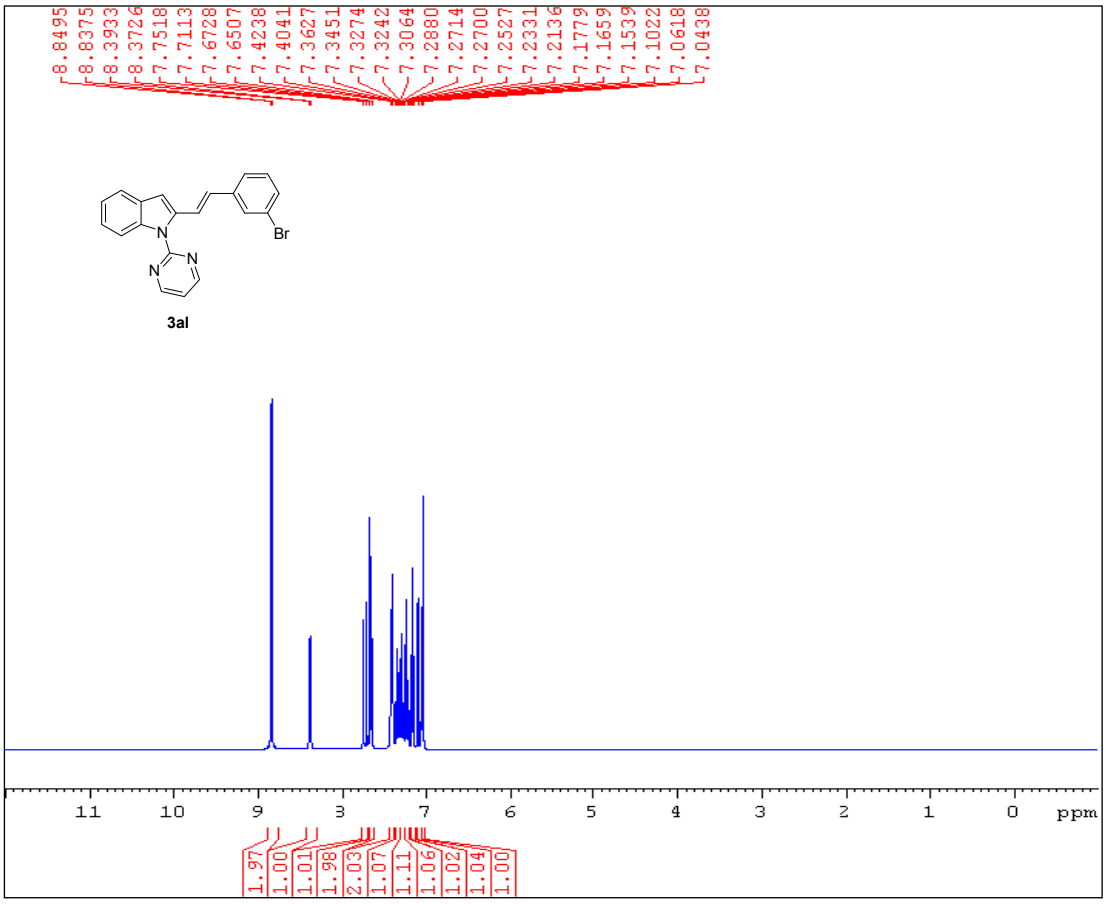
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7.1539
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7.0618
7.0438
Br
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N
3al
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10
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3
7
6
5
4
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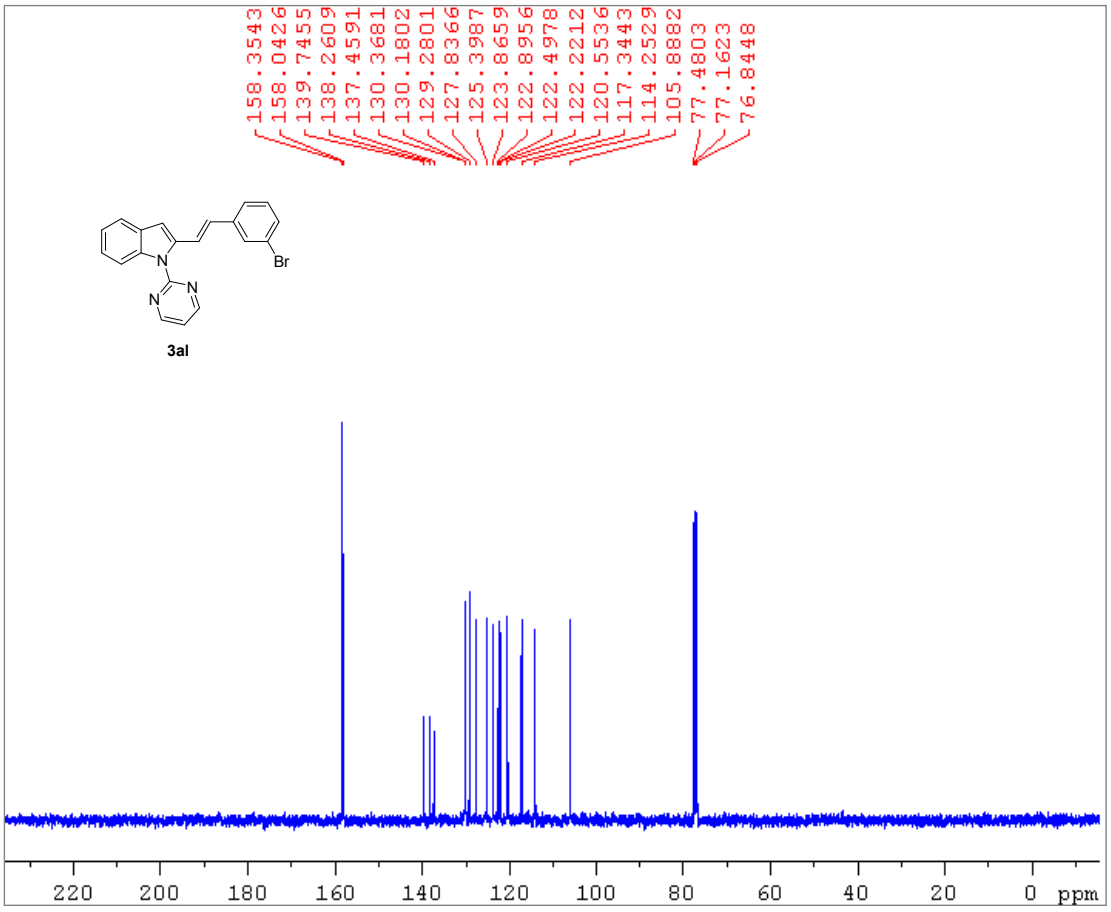
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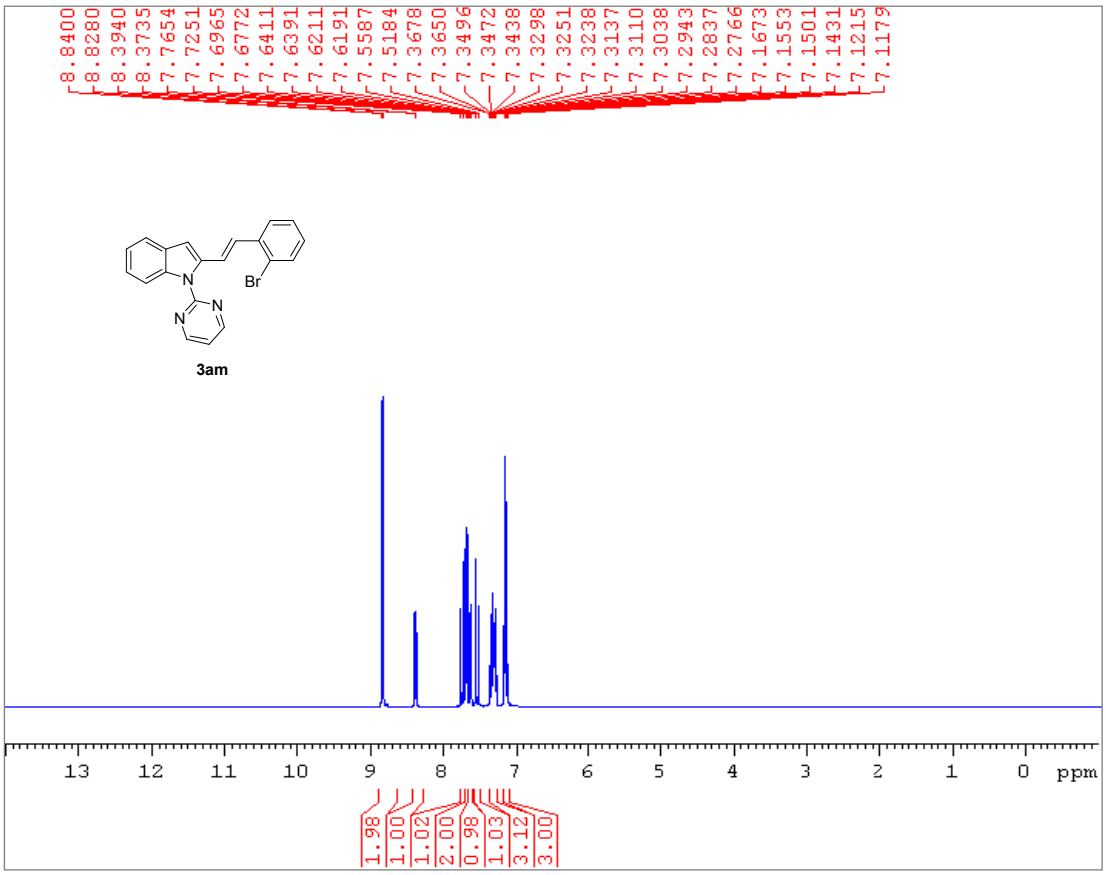
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7.1553
7.1501
7.1431
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7.1179
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N
3am
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12
11
10
9
8
7
6
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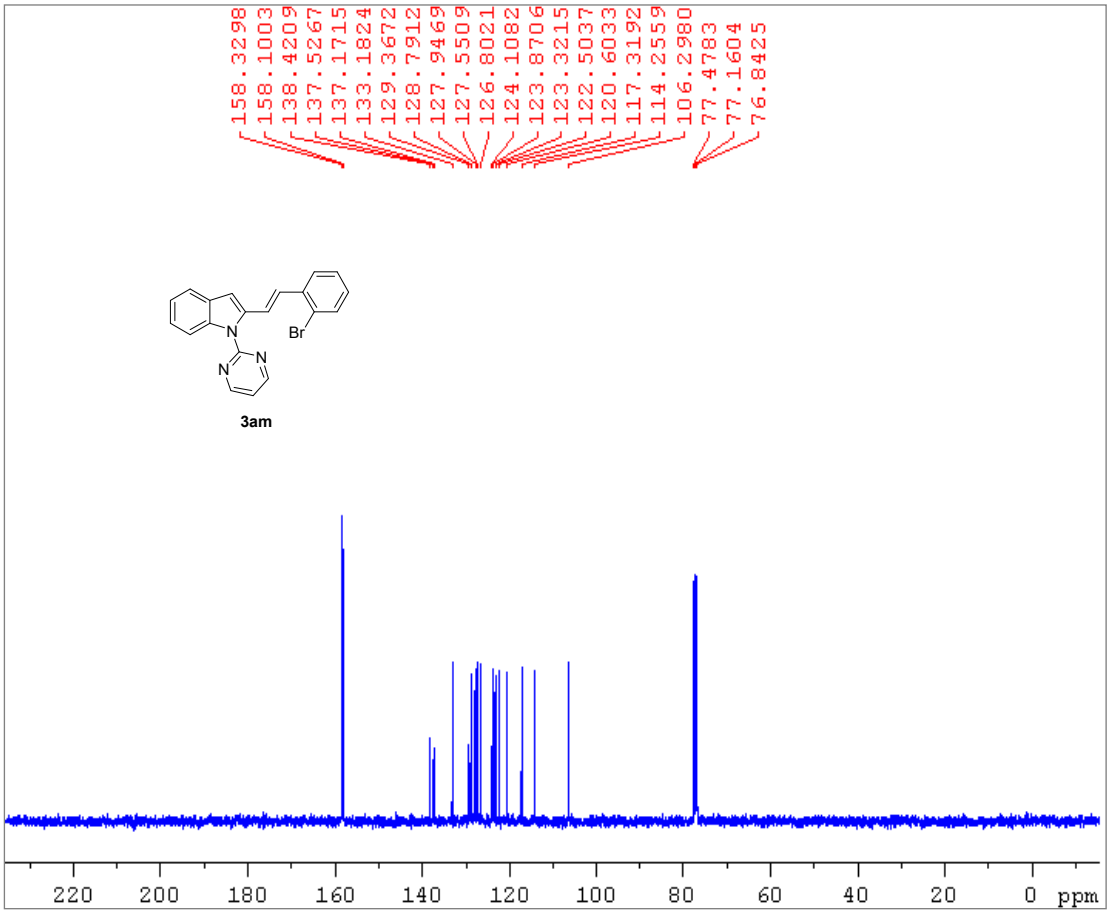
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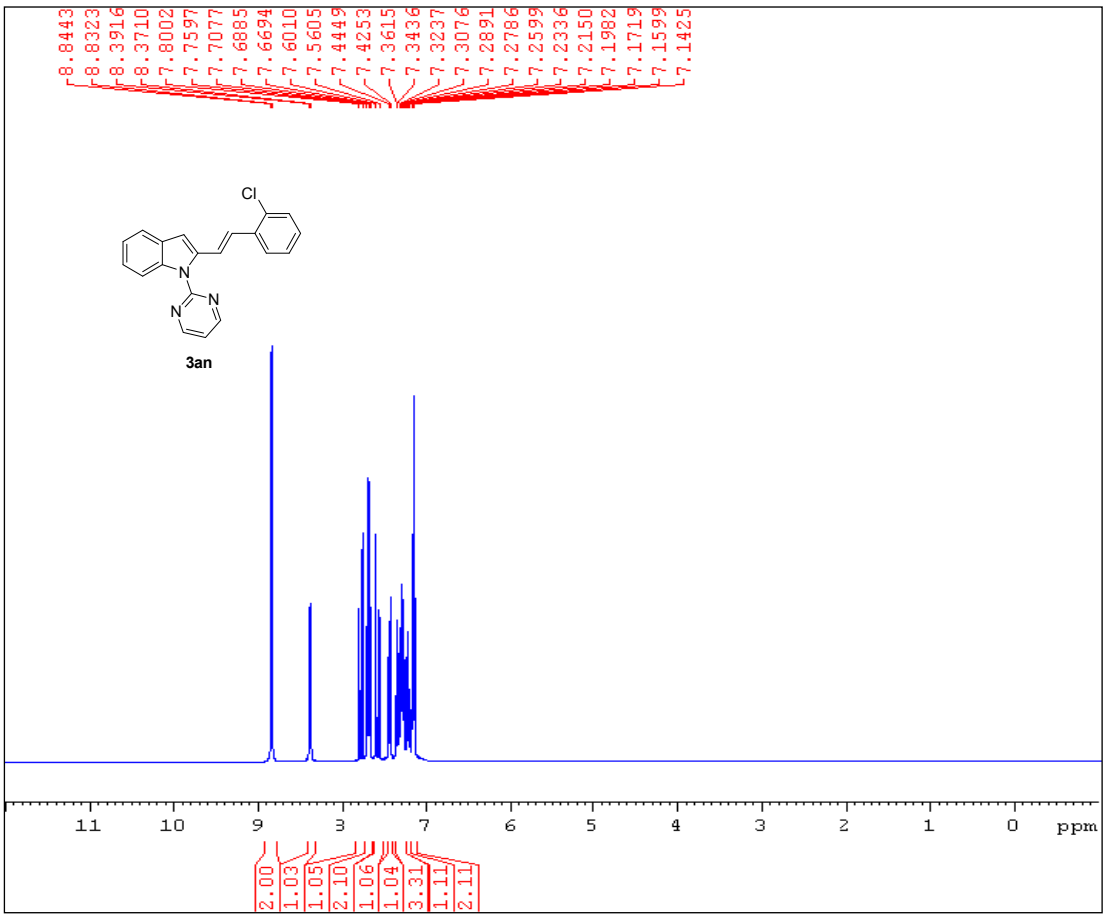
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7.1599
7.1425
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N
3an
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5
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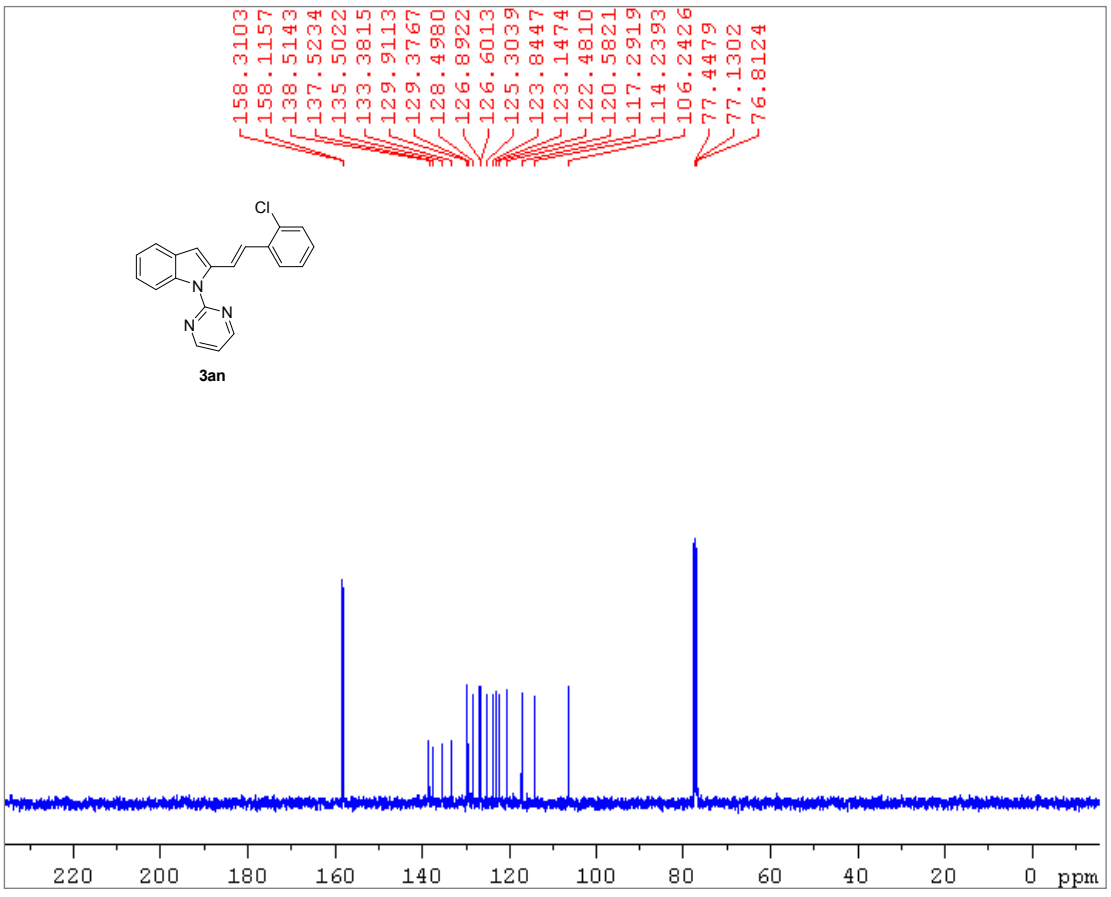
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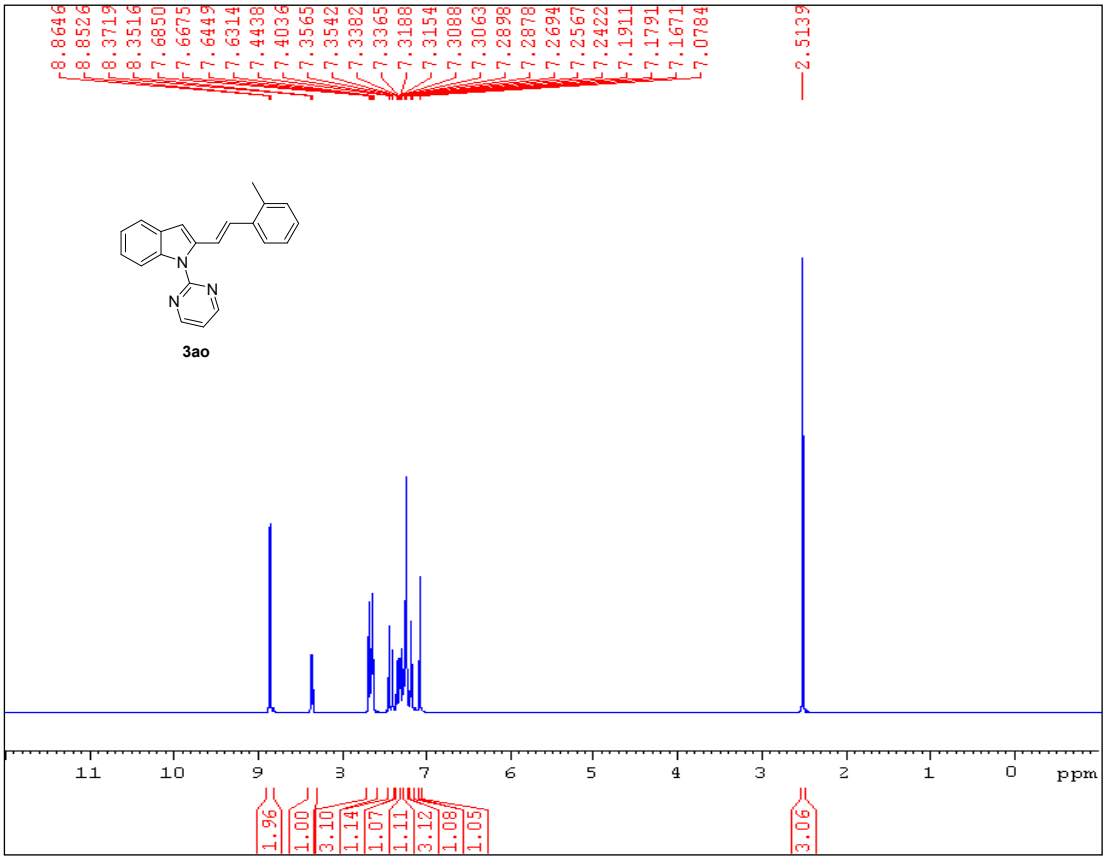
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7.3382
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7.3154
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7.2422
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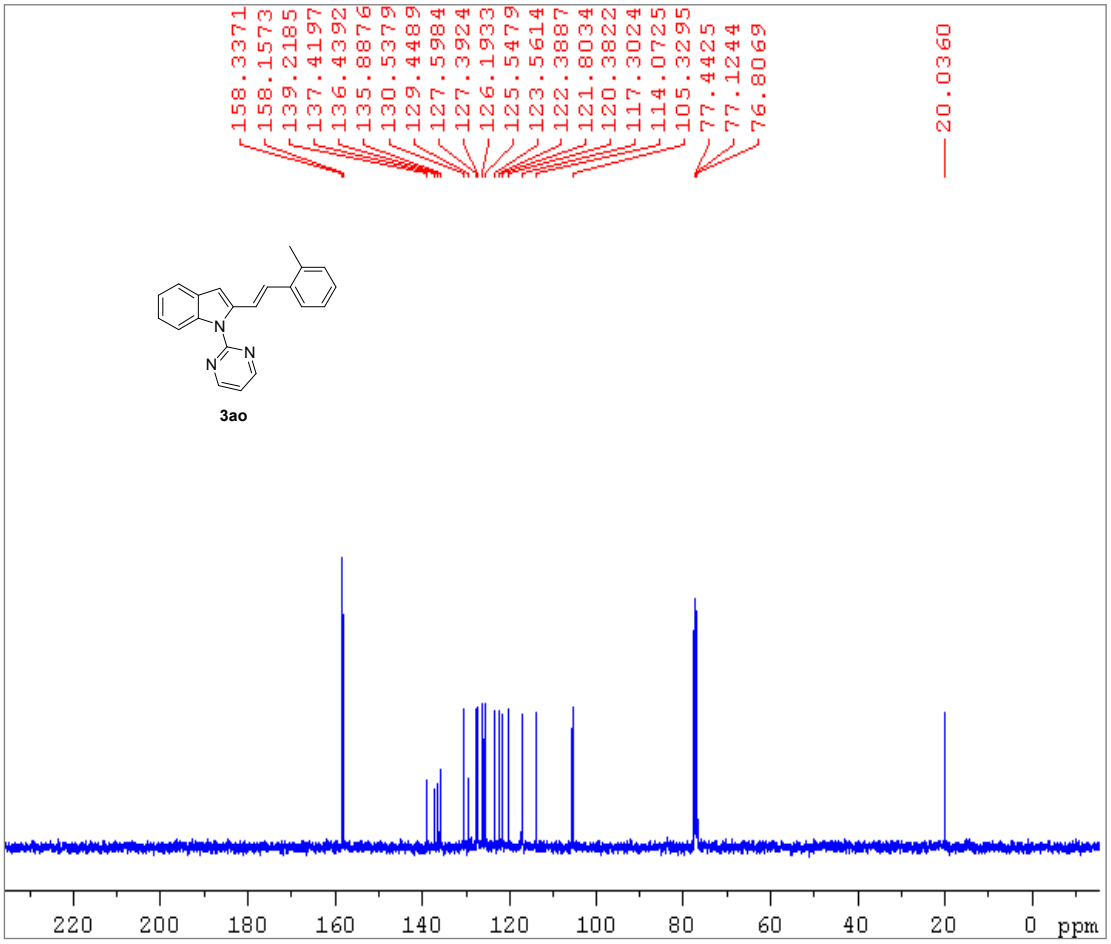
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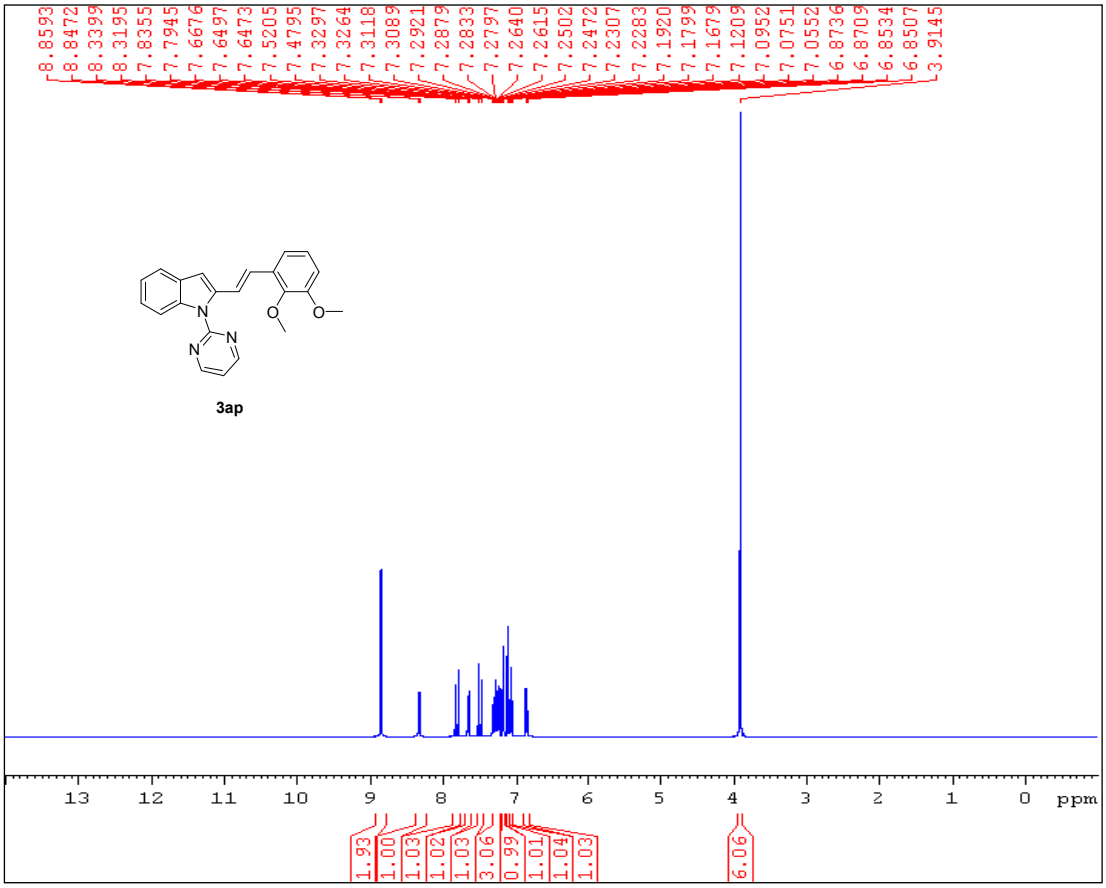
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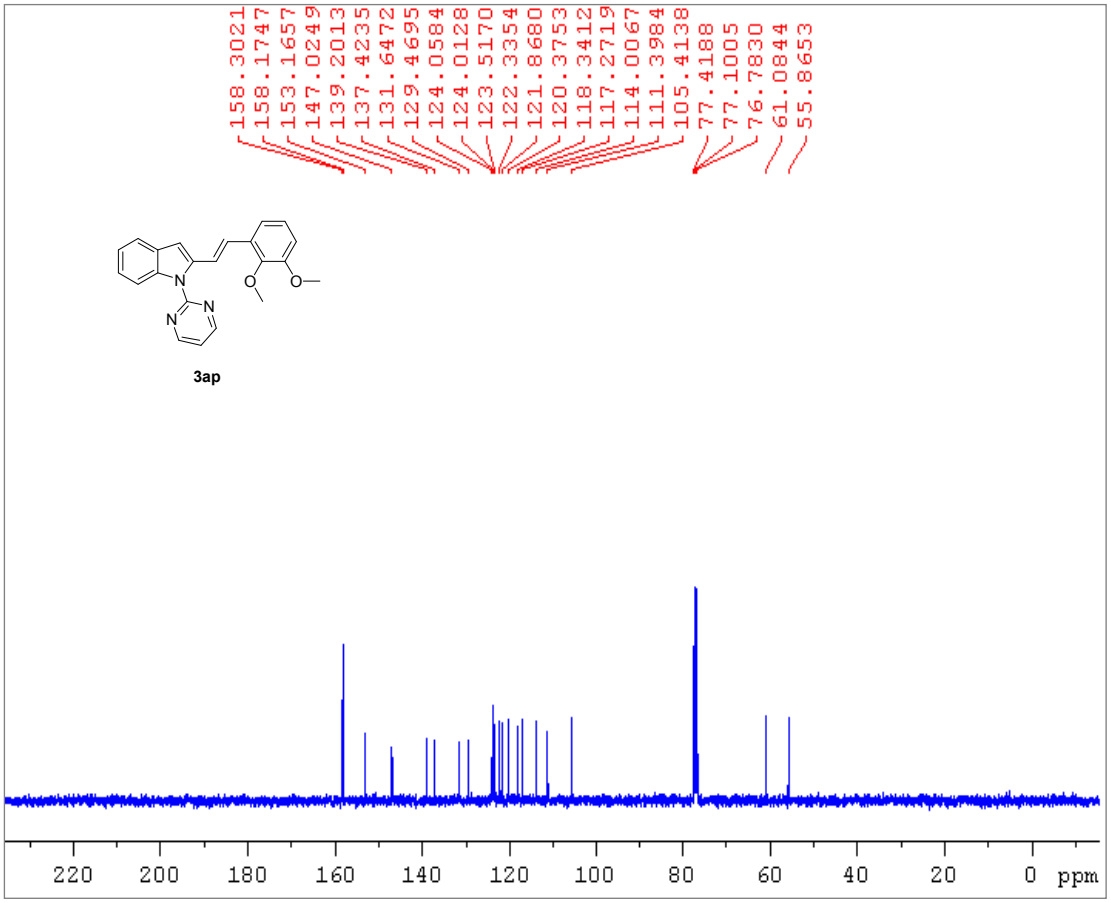
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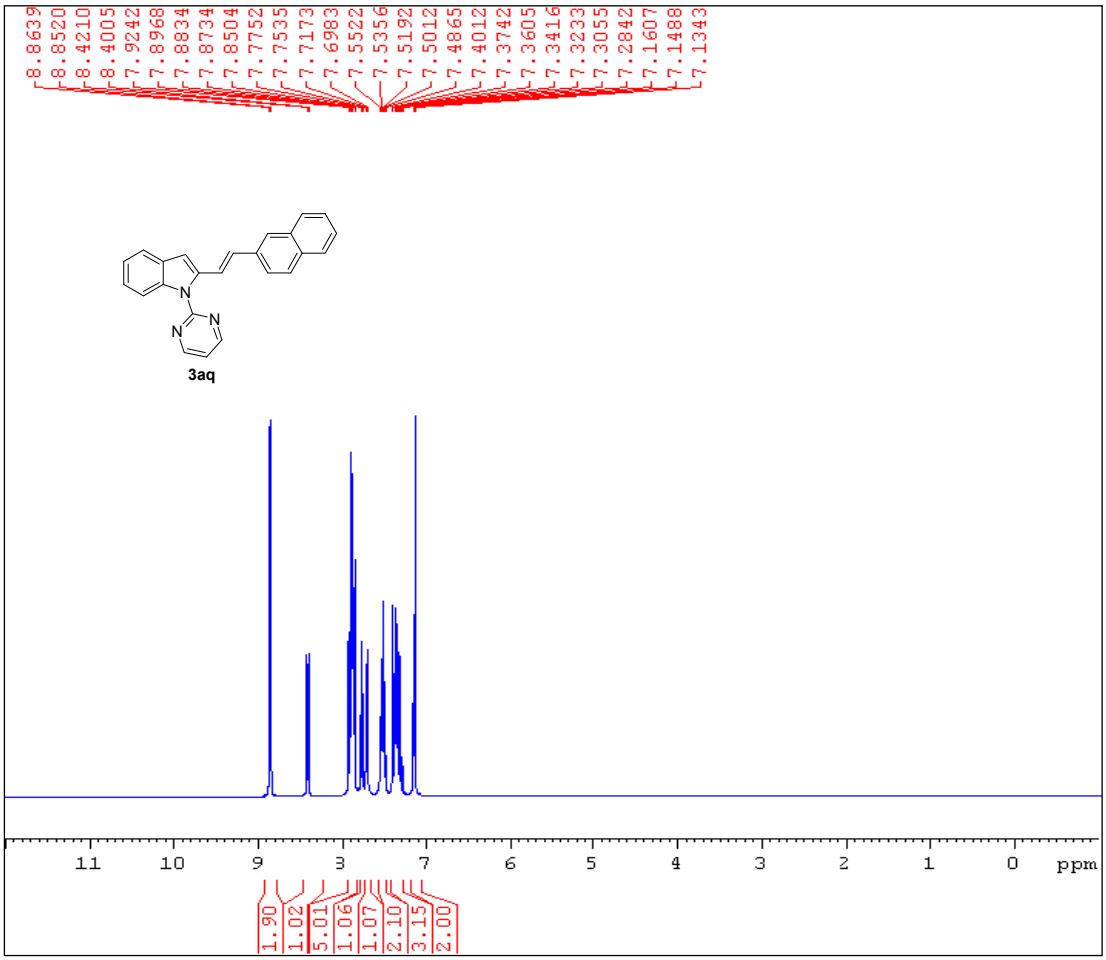
3ap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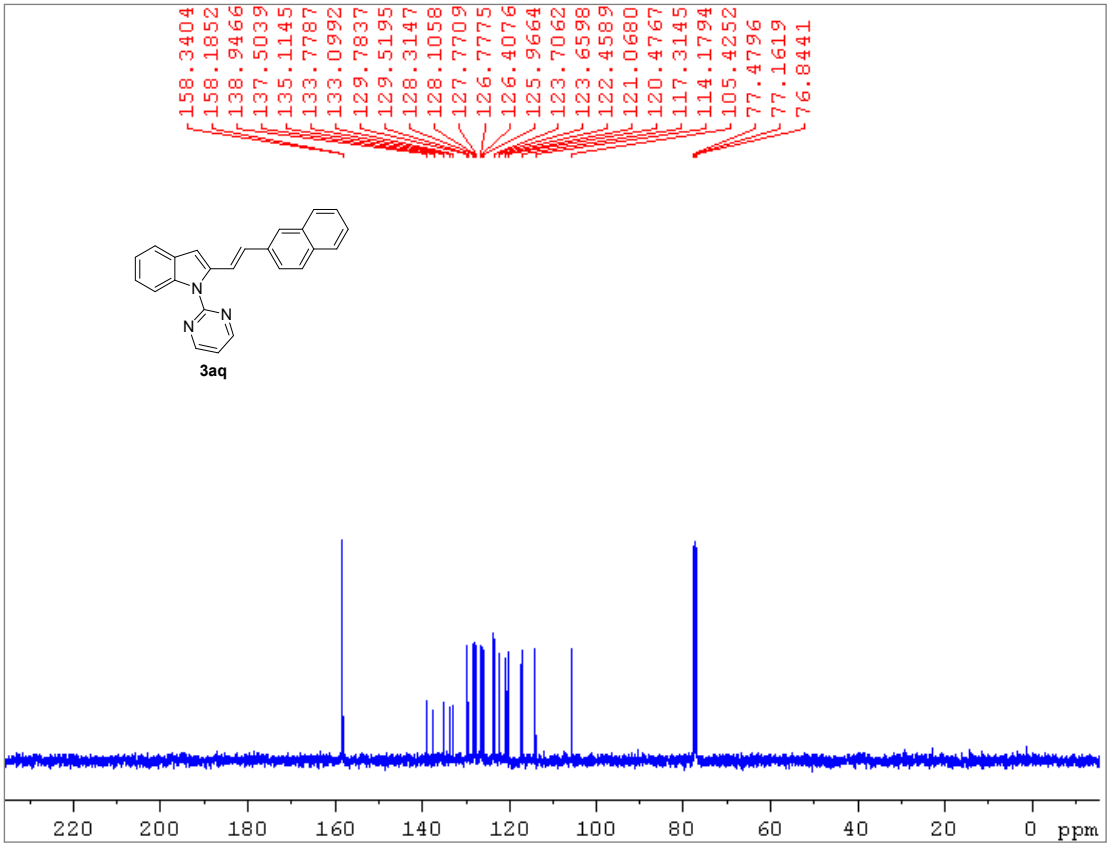
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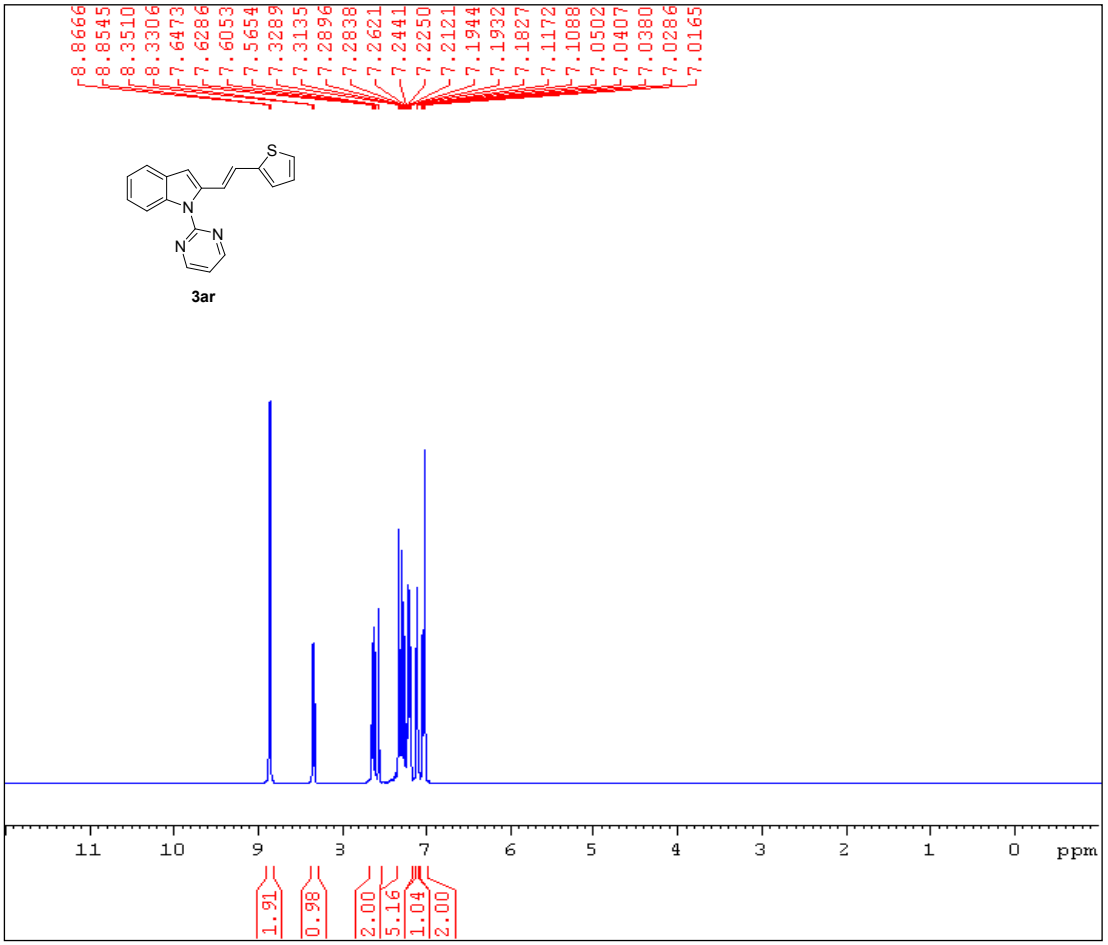
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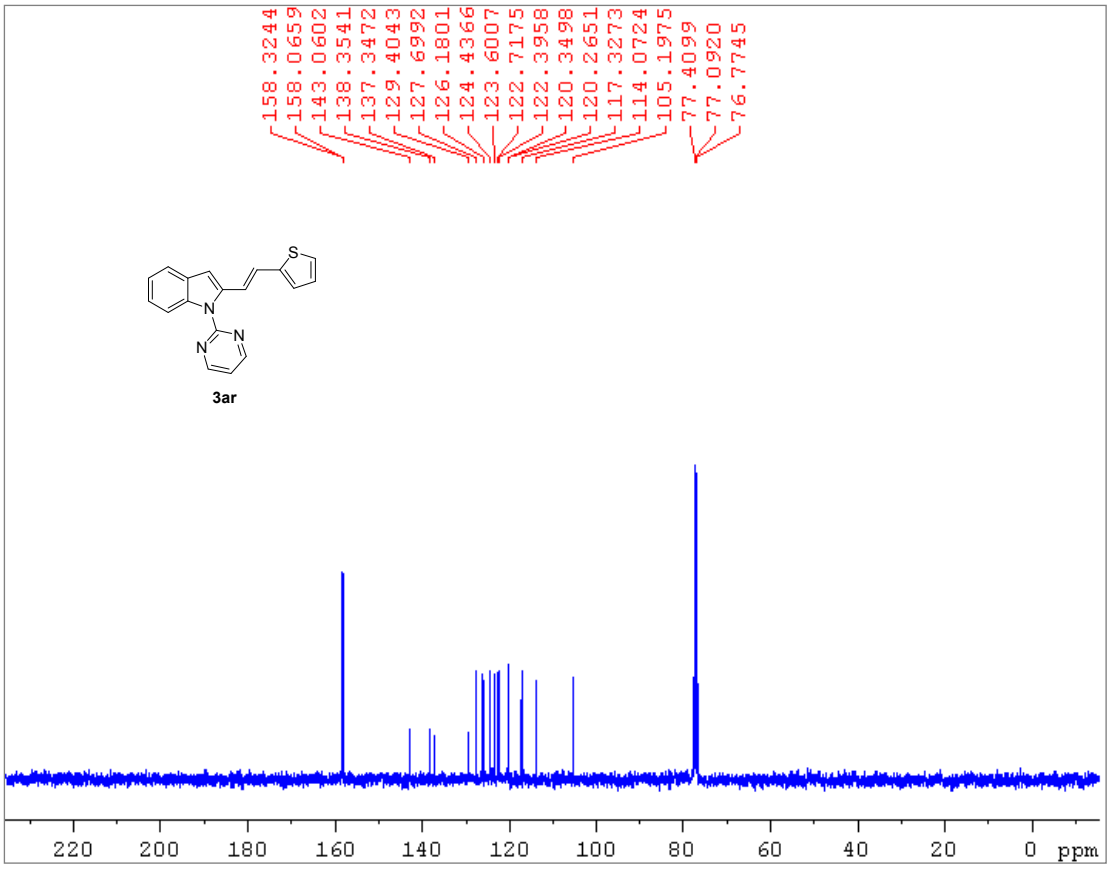
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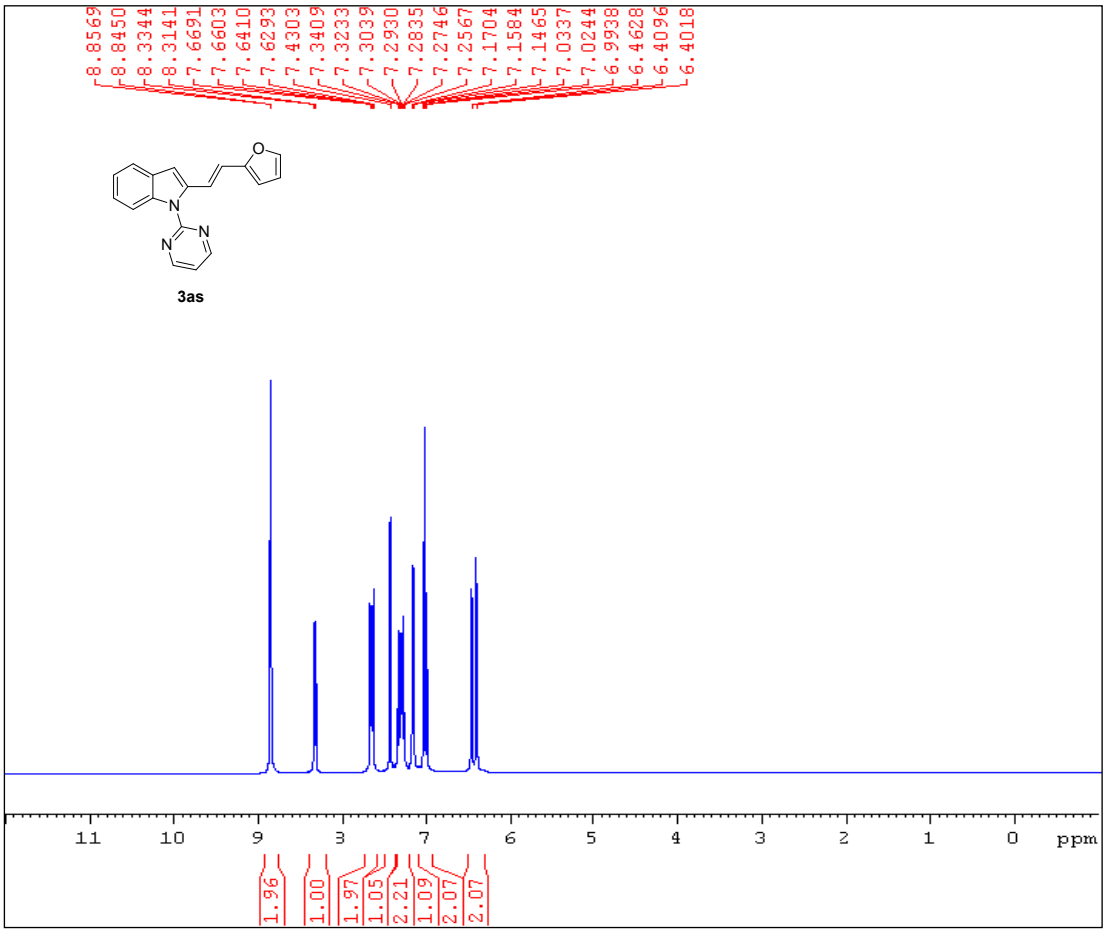
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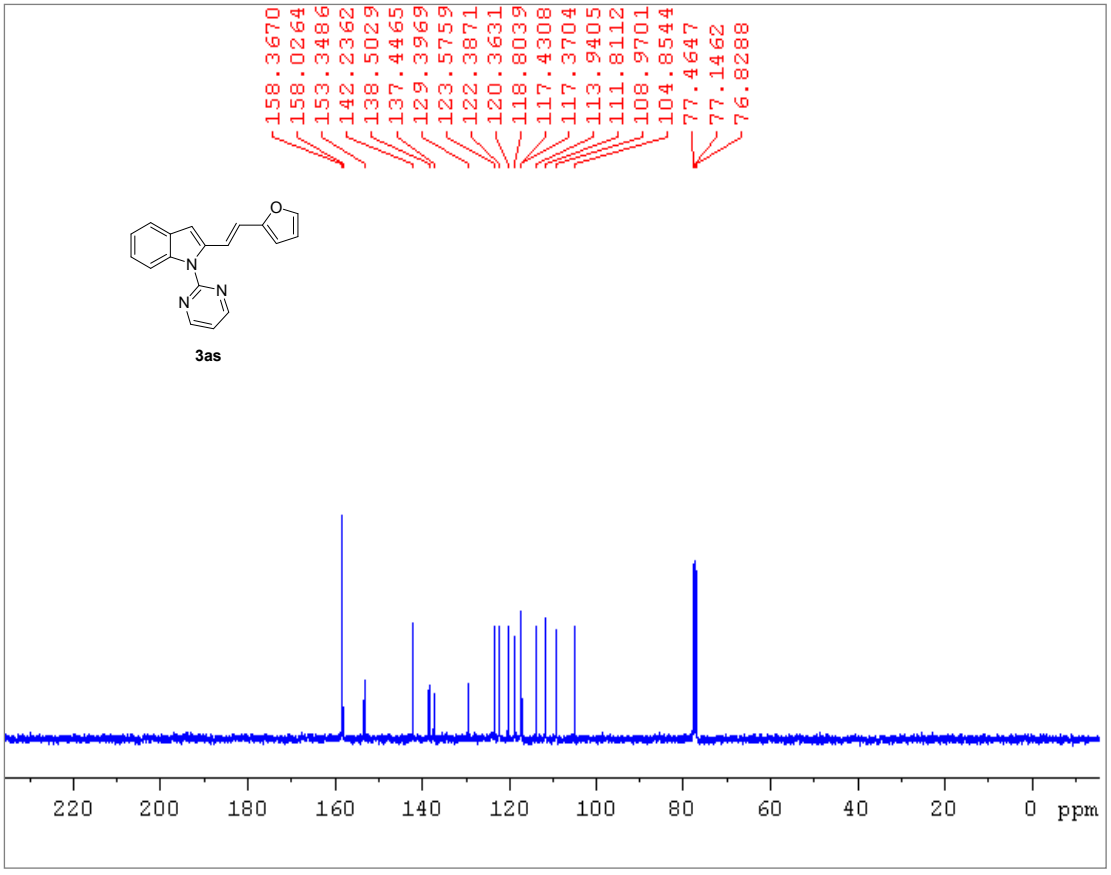
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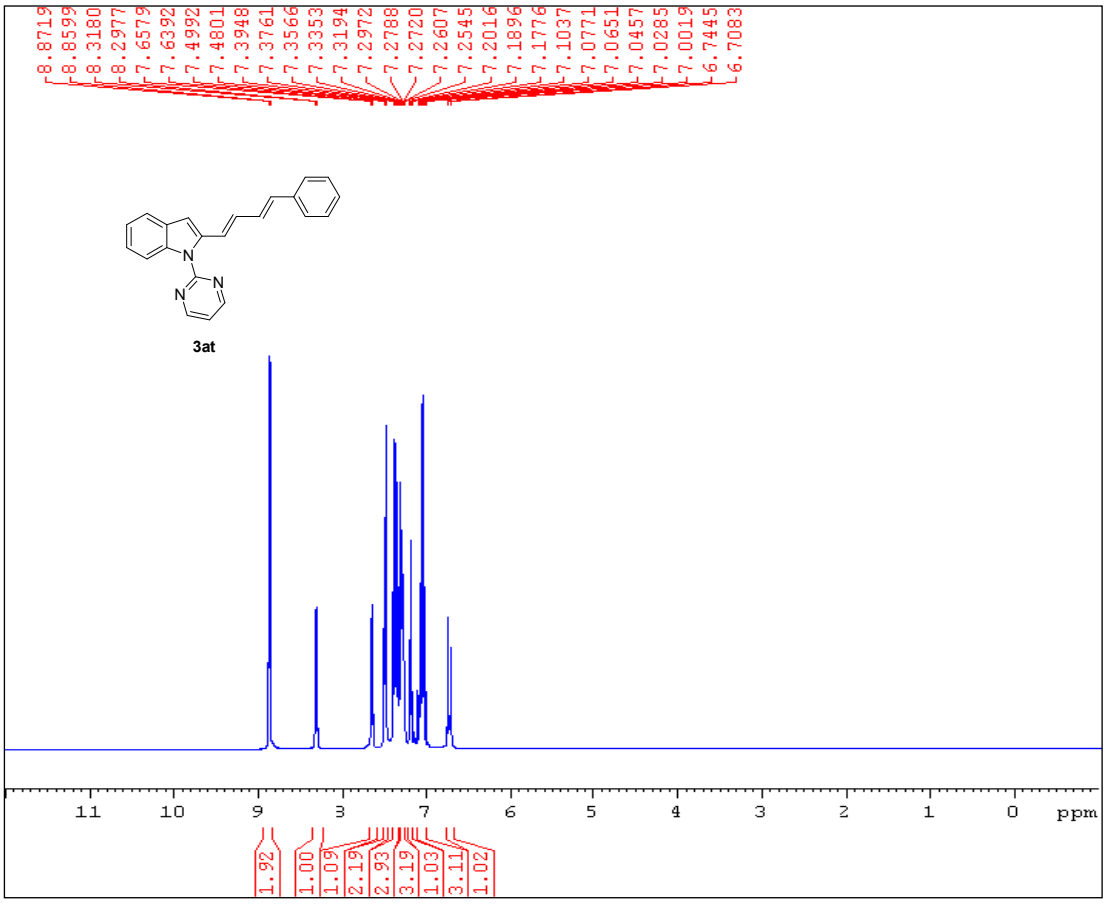
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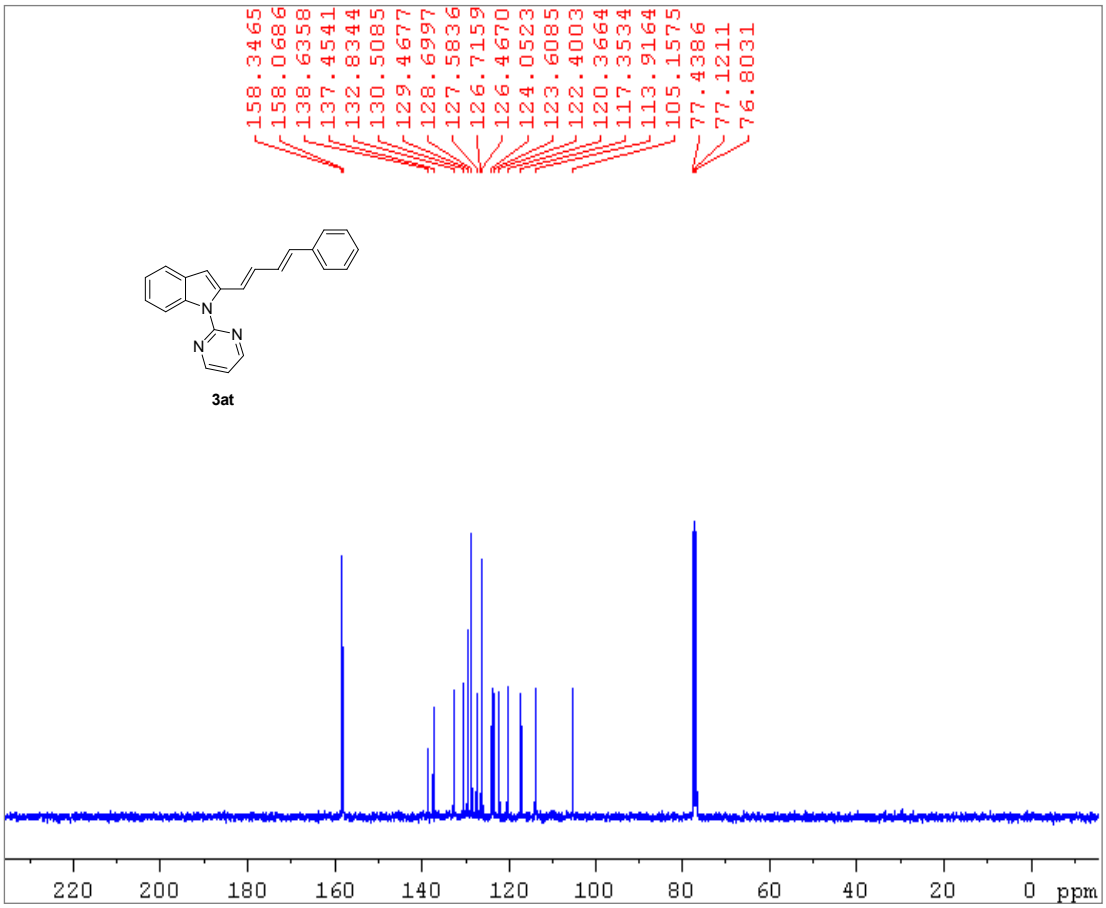
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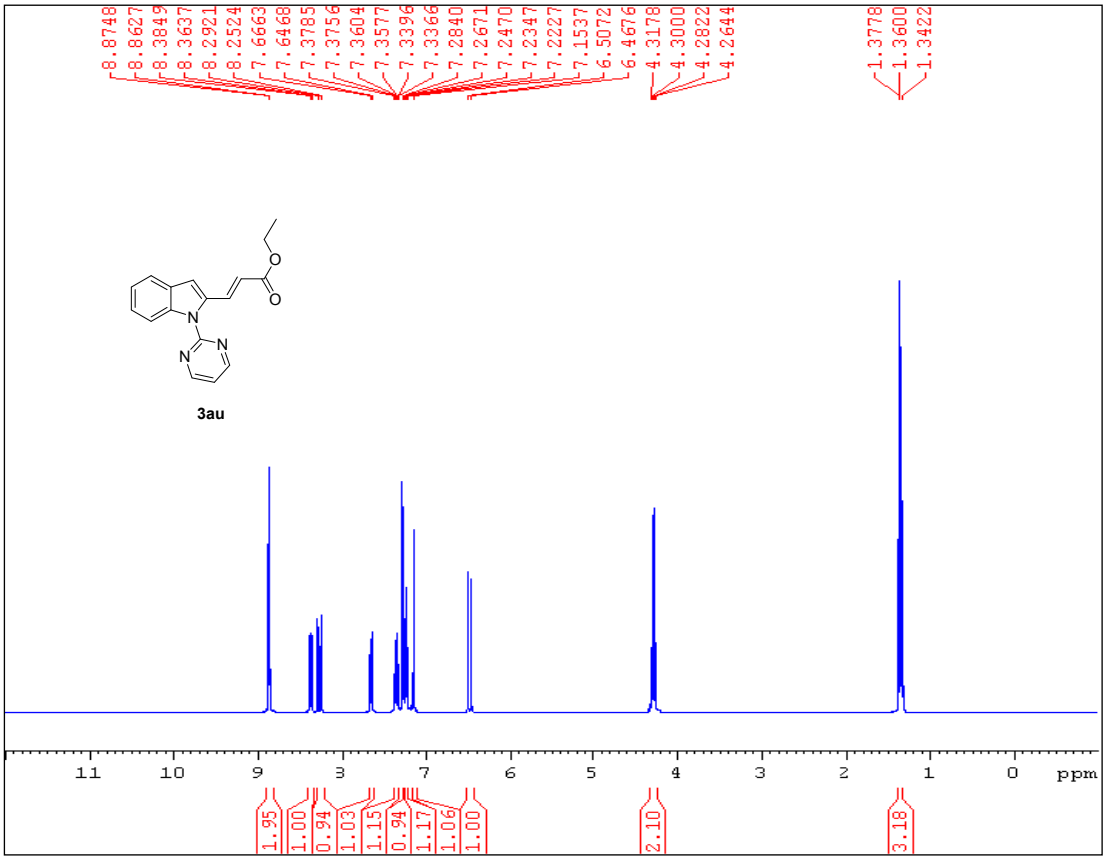
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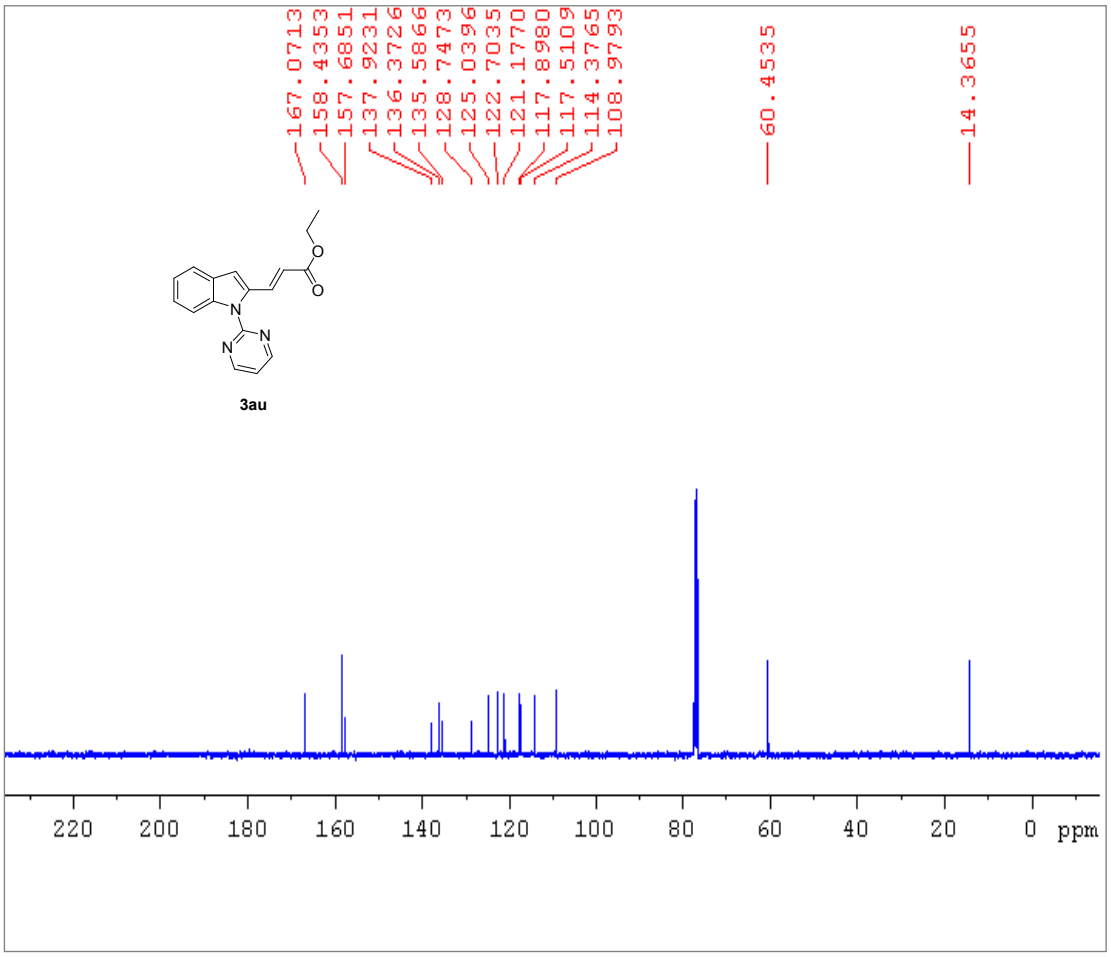
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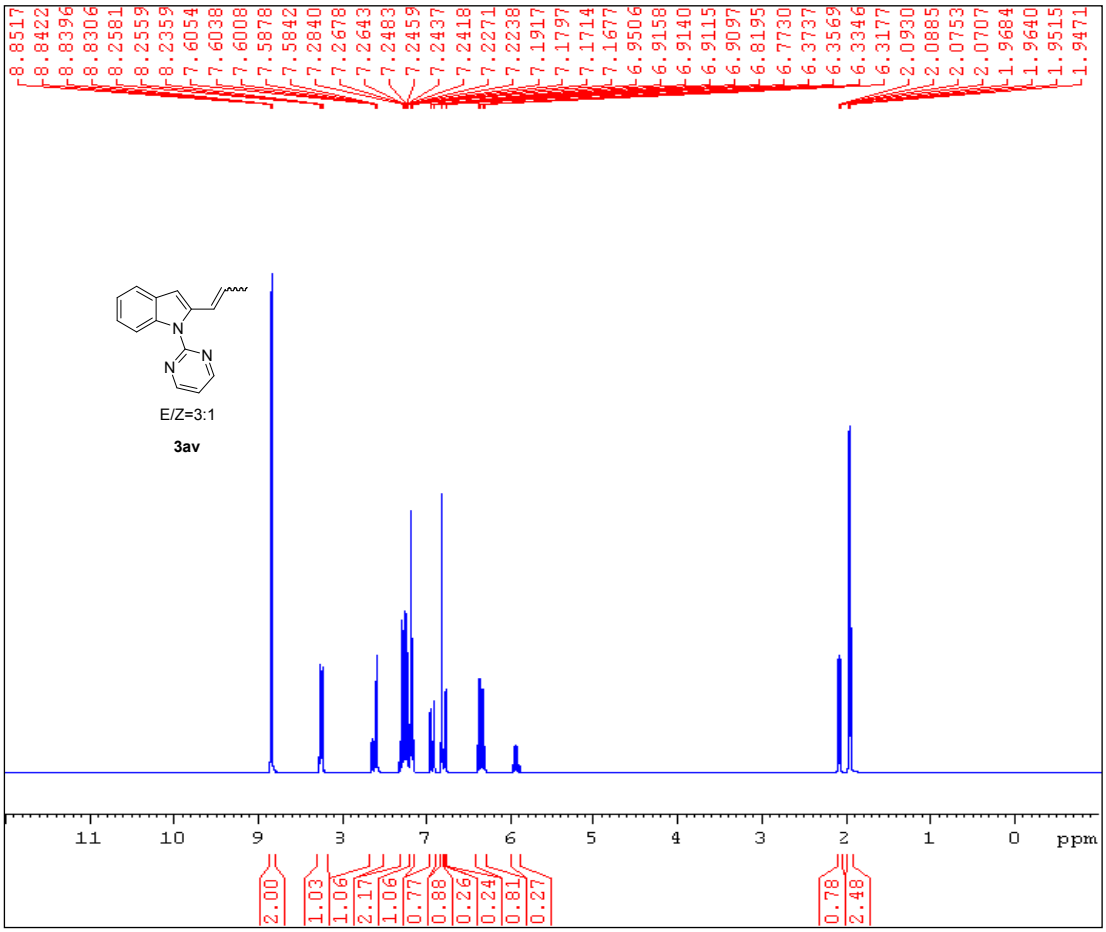
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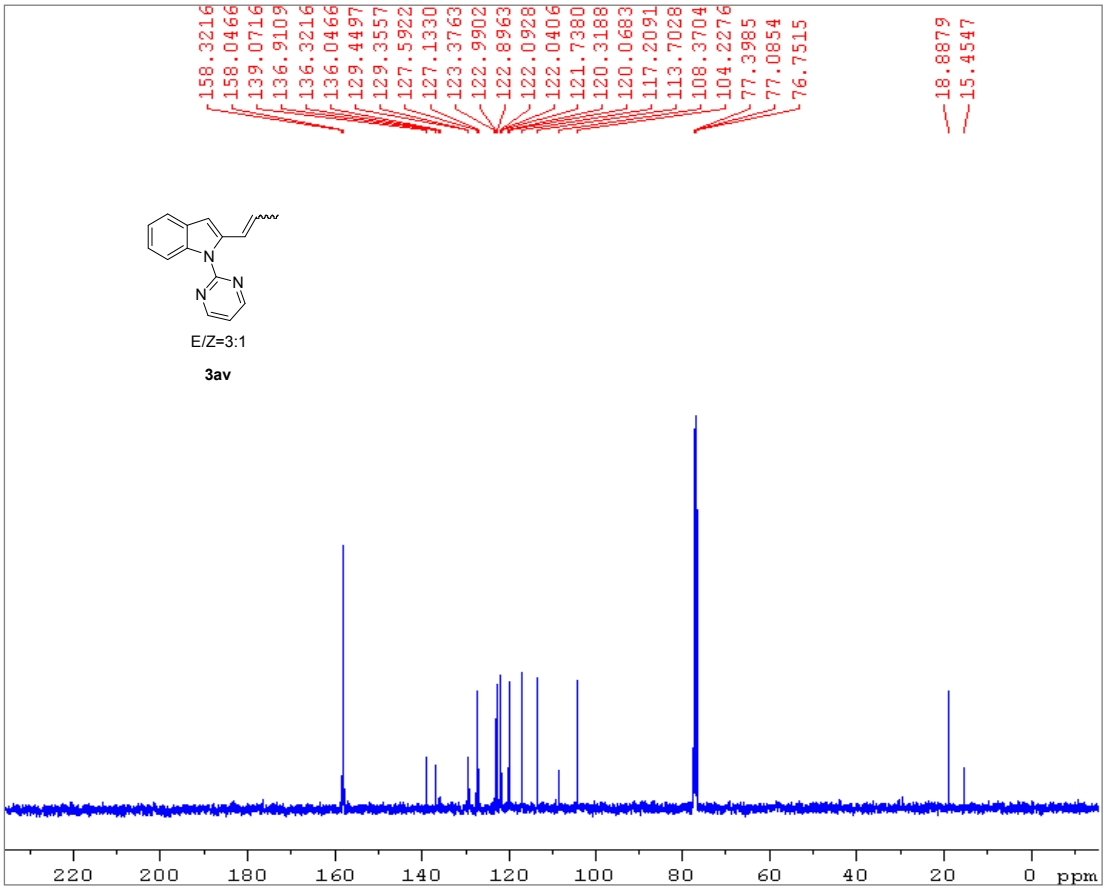
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E/Z=3:1
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160
140
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20
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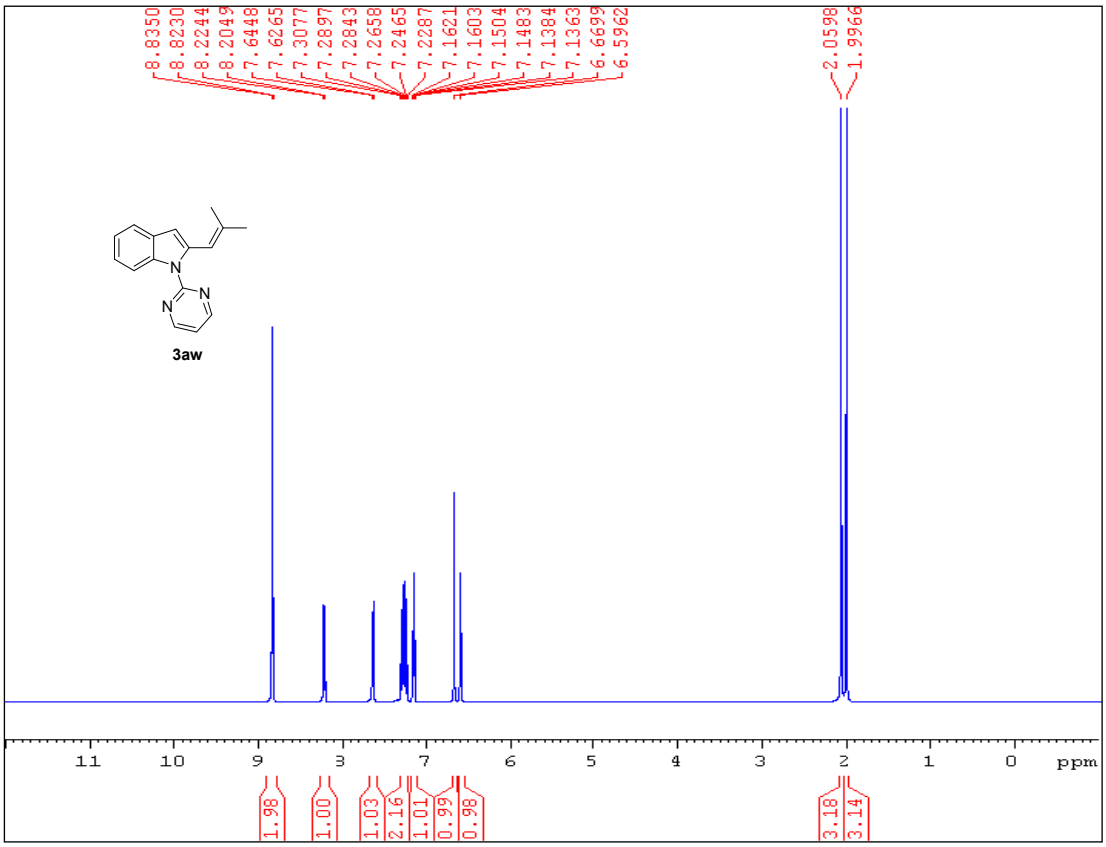
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7.6448
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7.3077
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7.2843
7.2658
7.2465
7.2287
7.1621
7.1603
7.1504
7.1483
7.1384
7.1363
6.6699
6.5962
2.0598
1.9966
3aw
11
10
9
3
7
6
5
4
3
2
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ppm
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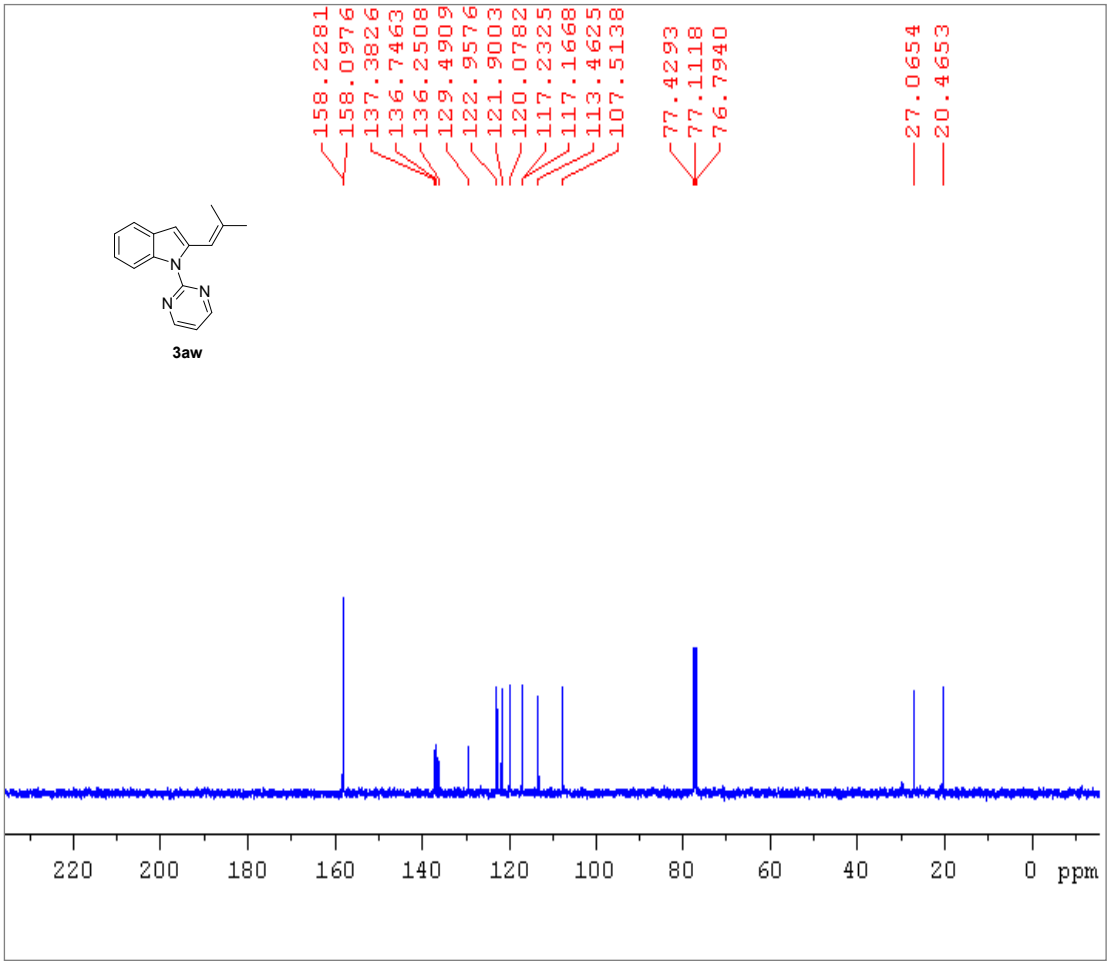
1.03
2.16
1.01
0.99
0.98
3.18
3.14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136.2508
129.4909
122.9576
121.9003
120.0782
117.2325
117.1668
113.4625
107.5138
77.4293
77.1118
76.7940
27.0654
20.4653
3aw
220
200
180
160
140
120
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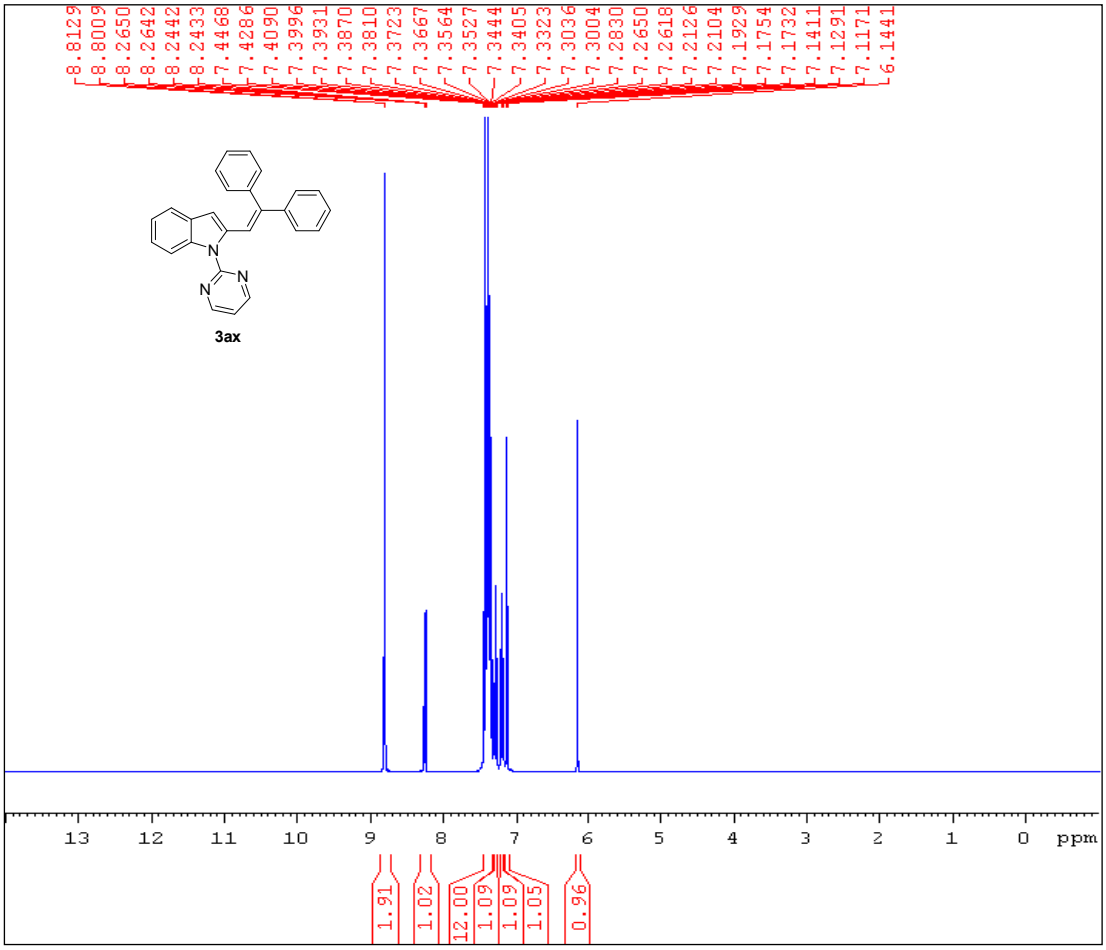
80
60
40
20
0
ppm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8.2650
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8.2442
8.2433
7.4468
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7.4090
7.3996
7.3931
7.3870
7.3810
7.3723
7.3667
7.3564
7.3527
7.3444
7.3405
7.3323
7.3036
7.3004
7.2830
7.2650
7.2618
7.2126
7.2104
7.1929
7.1754
7.1732
7.1411
7.1291
7.1171
6.1441
3ax
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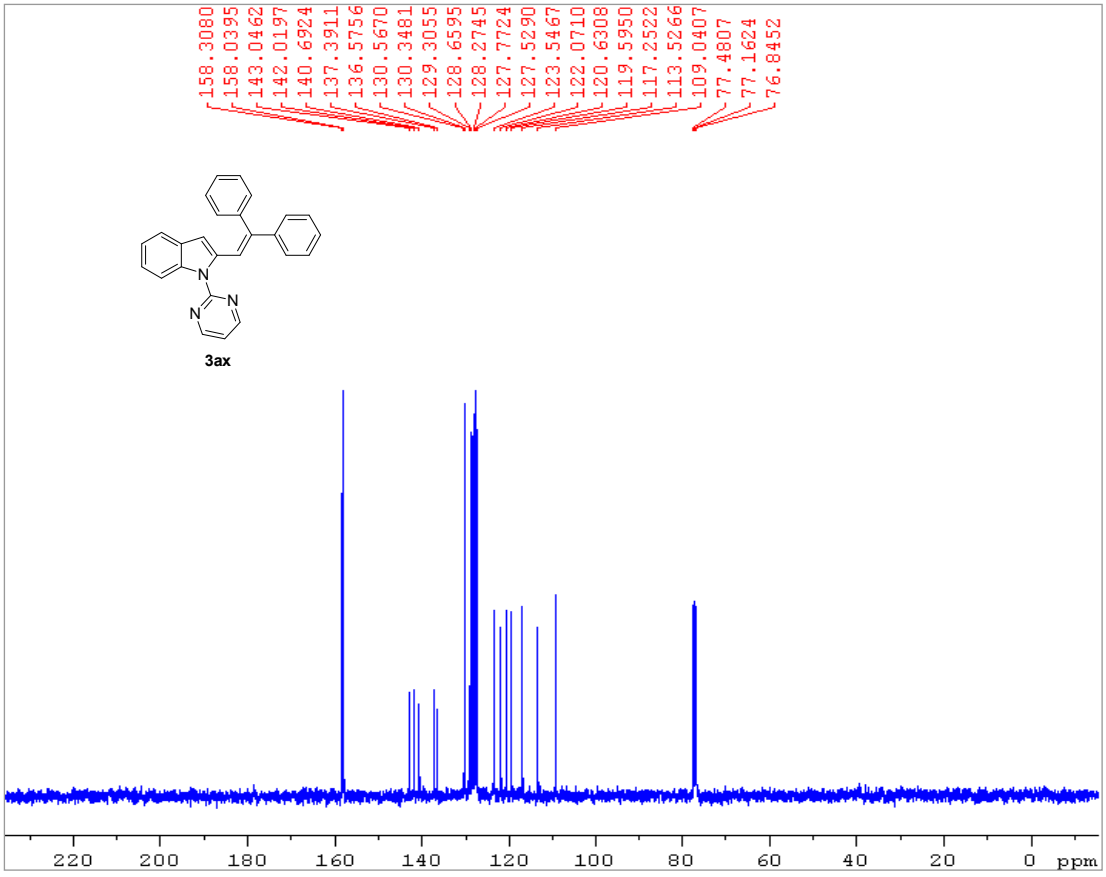
1.91
1.02
12.00
1.09
1.09
1.05
0.96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143.0462
142.0197
140.6924
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136.5756
130.5670
130.3481
129.3055
128.6595
128.2745
127.7724
127.5290
123.5467
122.0710
120.6308
119.5950
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113.5266
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76.8452
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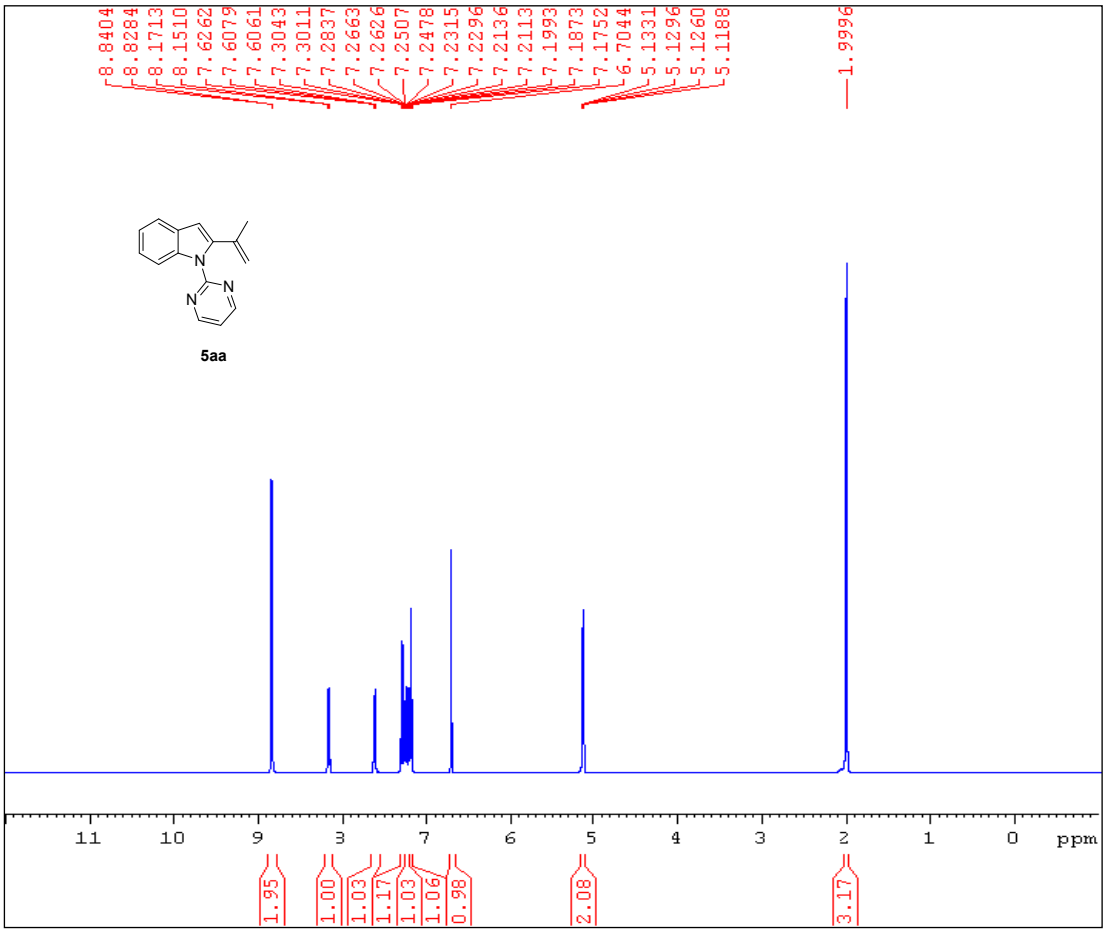
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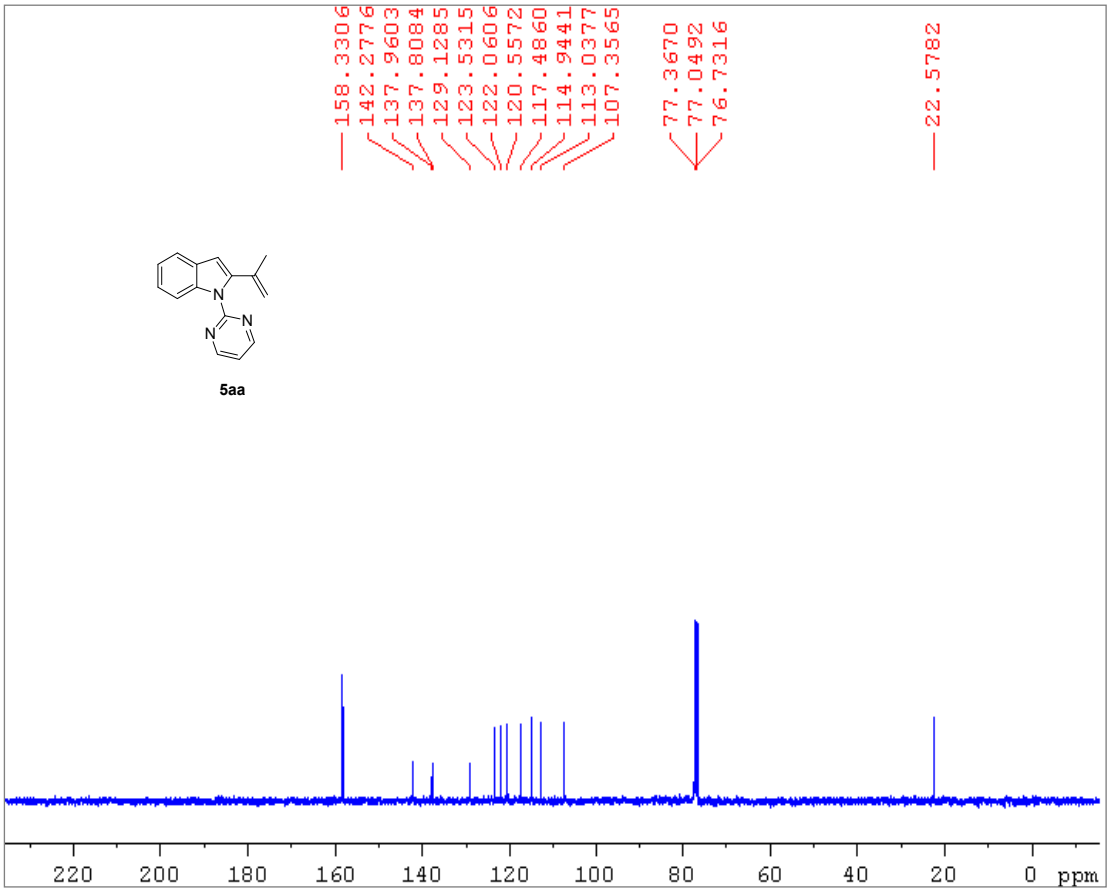
8.8284
8.1713
8.1510
7.6262
7.6079
7.6061
7.3043
7.3011
7.2837
7.2663
7.2626
7.2507
7.2478
7.2315
7.2296
7.2136
7.2113
7.1993
7.1873
7.1752
6.7044
5.1331
5.1296
5.1260
5.1188
1.9996
5aa
11
10
9
3
7
6
5
4
3
2
1
0
ppm
1.95
1.00
1.03
1.17
1.03
1.06
0.98
2.08
3.17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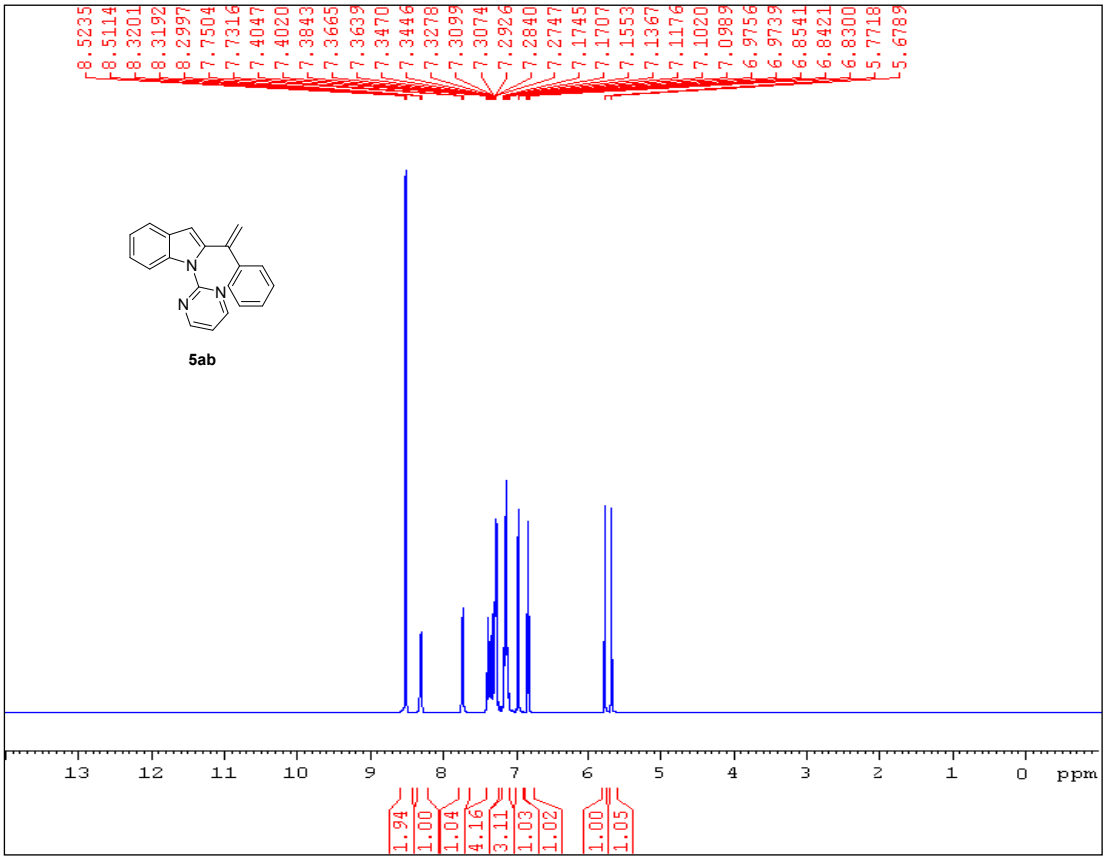
137.8084
129.1285
123.5315
122.0606
120.5572
117.4860
114.9441
113.0377
107.3565
77.3670
77.0492
76.7316
22.5782
5aa
220
200
180
160
140
120
100
80
60
40
20
0
ppm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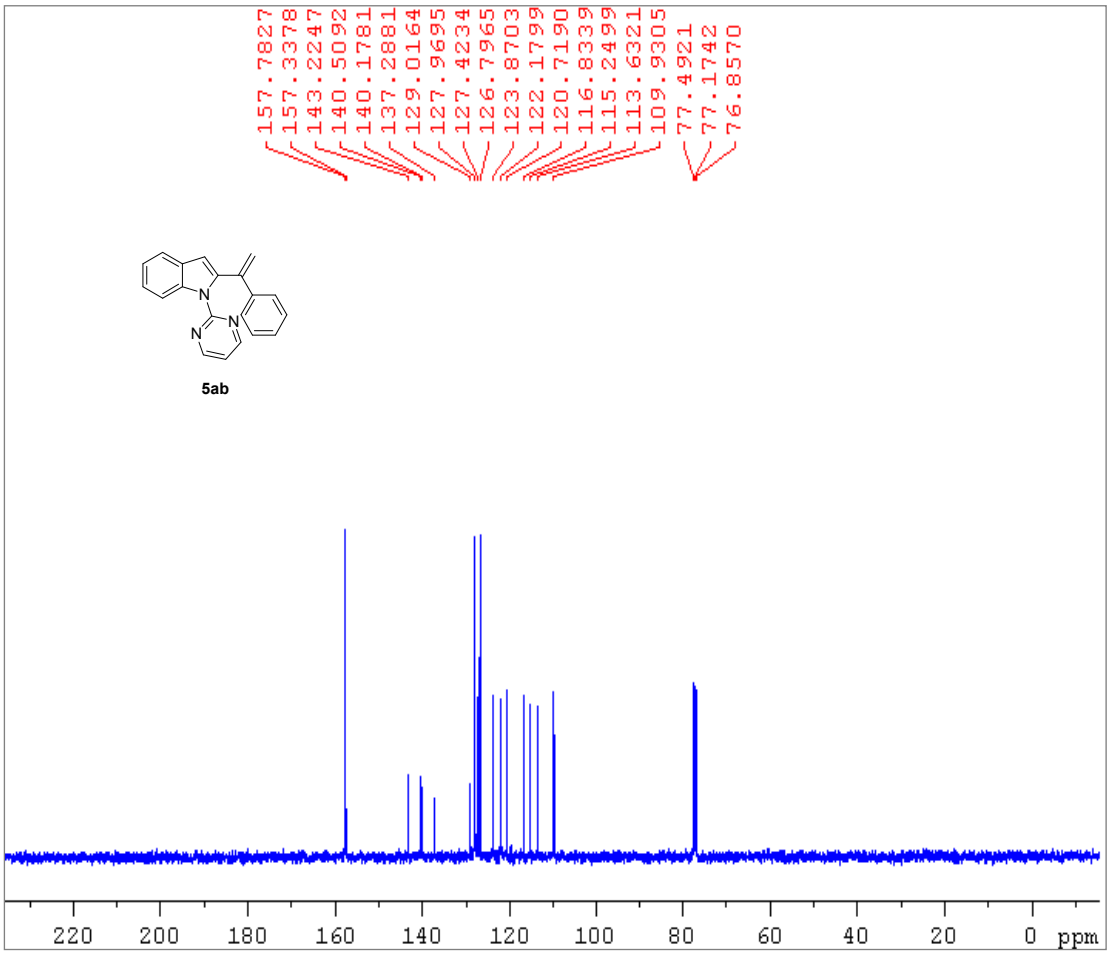
8.3201
8.3192
8.2997
7.7504
7.7316
7.4047
7.4020
7.3843
7.3665
7.3639
7.3470
7.3446
7.3278
7.3099
7.3074
7.2926
7.2840
7.2747
7.1745
7.1707
7.1553
7.1367
7.1176
7.1020
7.0989
6.9756
6.9739
6.8541
6.8421
6.8300
5.7718
5.6789
5ab
13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.94 1.00 1.04 4.16 3.11 1.03 1.02 1.00 1.05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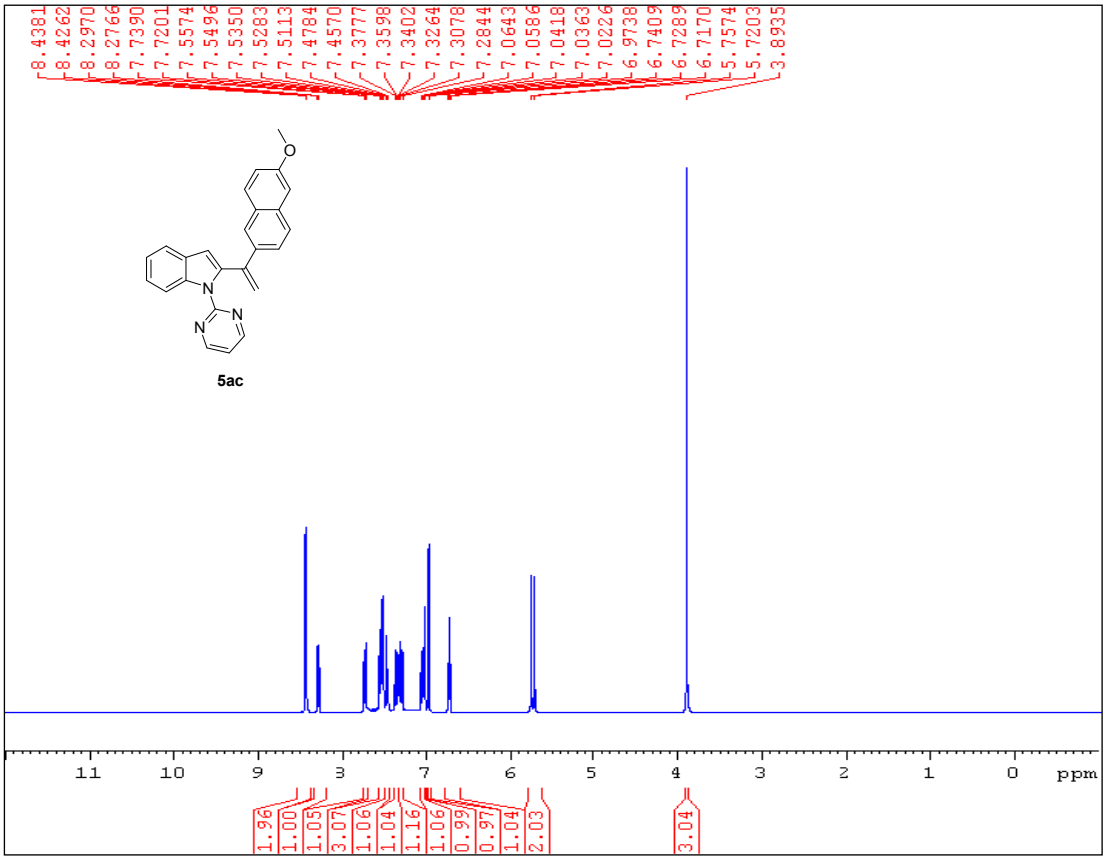
157.3378
143.2247
140.5092
140.1781
137.2881
129.0164
127.9695
127.4234
126.7965
123.8703
122.1799
120.7190
116.8339
115.2499
113.6321
109.9305
77.4921
77.1742
76.8570
5ab
220 200 180 160 140 120 100 80 60 40 20 0 ppm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8.2970
8.2766
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7.7201
7.5574
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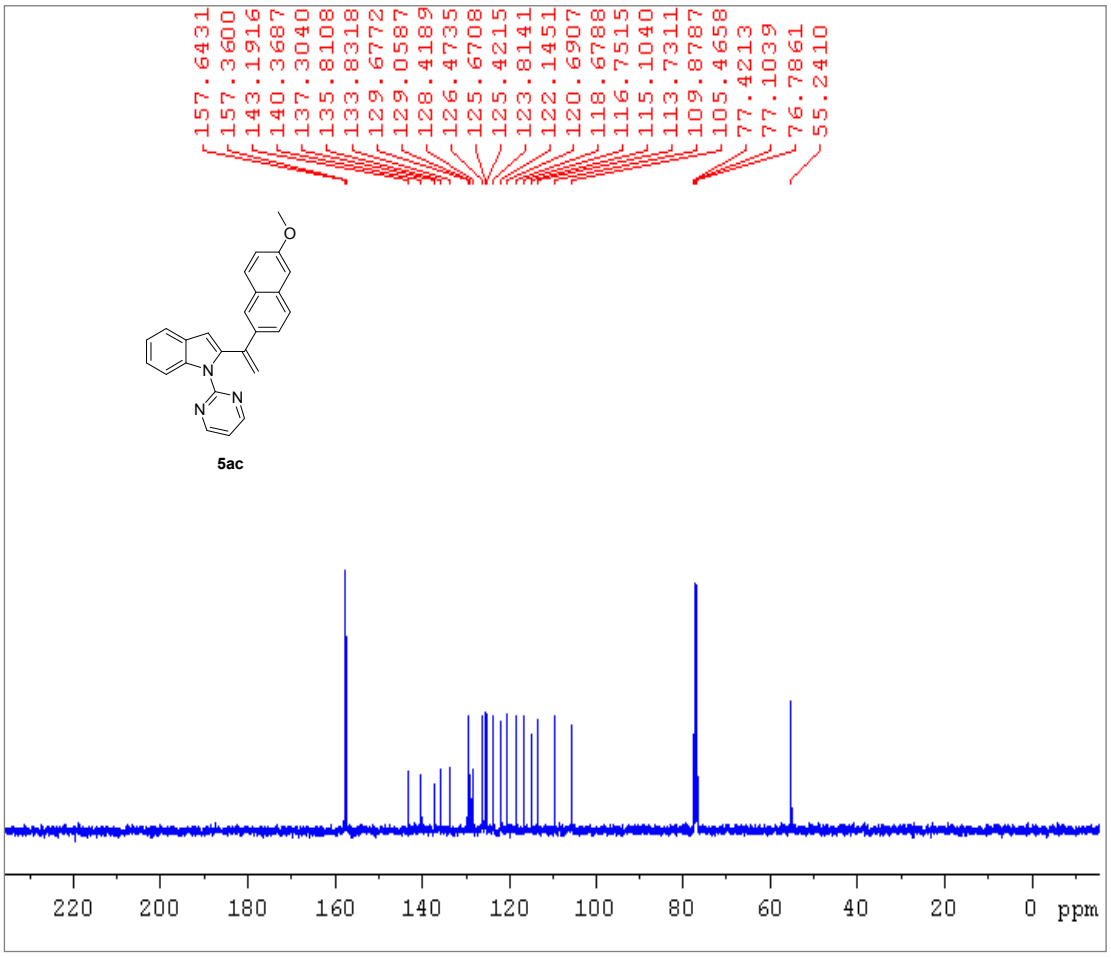
7.5350
7.5283
7.5113
7.4784
7.4570
7.3777
7.3598
7.3402
7.3264
7.3078
7.2844
7.0643
7.0586
7.0418
7.0363
7.0226
6.9738
6.7409
6.7289
6.7170
5.7574
5.7203
3.8935
O
N
N
5ac
11
10
9
3
7
6
5
4
3
2
1
0
ppm
1.96
1.00
1.05
3.07
1.06
1.04
1.16
1.06
0.99
0.97
1.04
2.03
3.04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157.3600
143.1916
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137.3040
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129.0587
128.4189
126.4735
125.6708
125.4215
123.8141
122.1451
120.6907
118.6788
116.7515
115.1040
113.7311
109.8787
105.4658
77.4213
77.1039
76.7861
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O
N
N
5ac
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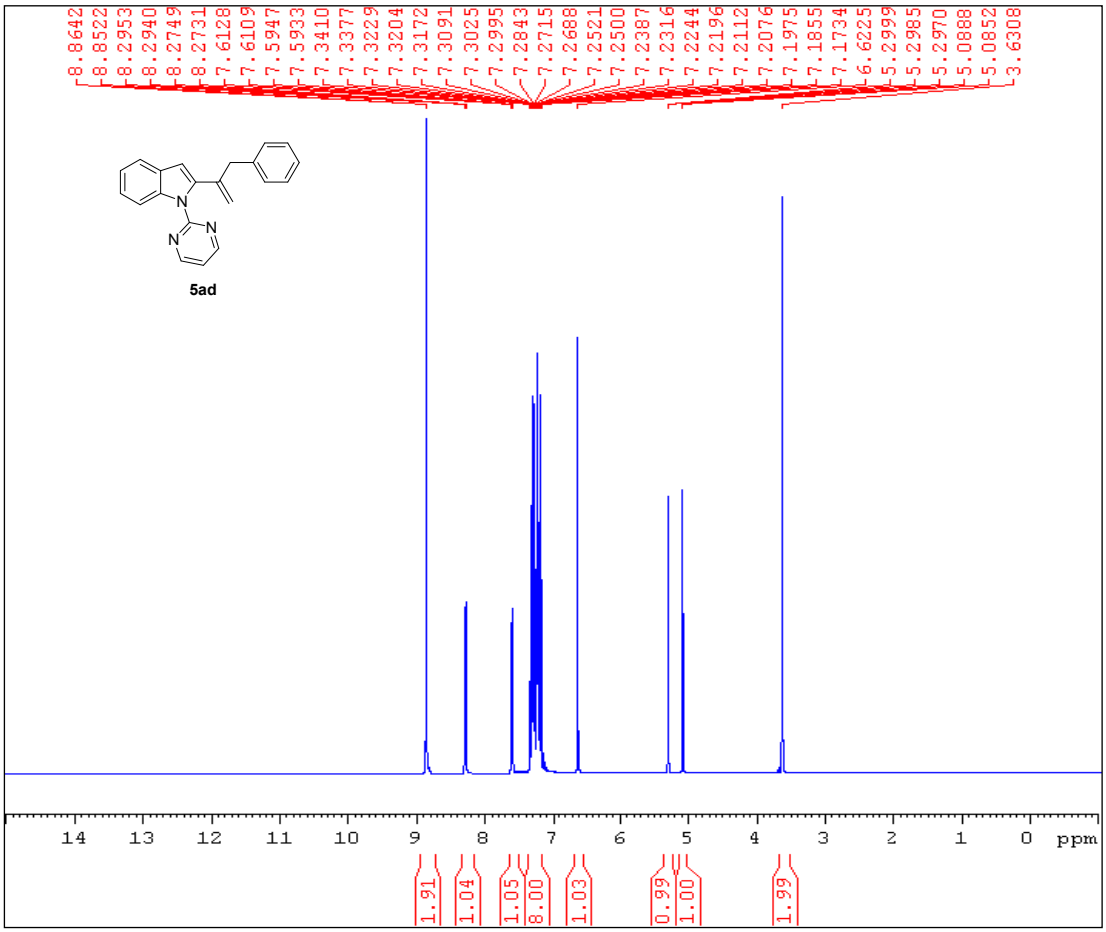
200
180
160
140
120
100
80
60
40
20
0
ppm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8.2940
8.2749
8.2731
7.6128
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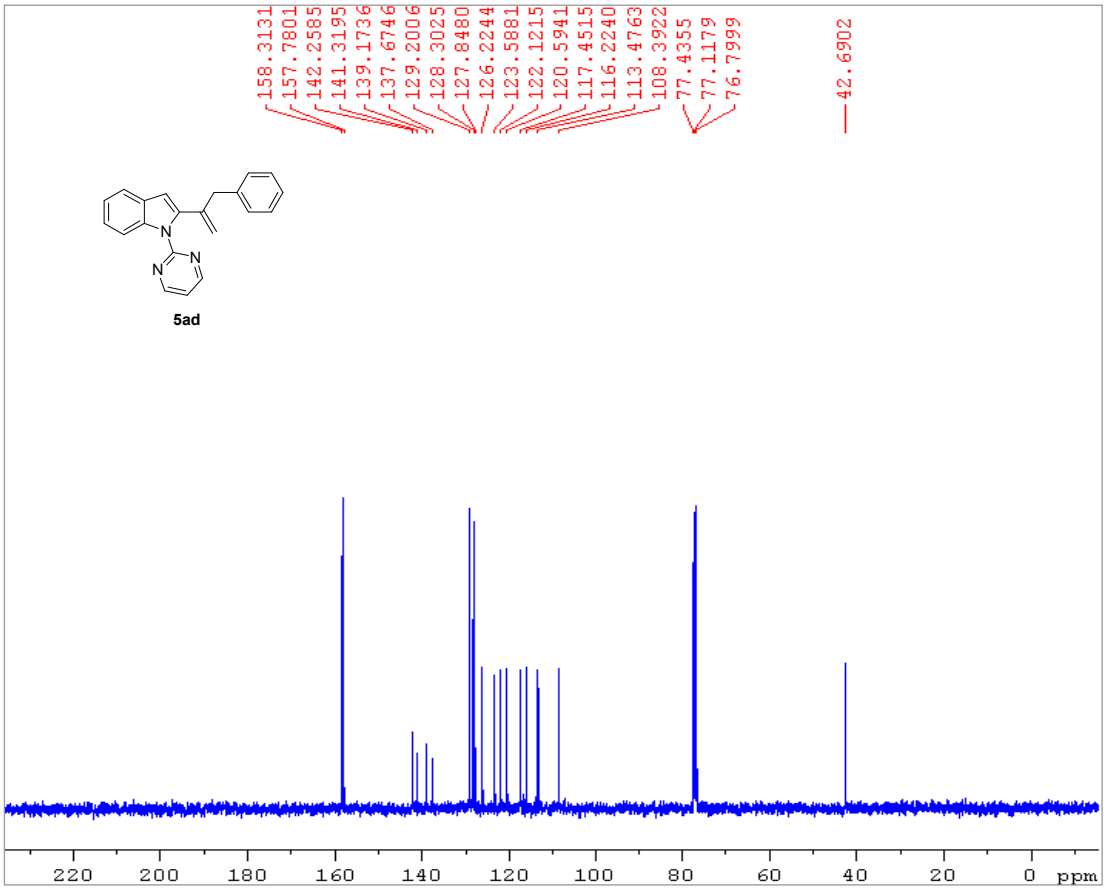
7.5947
7.5933
7.3410
7.3377
7.3229
7.3204
7.3172
7.3091
7.3025
7.2995
7.2843
7.2715
7.2688
7.2521
7.2500
7.2387
7.2316
7.2244
7.2196
7.2112
7.2076
7.1975
7.1855
7.1734
6.6225
5.2999
5.2985
5.2970
5.0888
5.0852
3.6308
5ad
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.91
1.04
1.05
8.00
1.03
0.99
1.00
1.99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157.7801
142.2585
141.3195
139.1736
137.6746
129.2006
128.3025
127.8480
126.2244
123.5881
122.1215
120.5941
117.4515
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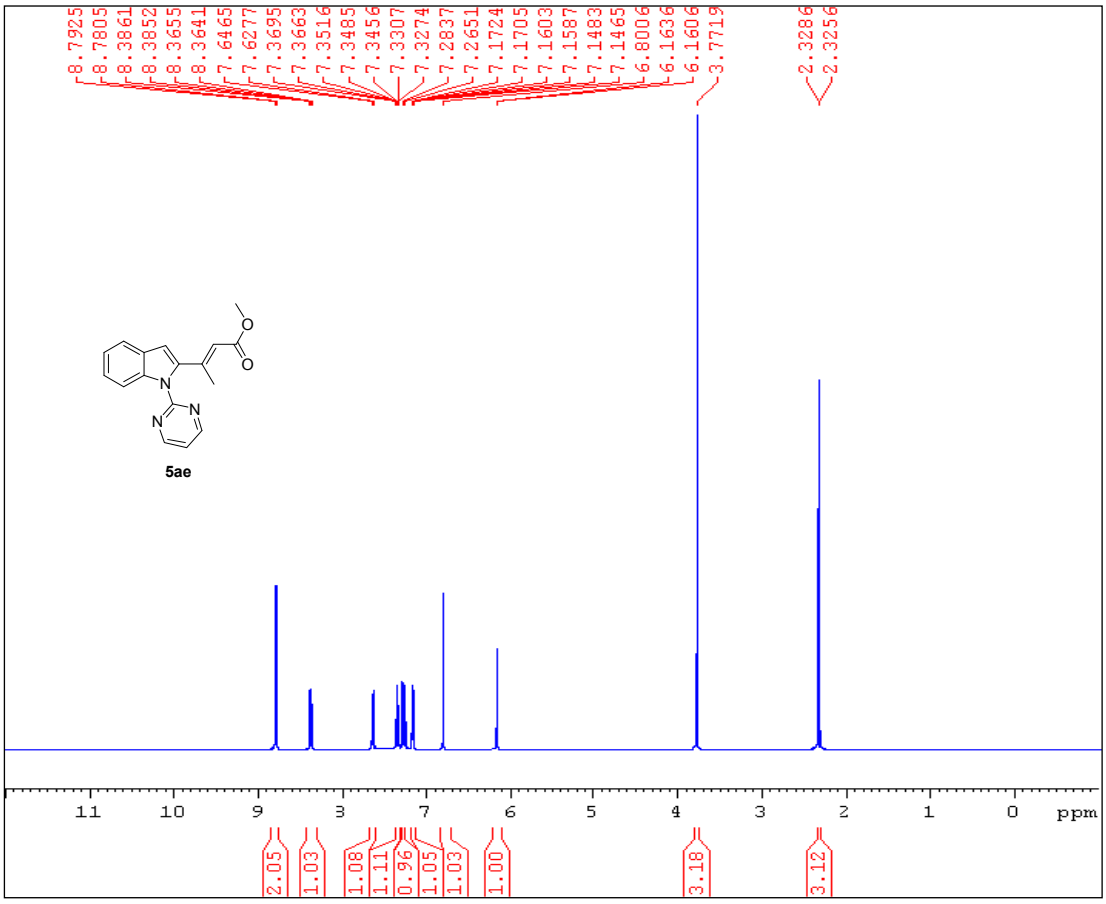
108.3922
77.4355
77.1179
76.7999
42.6902
5ad
220 200 180 160 140 120 100 80 60 40 20 0 ppm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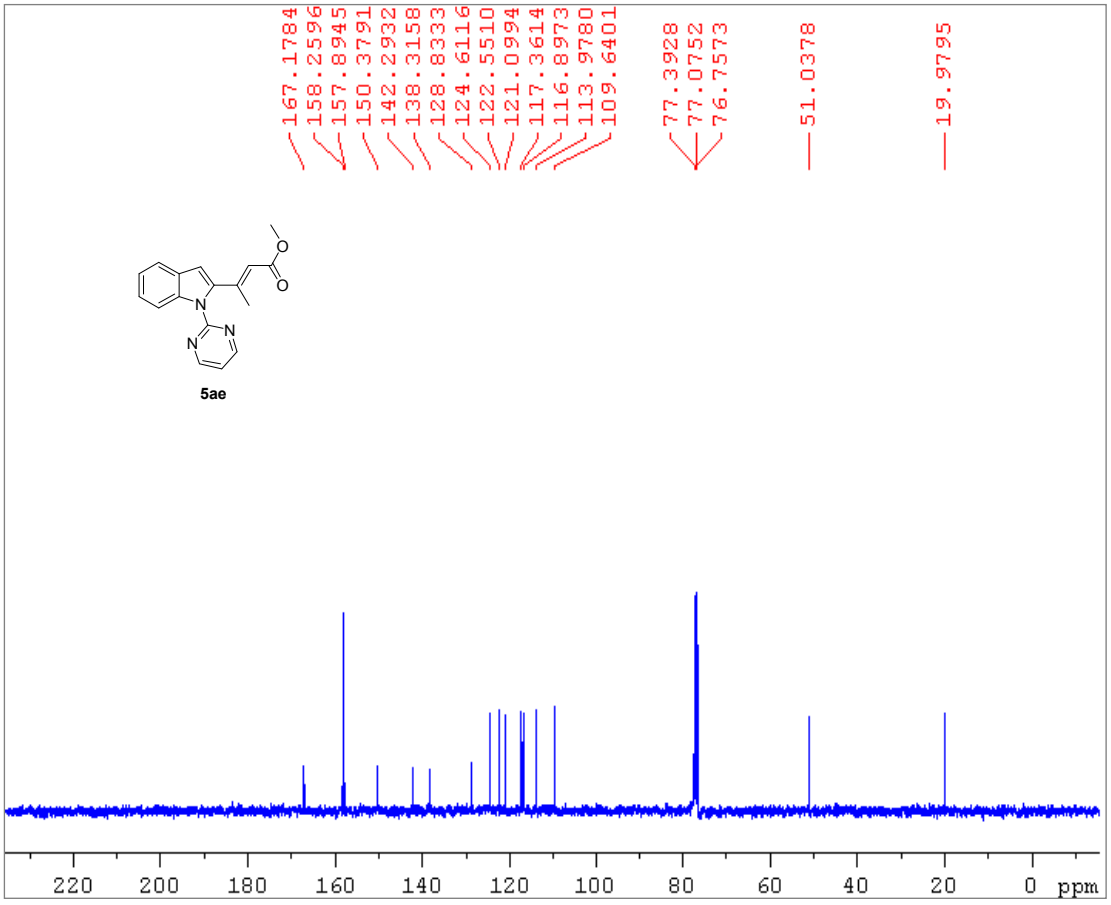
8.3861
8.3852
8.3655
8.3641
7.6465
7.6277
7.3695
7.3663
7.3516
7.3485
7.3456
7.3307
7.3274
7.2837
7.2651
7.1724
7.1705
7.1603
7.1587
7.1483
7.1465
6.8006
6.1636
6.1606
3.7719
2.3286
2.3256
5ae
11
10
9
3
7
6
5
4
3
2
1
0
ppm
2.05
1.03
1.08
1.11
0.96
1.05
1.03
1.00
3.18
3.12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158.2596
157.8945
150.3791
142.2932
138.3158
128.8333
124.6116
122.5510
121.0994
117.3614
116.8973
113.9780
109.6401
77.3928
77.0752
76.7573
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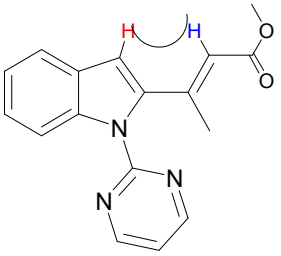
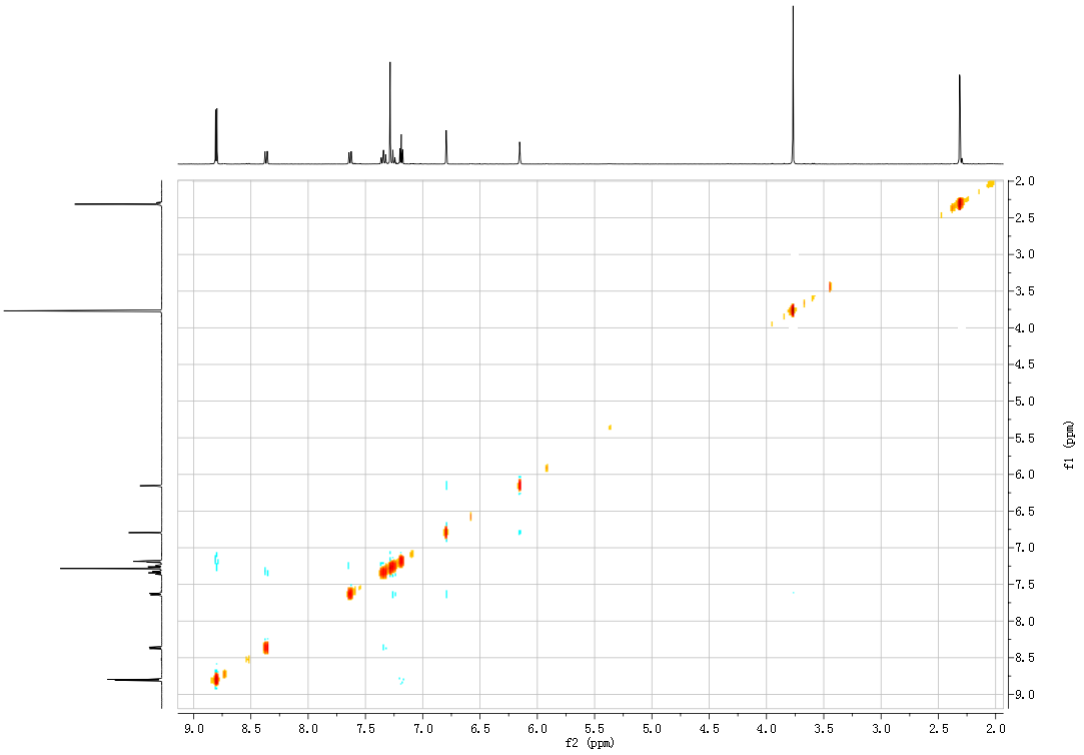
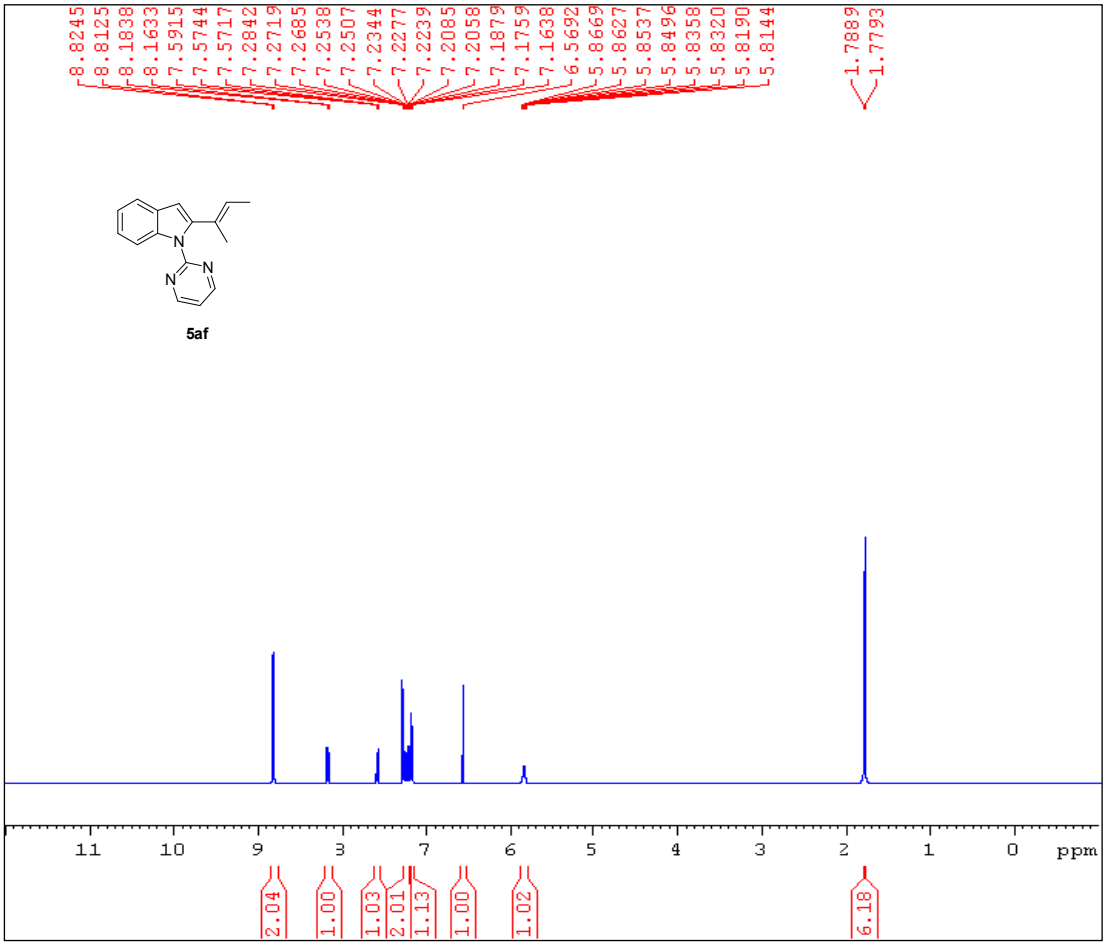
19.9795
5ae
220
200
180
160
140
120
100
80
60
40
20
0
ppm

NOE



5ae

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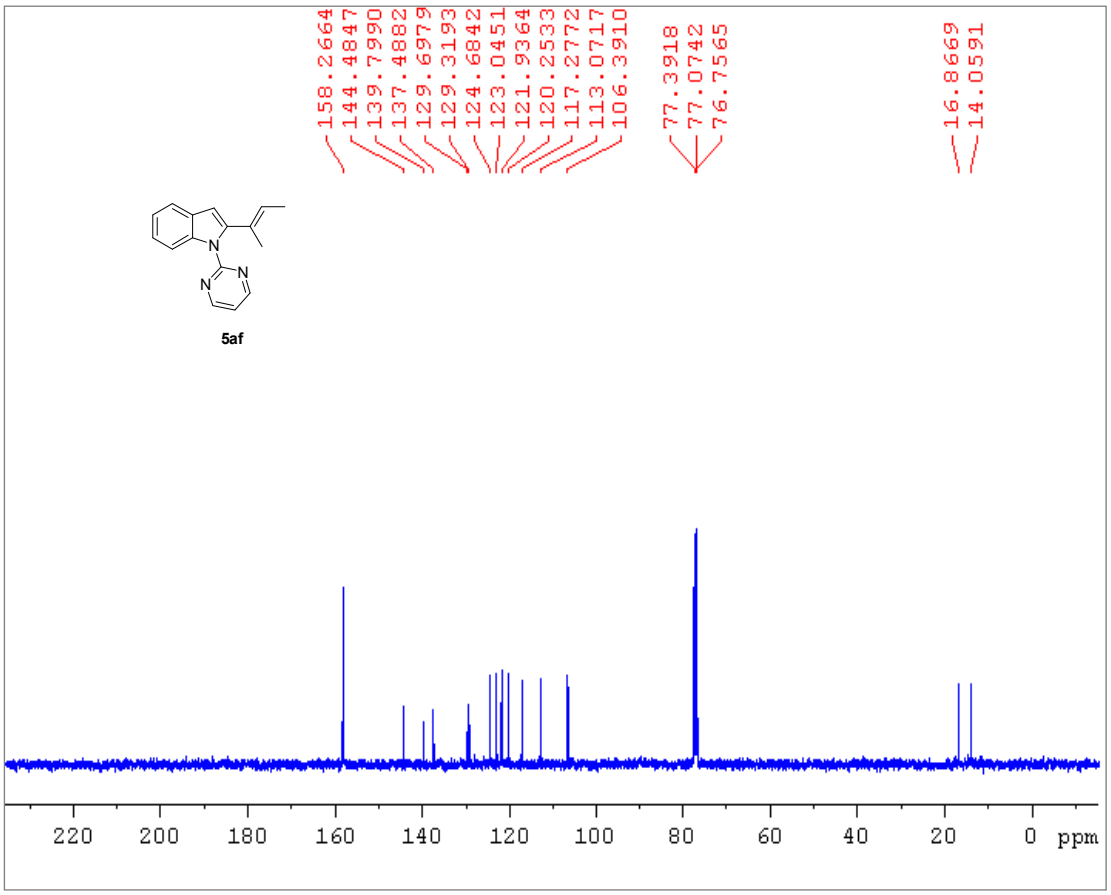
8.1838
8.1633
7.5915
7.5744
7.5717
7.2842
7.2719
7.2685
7.2538
7.2507
7.2344
7.2277
7.2239
7.2085
7.2058
7.1879
7.1759
7.1638
6.5692
5.8669
5.8627
5.8537
5.8496
5.8358
5.8320
5.8190
5.8144
1.7889
1.7793
5af
11
10
9
3
7
6
5
4
3
2
1
0
ppm
2.04
1.00
1.03
2.01
1.13
1.00
1.02
6.18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139.7990
137.4882
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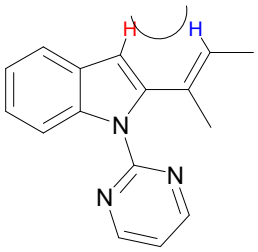
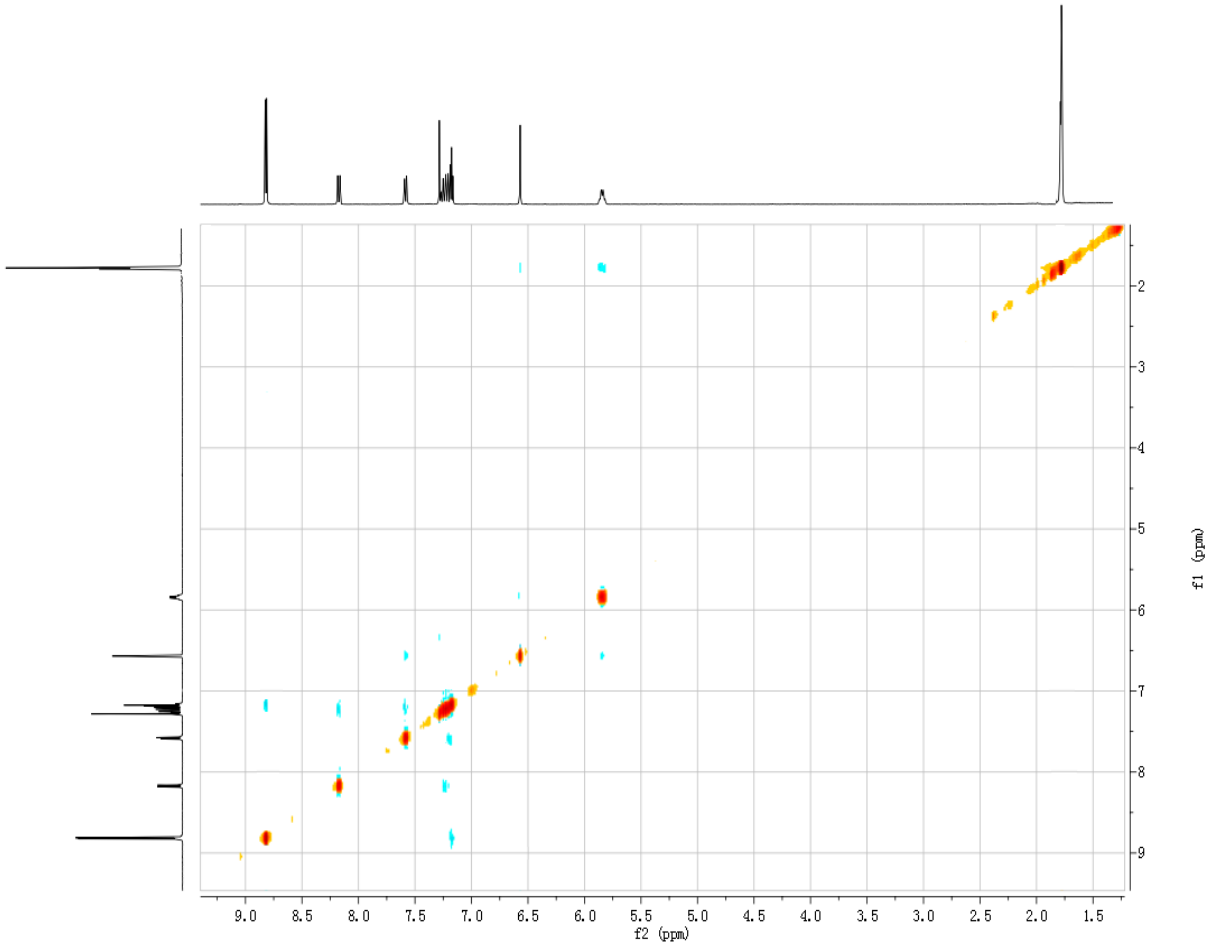
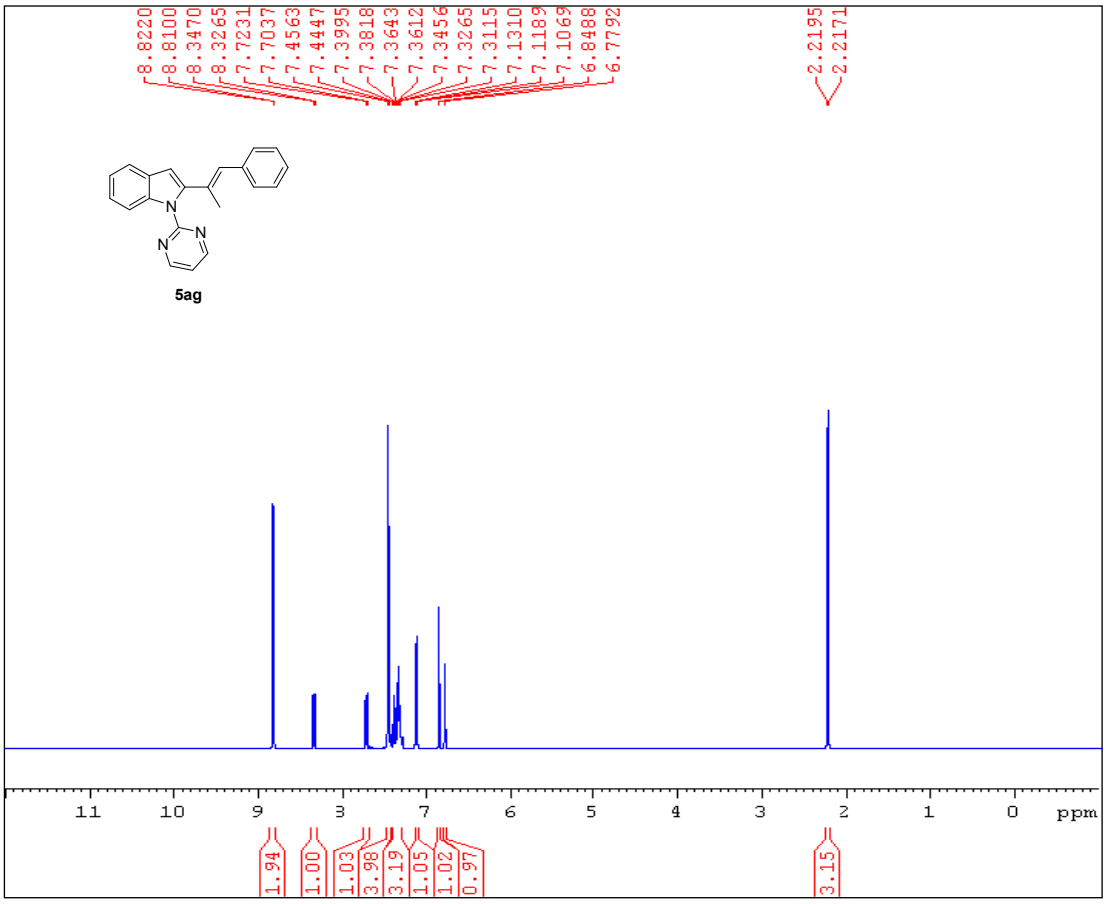
129.3193
124.6842
123.0451
121.9364
120.2533
117.2772
113.0717
106.3910
77.3918
77.0742
76.7565
16.8669
14.0591
5af
220
200
180
160
140
120
100
80
60
40
20
0
ppm

NOE



5af

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8.8100
8.3470
8.3265
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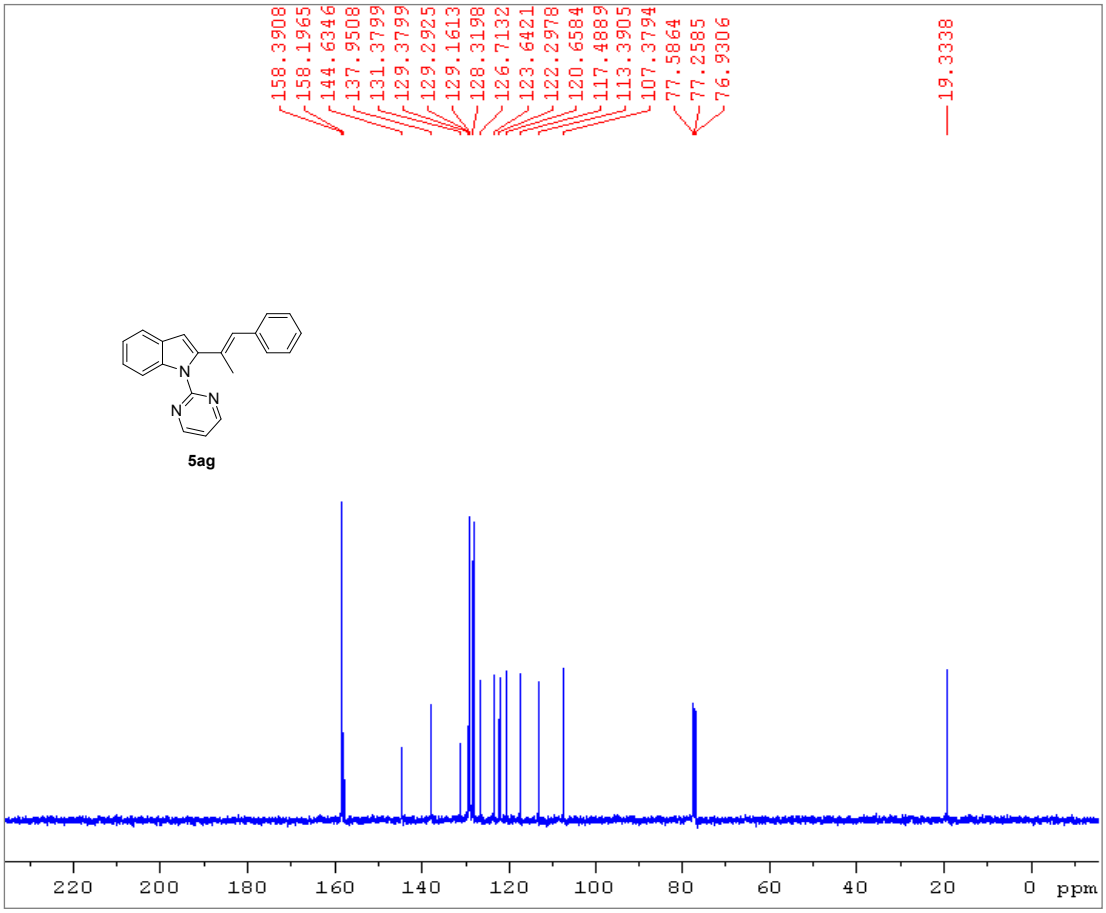
7.7037
7.4563
7.4447
7.3995
7.3818
7.3643
7.3612
7.3456
7.3265
7.3115
7.1310
7.1189
7.1069
6.8488
6.7792
2.2195
2.2171
5ag
11
10
9
3
7
6
5
4
3
2
1
0
ppm
1.94
1.00
1.03
3.98
3.19
1.05
1.02
0.97
3.15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144.6346
137.9508
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128.3198
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123.6421
122.2978
120.6584
117.4889
113.3905
107.3794
77.5864
77.2585
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19.3338
5ag
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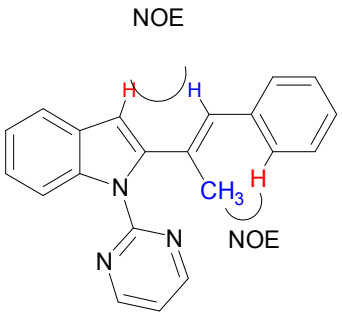
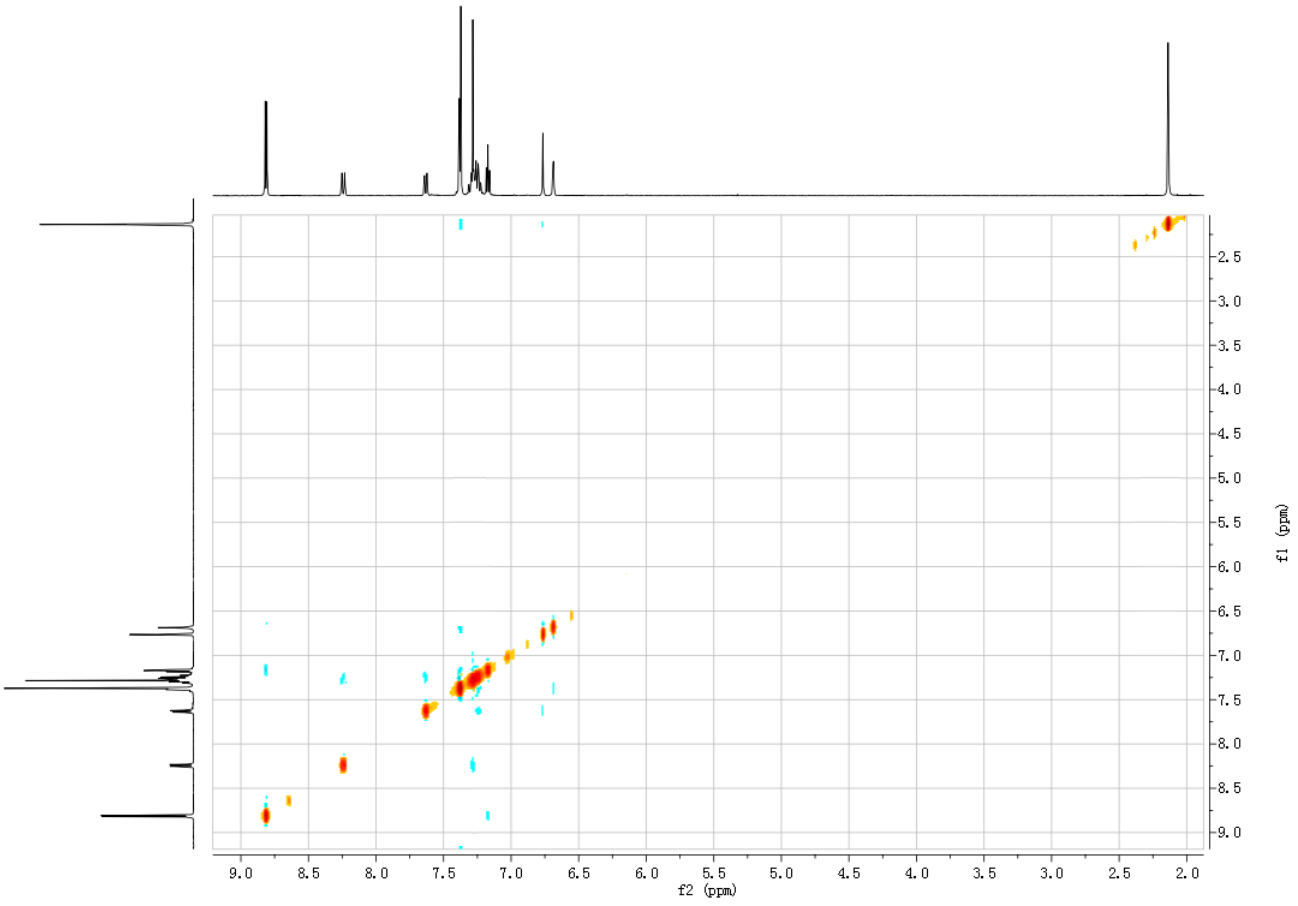
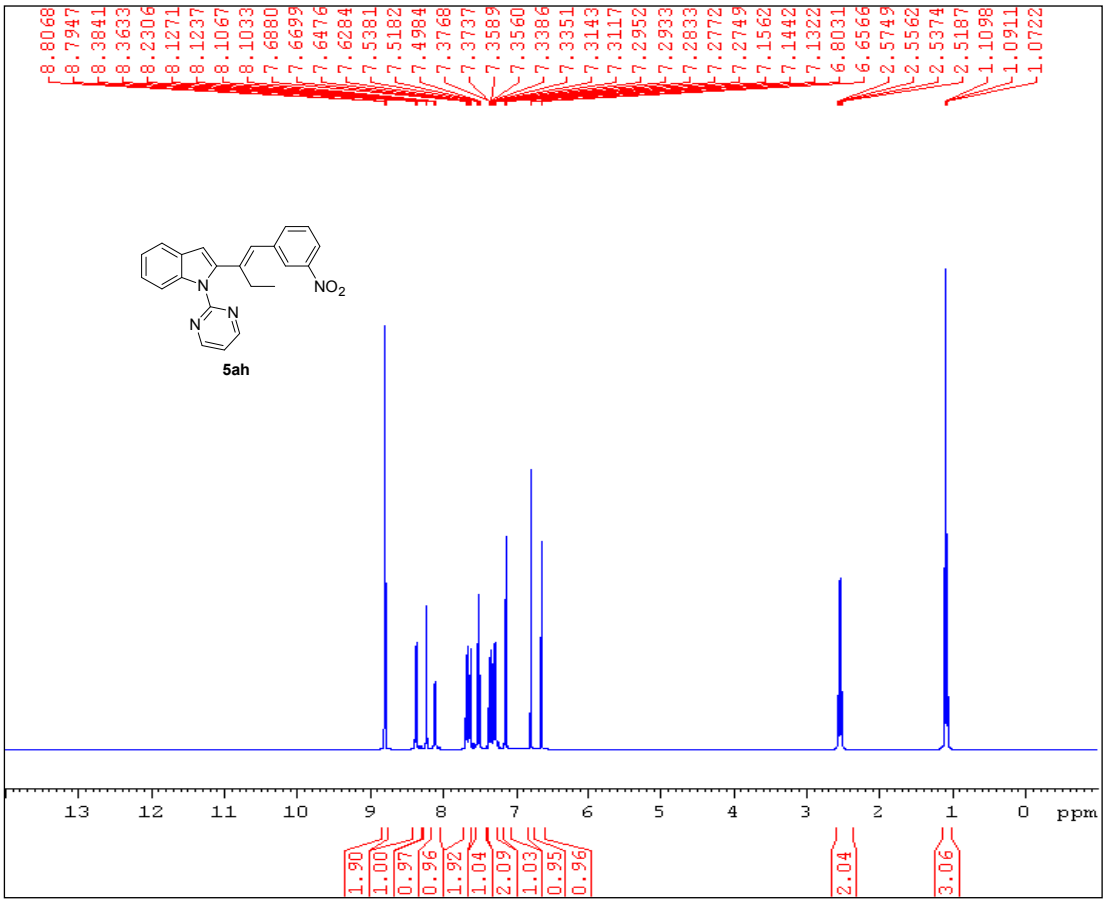
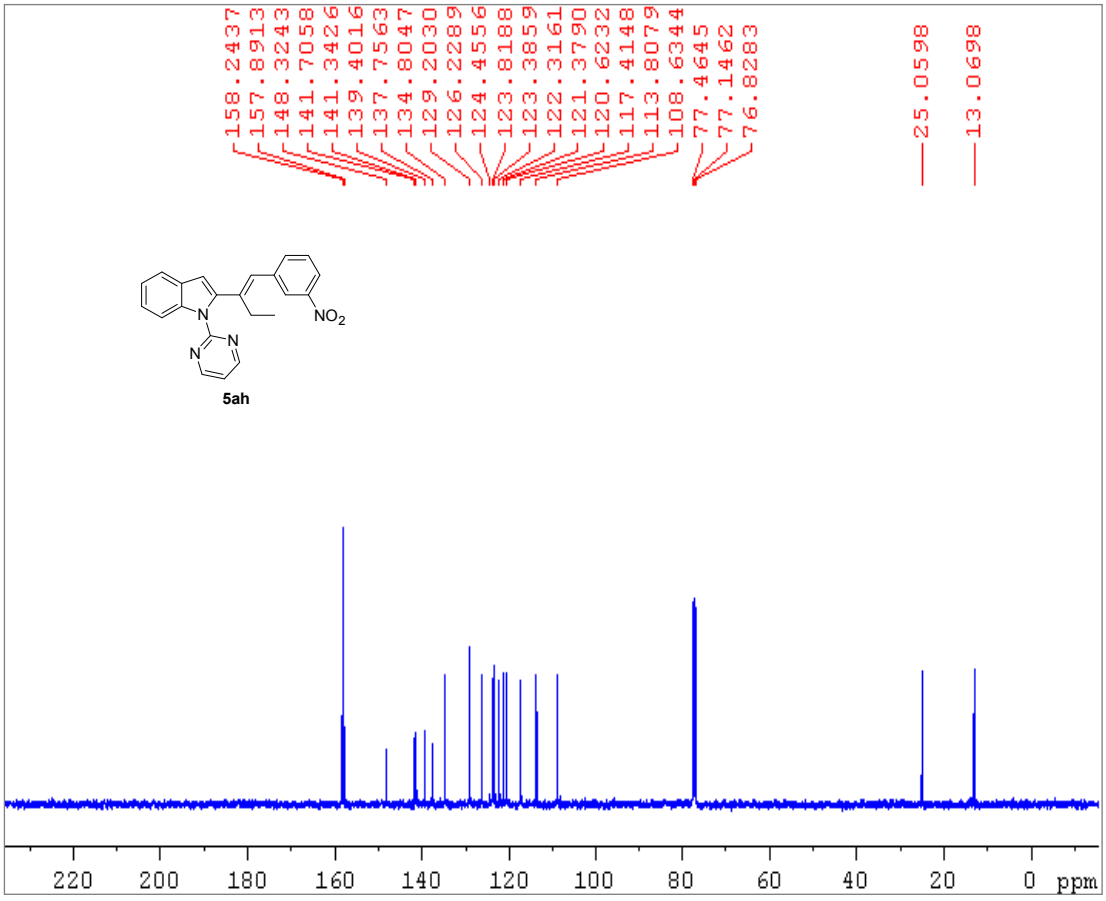
200
180
160
140
120
100
80
60
40
20
0
ppm

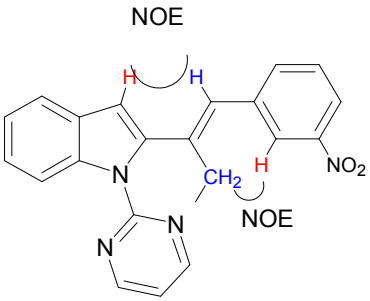

NOE
H
H
N
CH3
H
N
N
NOE

5ag

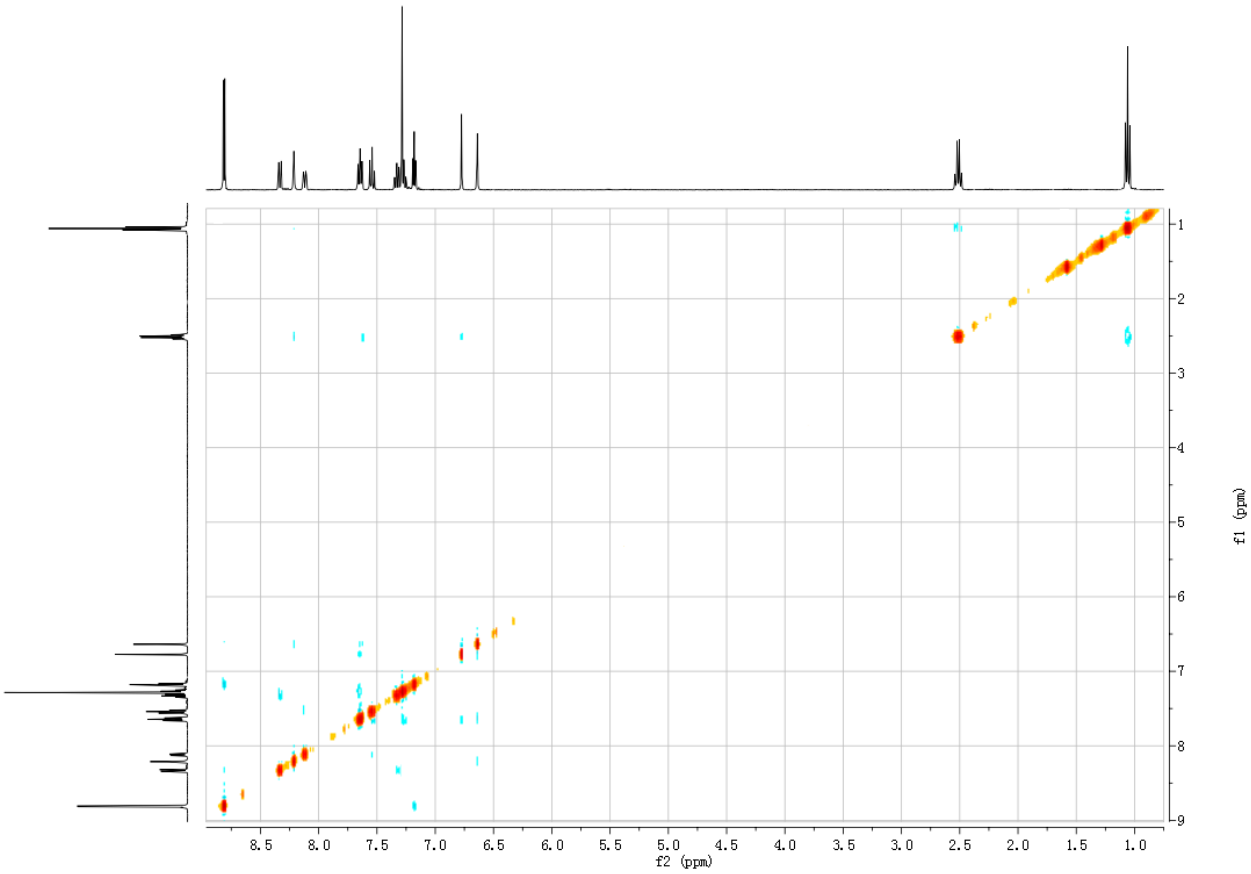

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
f2 (ppm)
f1 (ppm)

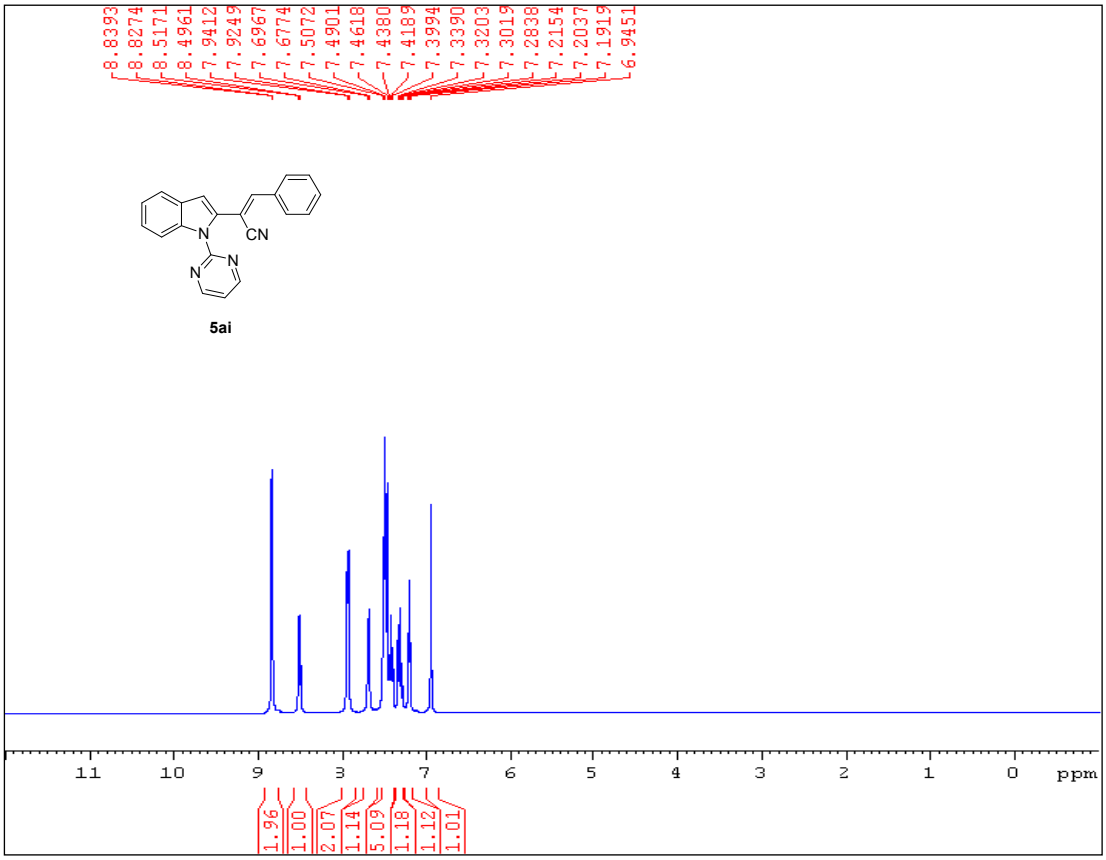

8.8068
8.7947
8.3841
8.3633
8.2306
8.1271
8.1237
8.1067
8.1033
7.6880
7.6699
7.6476
7.6284
7.5381
7.5182
7.4984
7.3768
7.3737
7.3589
7.3560
7.3386
7.3351
7.3143
7.3117
7.2952
7.2933
7.2833
7.2772
7.2749
7.1562
7.1442
7.1322
6.8031
6.6566
2.5749
2.5562
2.5374
2.5187
1.1098
1.0911
1.0722
NO2
N
N
5ah
13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.90
1.00
0.97
0.96
1.92
1.04
2.09
1.03
0.95
0.96
2.04
3.06


158.2437
157.8913
148.3243
141.7058
141.3426
139.4016
137.7563
134.8047
129.2030
126.2289
124.4556
123.8188
123.3859
122.3161
121.3790
120.6232
117.4148
113.8079
108.6344
77.4645
77.1462
76.8283
25.0598
13.0698
NO2
N
N
5ah
220 200 180 160 140 120 100 80 60 40 20 0 ppm


NOE
H
H
N
CH2
H
NO2
NOE
N
N

5ah


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
f2 (ppm)
f1 (ppm)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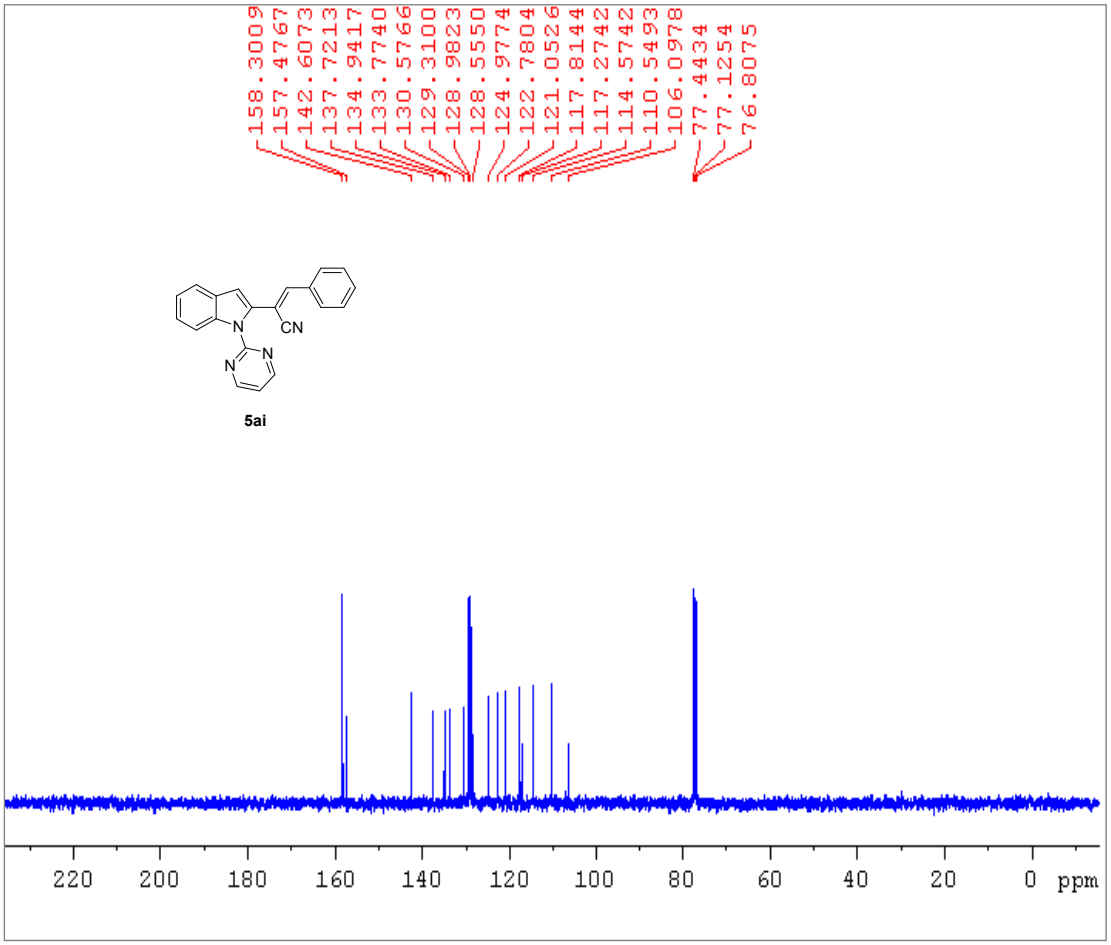
8.4961
7.9412
7.9249
7.6967
7.6774
7.5072
7.4901
7.4618
7.4380
7.4189
7.3994
7.3390
7.3203
7.3019
7.2838
7.2154
7.2037
7.1919
6.9451
CN
N
N
5ai
11
10
9
3
7
6
5
4
3
2
1
0
ppm
1.96
1.00
2.07
1.14
5.09
1.18
1.12
1.01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142.6073
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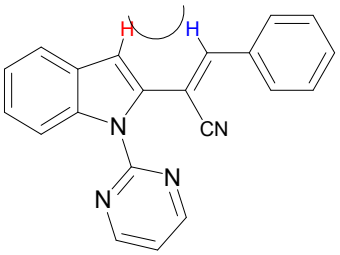
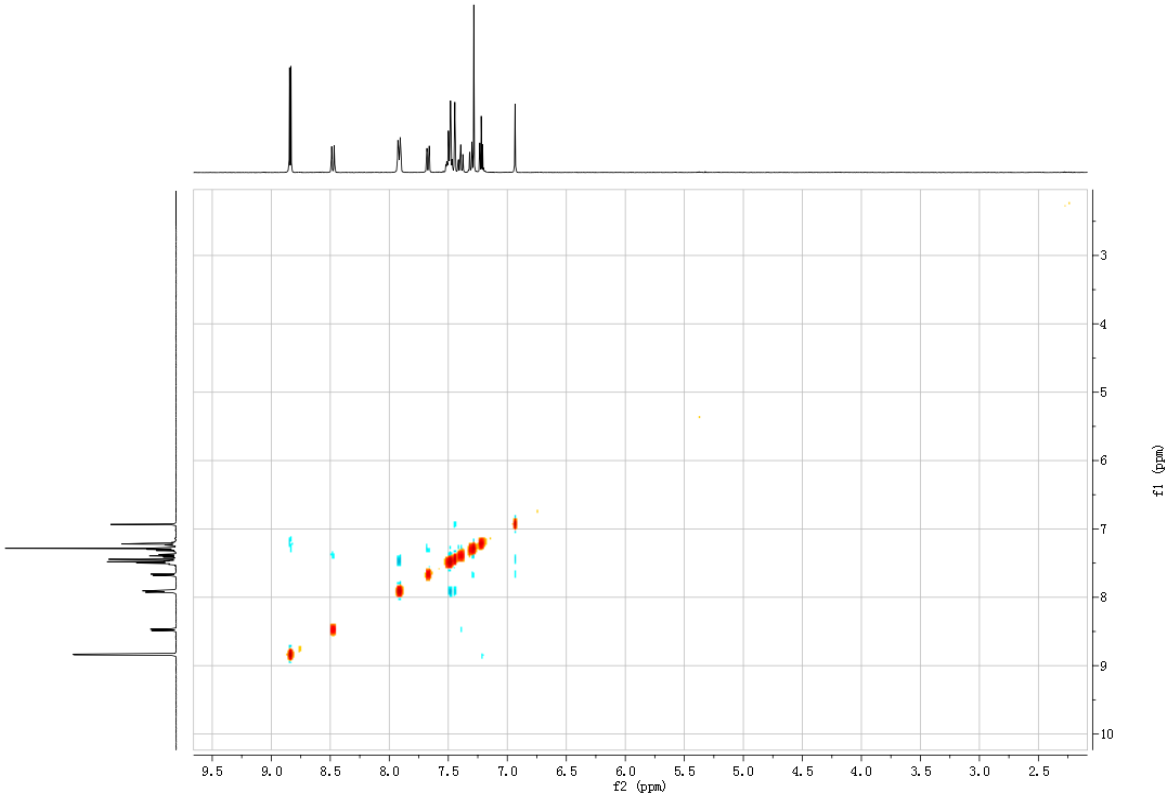
133.7740
130.5766
129.3100
128.9823
128.5550
124.9774
122.7804
121.0526
117.8144
117.2742
114.5742
110.5493
106.0978
77.4434
77.1254
76.8075
CN
N
N
5ai
220
200
180
160
140
120
100
80
60
40
20
0
ppm

NOE


H
H
N
CN
N
N

5ai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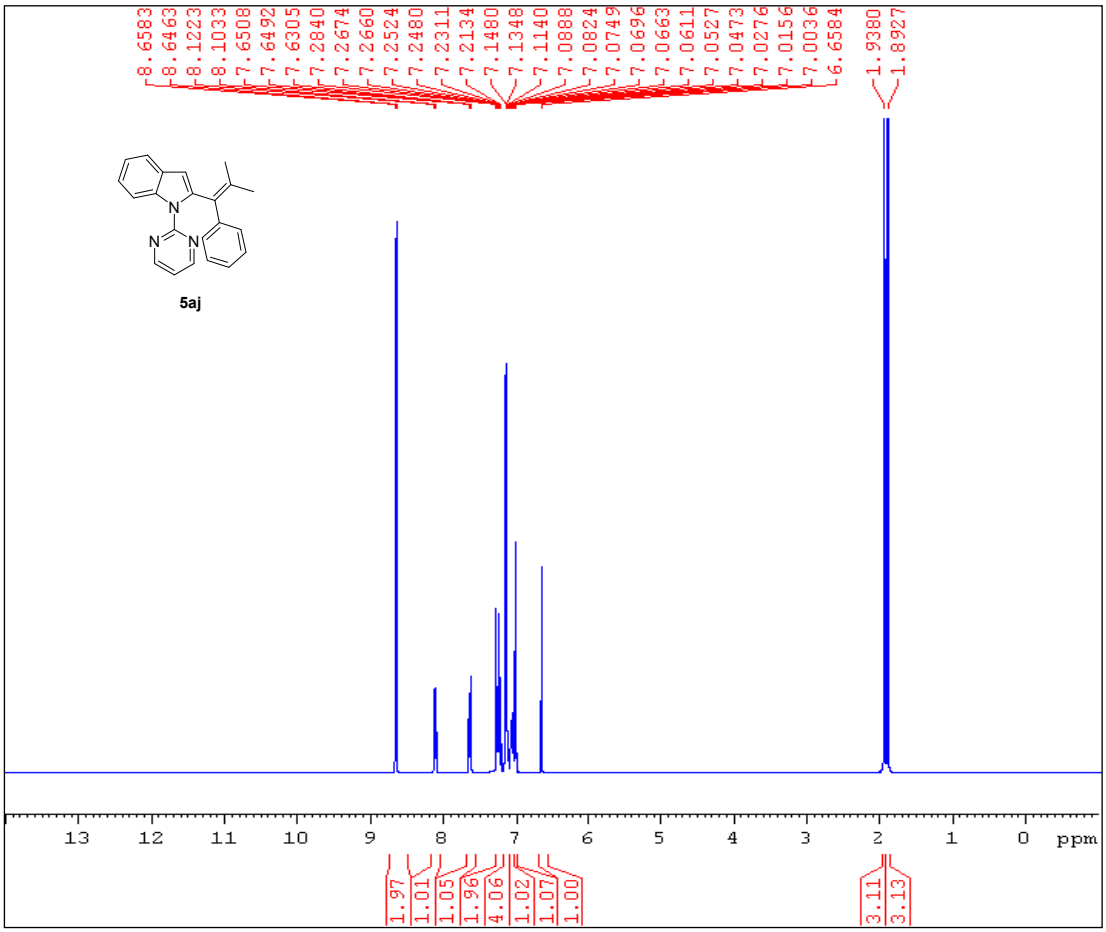
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
f2 (ppm)
3
4
5
6
7
8
9
10
f1 (ppm)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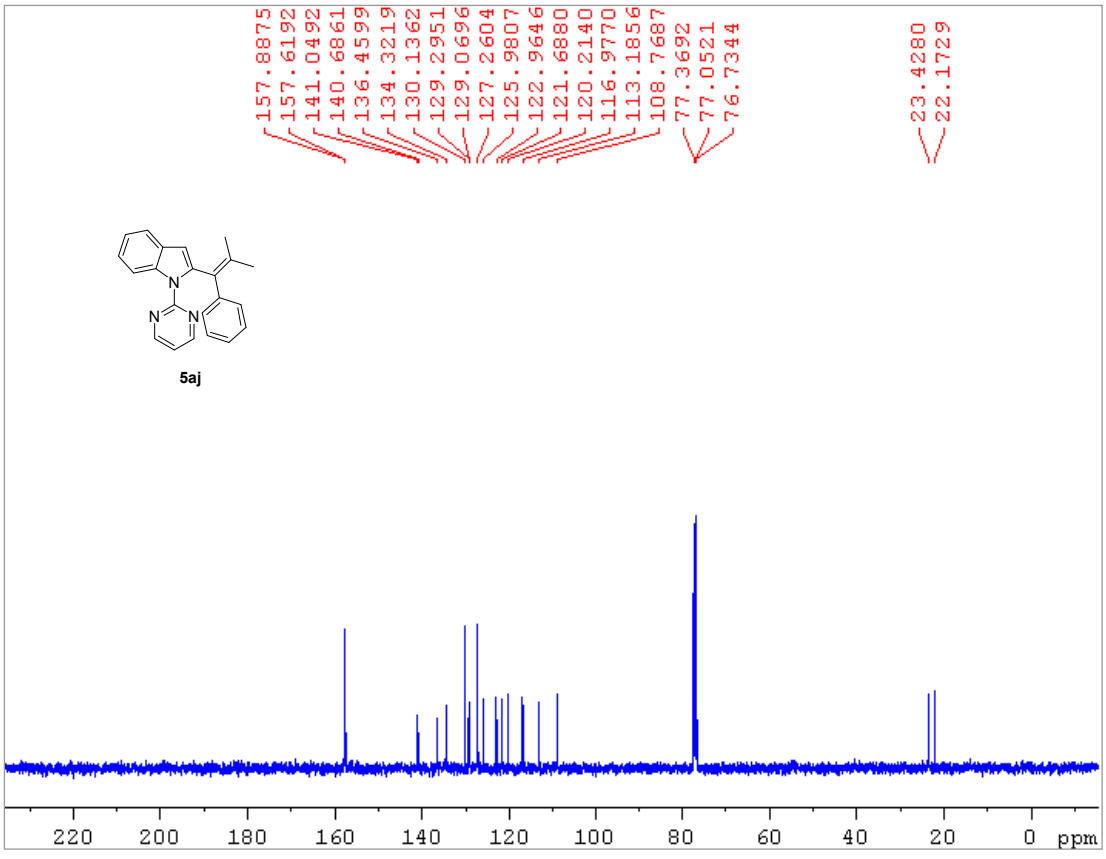
8.6463
8.1223
8.1033
7.6508
7.6492
7.6305
7.2840
7.2674
7.2660
7.2524
7.2480
7.2311
7.2134
7.1480
7.1348
7.1140
7.0888
7.0824
7.0749
7.0696
7.0663
7.0611
7.0527
7.0473
7.0276
7.0156
7.0036
6.6584
1.9380
1.8927
5aj
13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.97
1.01
1.05
1.96
4.06
1.02
1.07
1.00
3.11
3.13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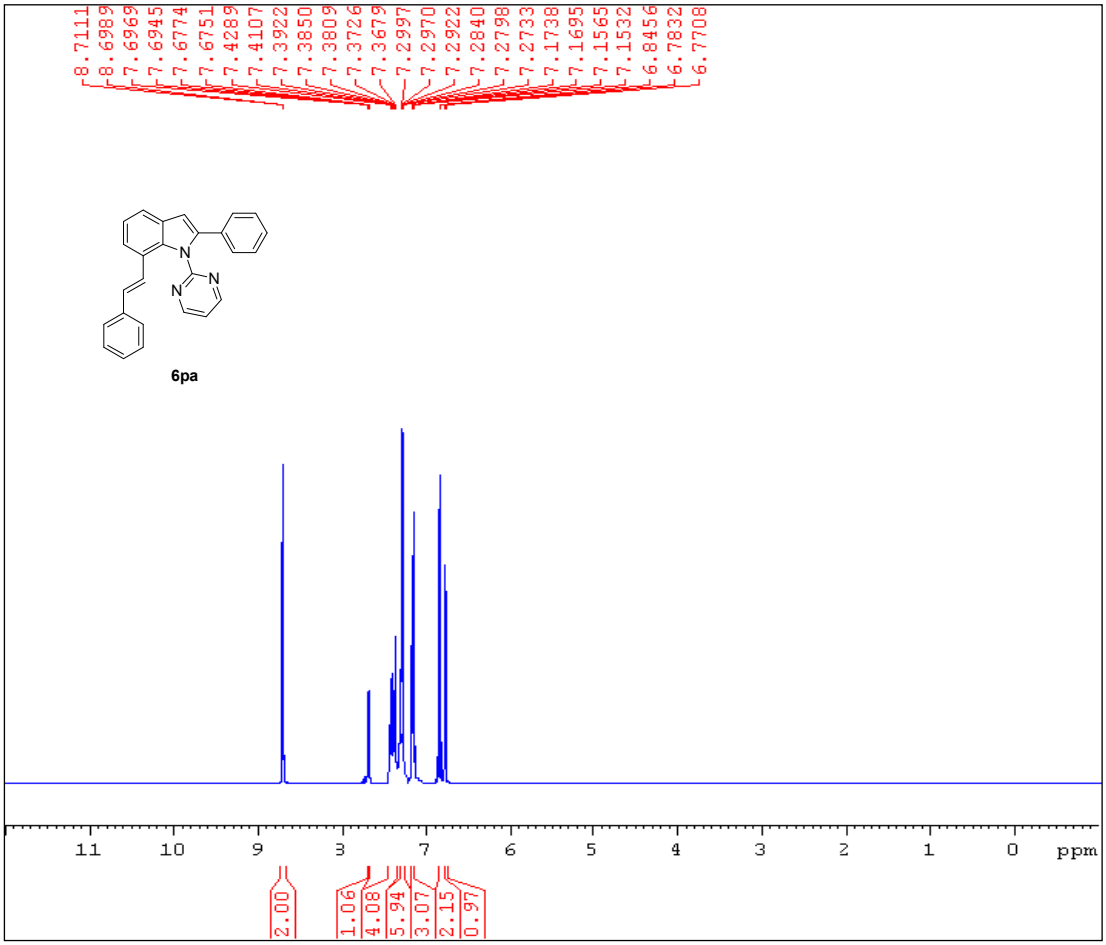
157.6192
141.0492
140.6861
136.4599
134.3219
130.1362
129.2951
129.0696
127.2604
125.9807
122.9646
121.6880
120.2140
116.9770
113.1856
108.7687
77.3692
77.0521
76.7344
23.4280
22.1729
5aj
220 200 180 160 140 120 100 80 60 40 20 0 ppm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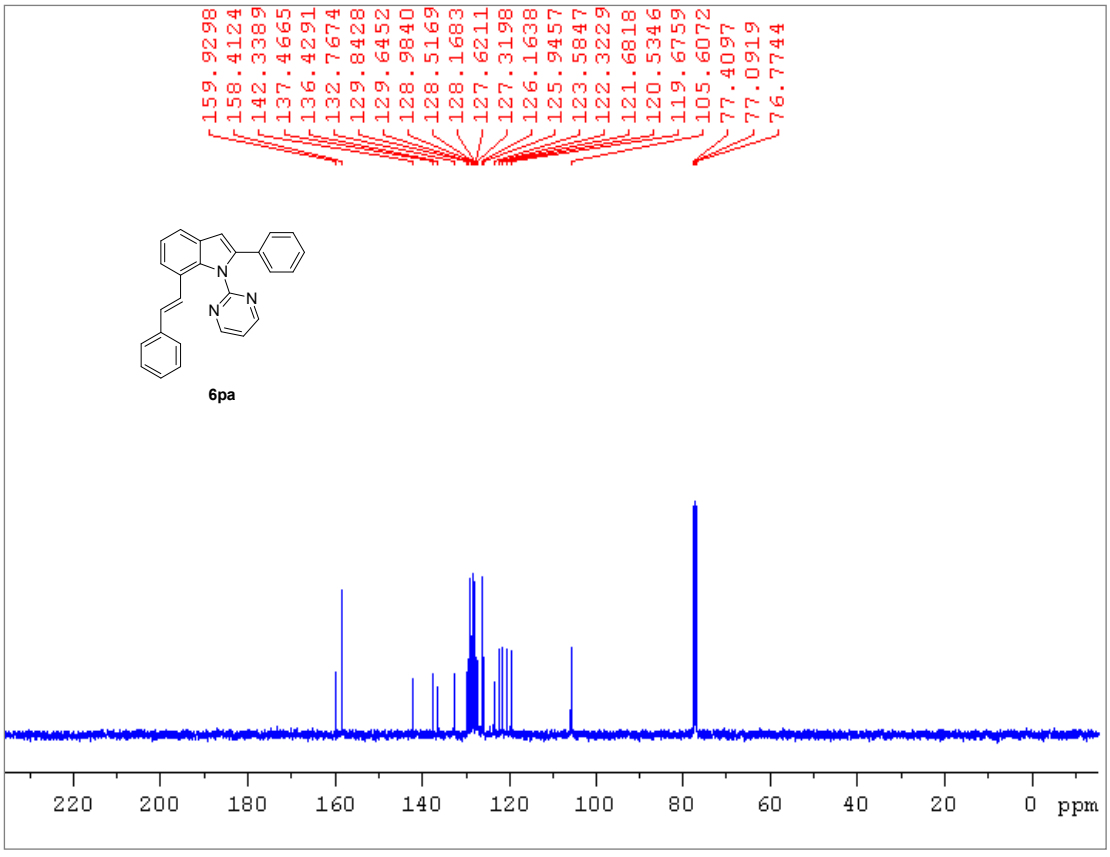
7.6969
7.6945
7.6774
7.6751
7.4289
7.4107
7.3922
7.3850
7.3809
7.3726
7.3679
7.2997
7.2970
7.2922
7.2840
7.2798
7.2733
7.1738
7.1695
7.1565
7.1532
6.8456
6.7832
6.7708
6pa
11
10
9
3
7
6
5
4
3
2
1
0
ppm
2.00
1.06
4.08
5.94
3.07
2.15
0.97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158.4124
142.3389
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136.4291
132.7674
129.8428
129.6452
128.9840
128.5169
128.1683
127.6211
127.3198
126.1638
125.9457
123.5847
122.3229
121.6818
120.5346
119.6759
105.6072
77.4097
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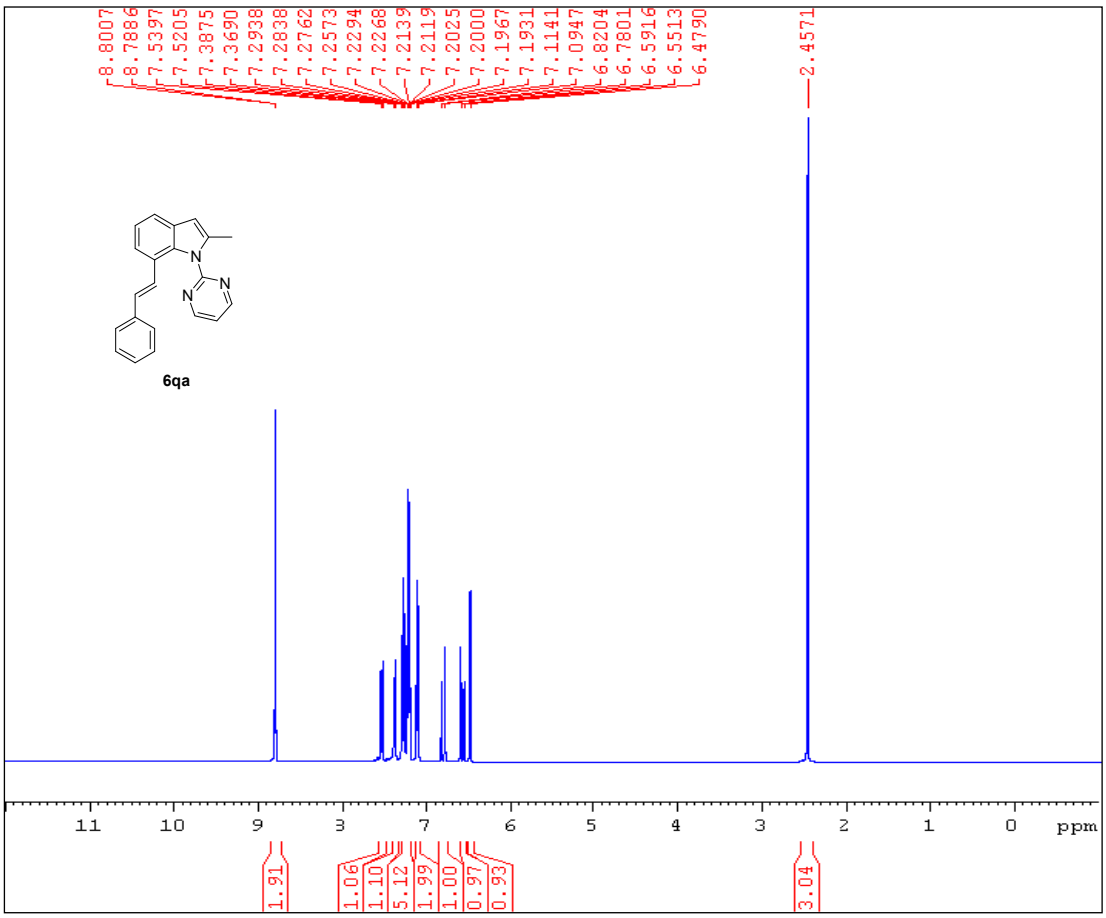
76.7744
6pa
220
200
180
160
140
120
100
80
60
40
20
0
ppm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8.7886
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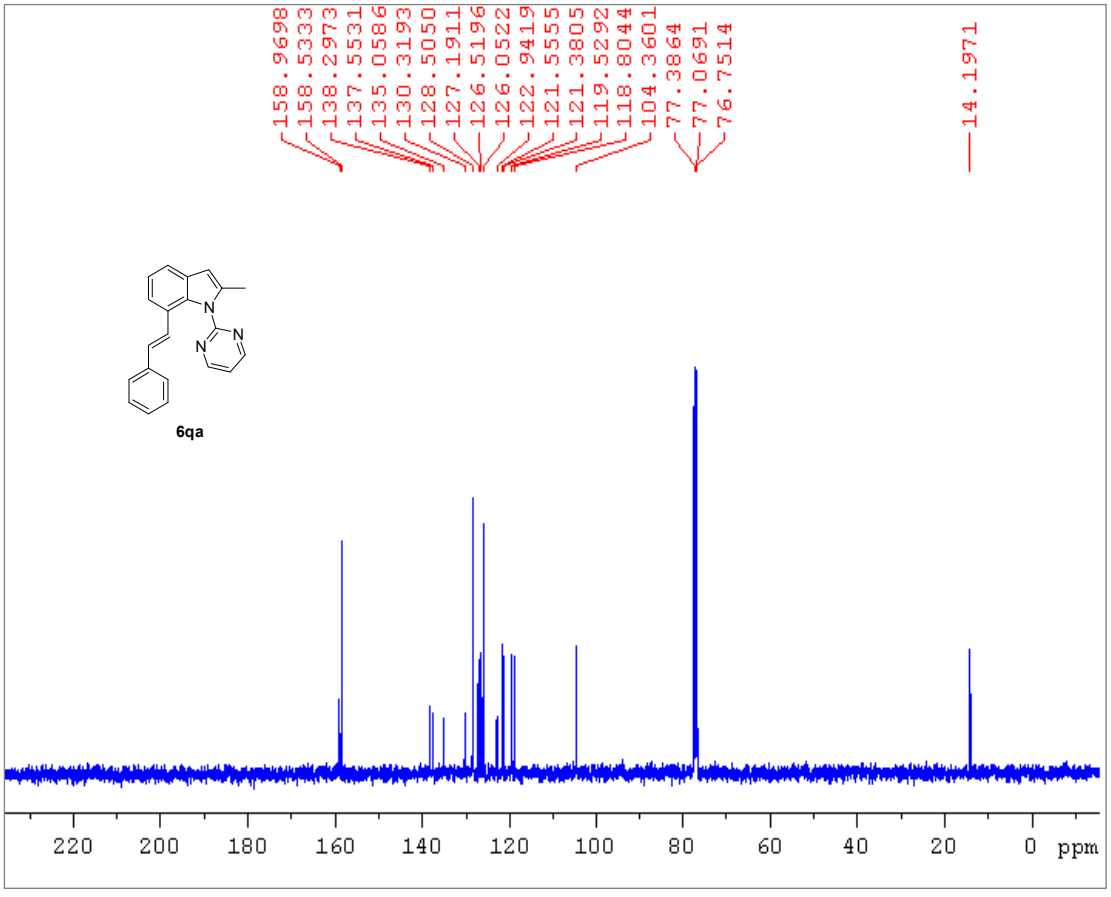
7.5205
7.3875
7.3690
7.2938
7.2838
7.2762
7.2573
7.2294
7.2268
7.2139
7.2119
7.2025
7.2000
7.1967
7.1931
7.1141
7.0947
6.8204
6.7801
6.5916
6.5513
6.4790
2.4571
6qa
11
10
9
3
7
6
5
4
3
2
1
0
ppm
1.91
1.06
1.10
5.12
1.99
1.00
0.97
0.93
3.04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130.3193
128.5050
127.1911
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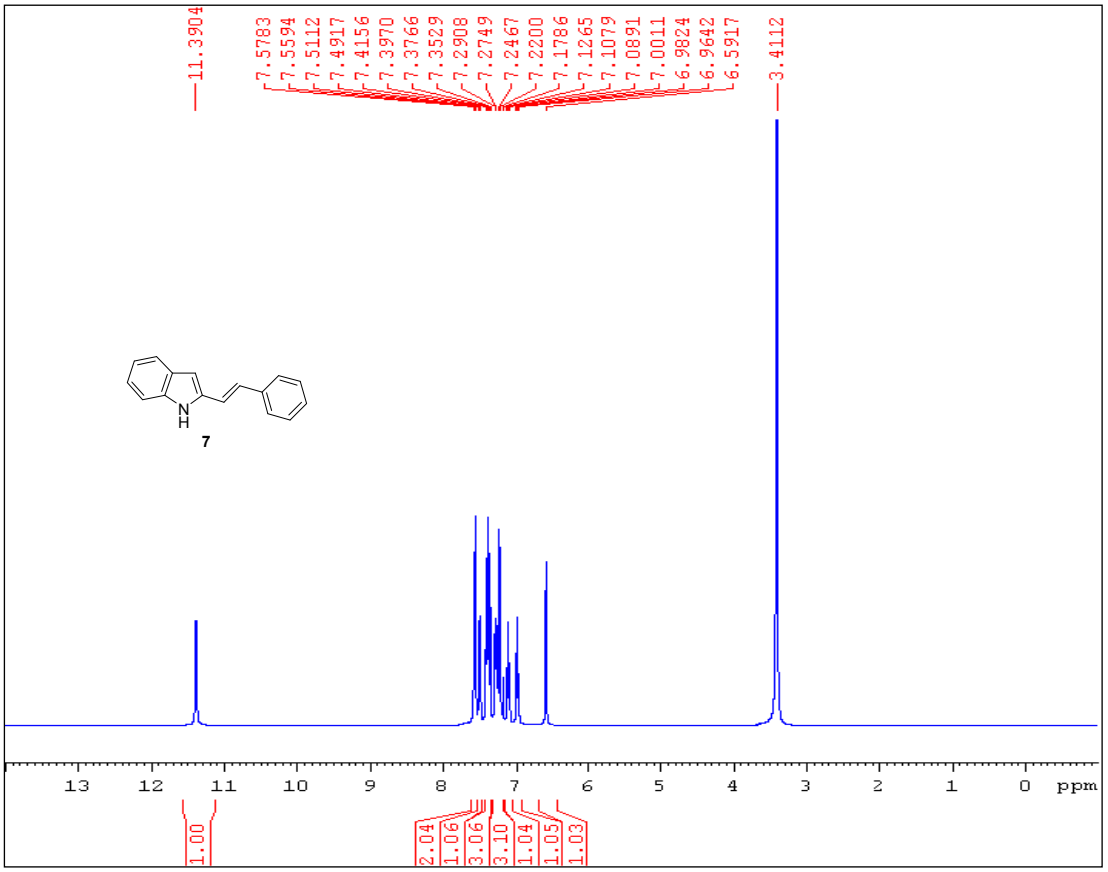
126.0522
122.9419
121.5555
121.3805
119.5292
118.8044
104.3601
77.3864
77.0691
76.7514
14.1971
6qa
220
200
180
160
140
120
100
80
60
40
20
0
ppm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7.5594
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7.4917
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7.3766
7.3529
7.2908
7.2749
7.2467
7.2200
7.1786
7.1265
7.1079
7.0891
7.0011
6.9824
6.9642
6.5917
3.4112
7
13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
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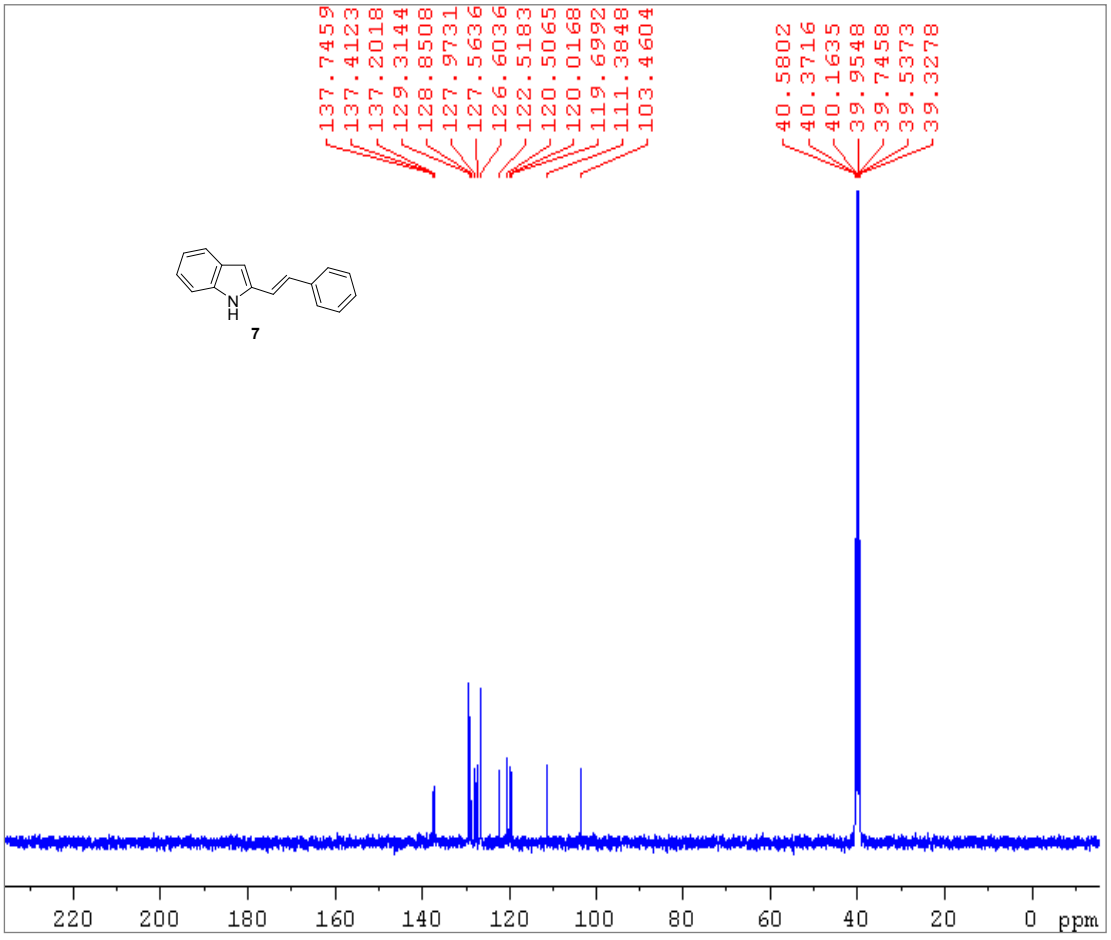
2.04
1.06
3.06
3.10
1.04
1.05
1.03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137.4123
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129.3144
128.8508
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127.5636
126.6036
122.5183
120.5065
120.0168
119.6992
111.3848
103.4604
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40.1635
39.9548
39.7458
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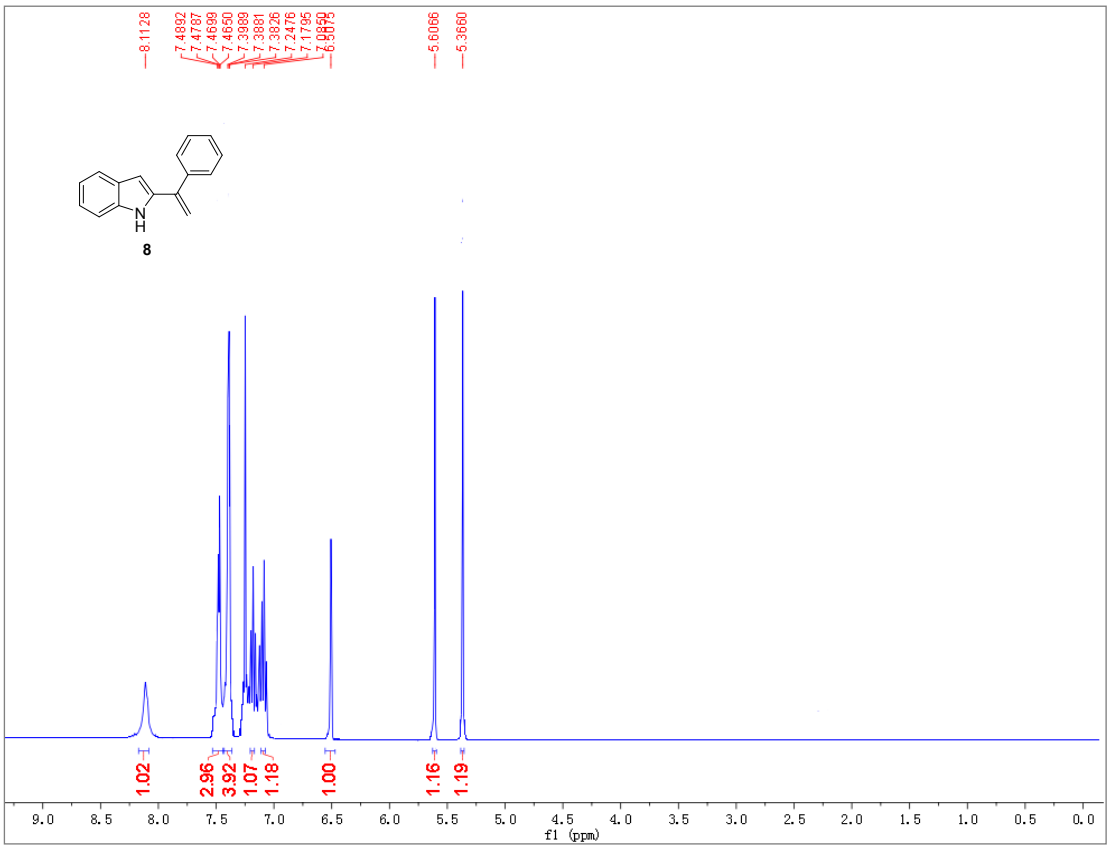
39.3278
7
220 200 180 160 140 120 100 80 60 40 20 0 ppm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7.3826
7.2476
7.1795
6.9979
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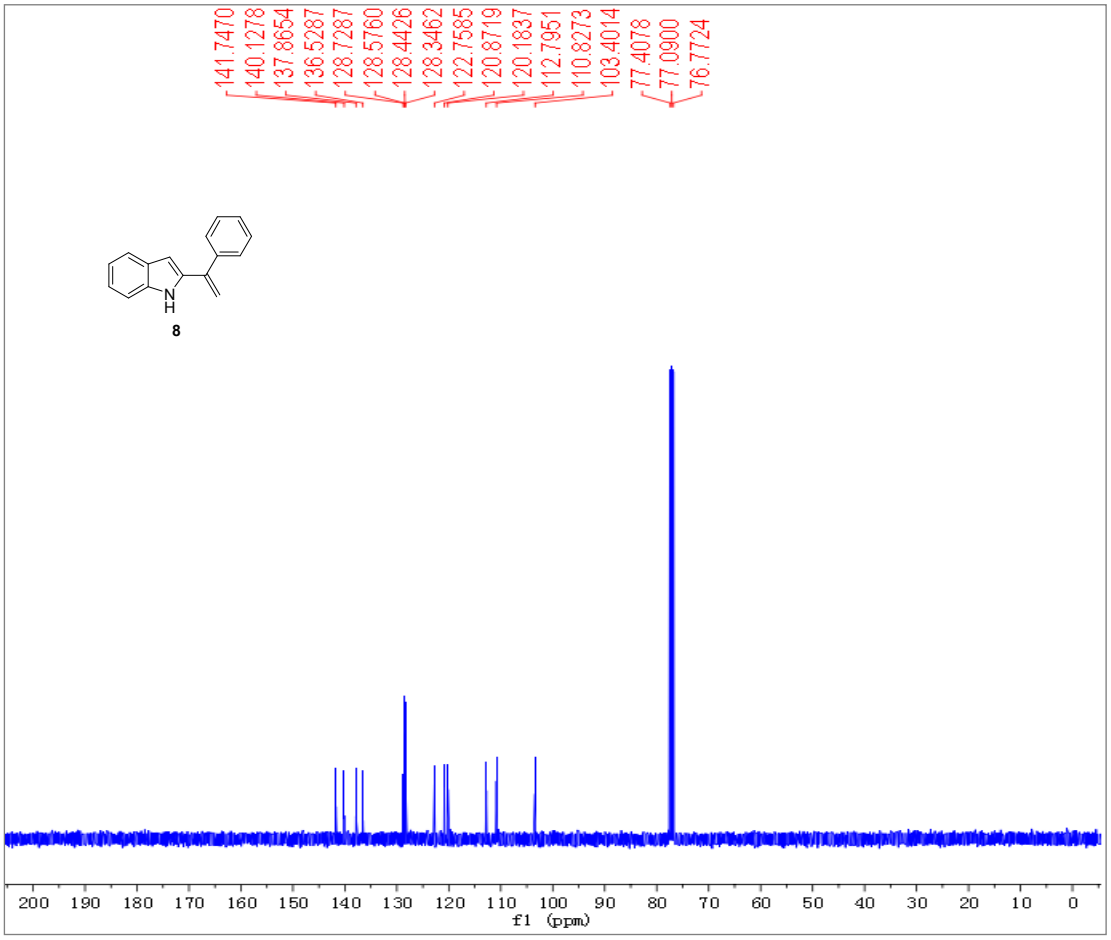
2.96
3.92
1.07
1.18
1.00
1.16
1.19
f1 (ppm)

8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112.7951
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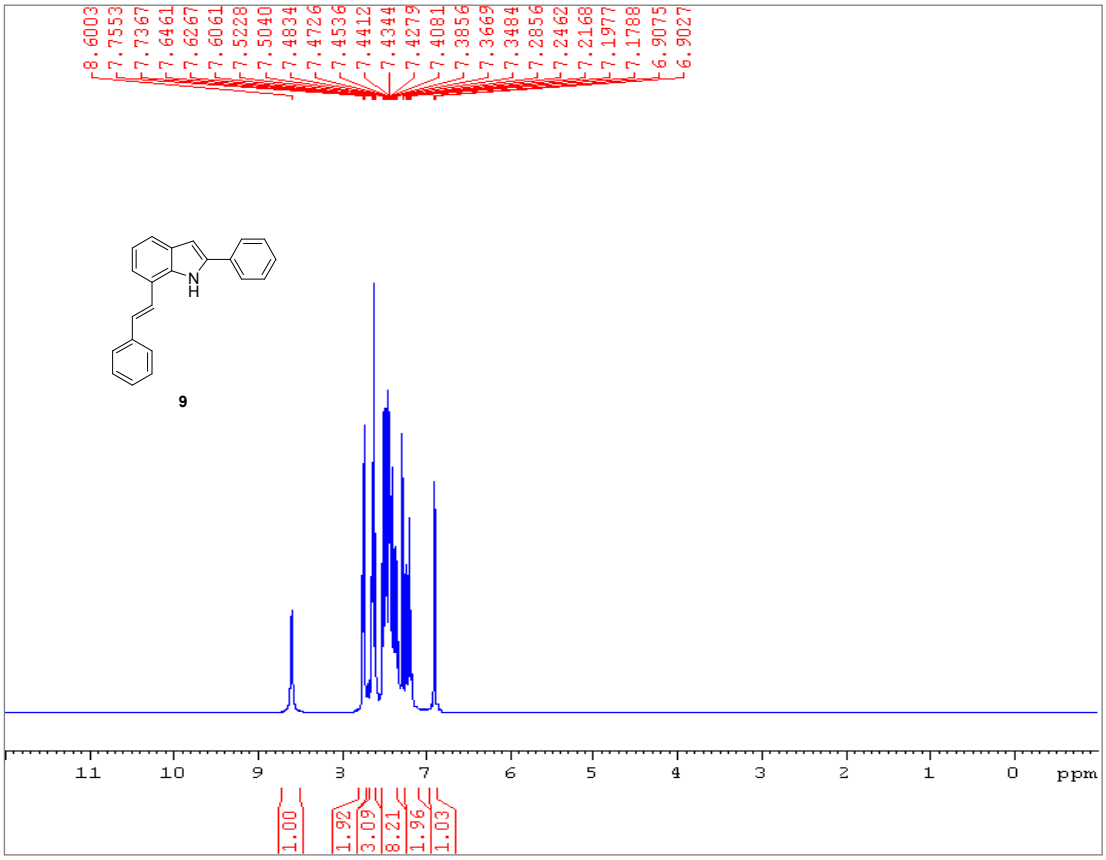
103.4014
77.4078
77.0900
76.7724
f1 (ppm)

8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7.6061
7.5228
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7.4834
7.4726
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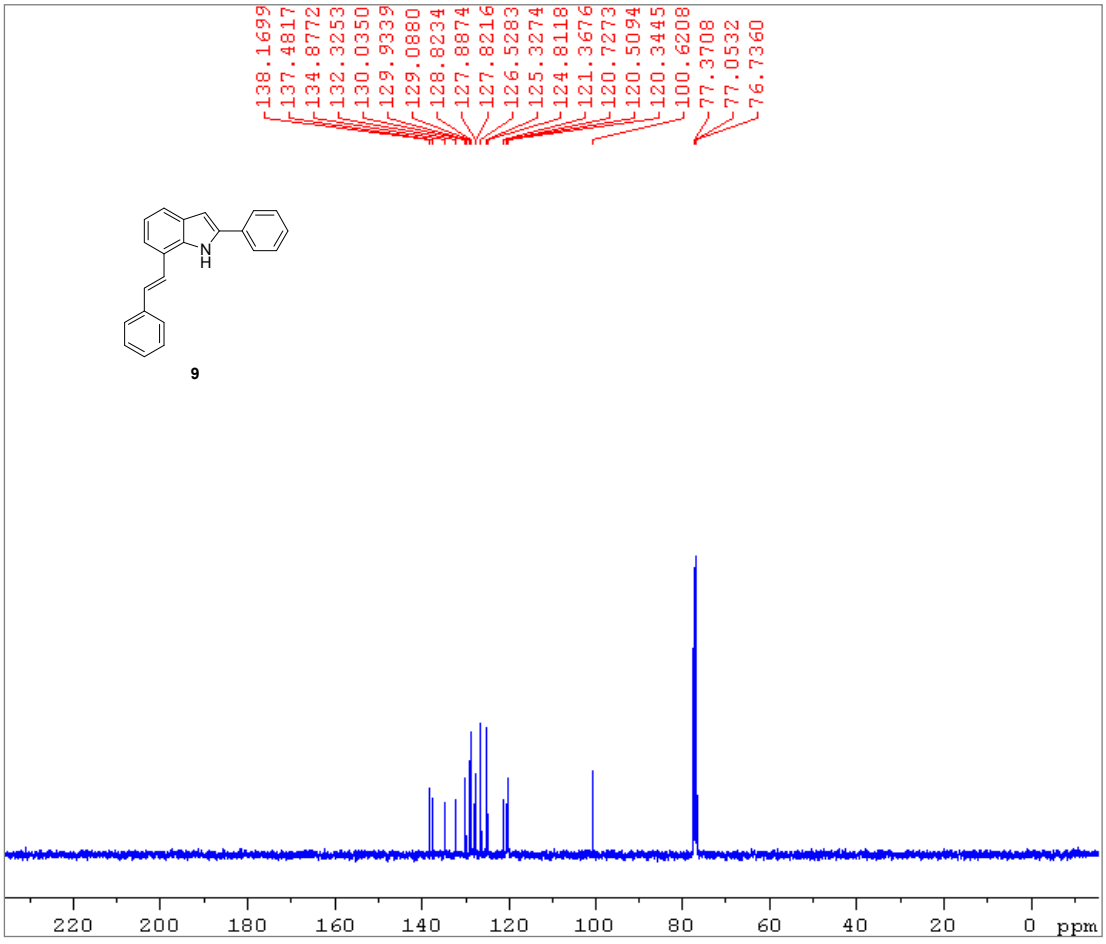
7.4412
7.4344
7.4279
7.4081
7.3856
7.3669
7.3484
7.2856
7.2462
7.2168
7.1977
7.1788
6.9075
6.9027
N
H
9
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.92
3.09
8.21
1.96
1.03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137.4817
134.8772
132.3253
130.0350
129.9339
129.0880
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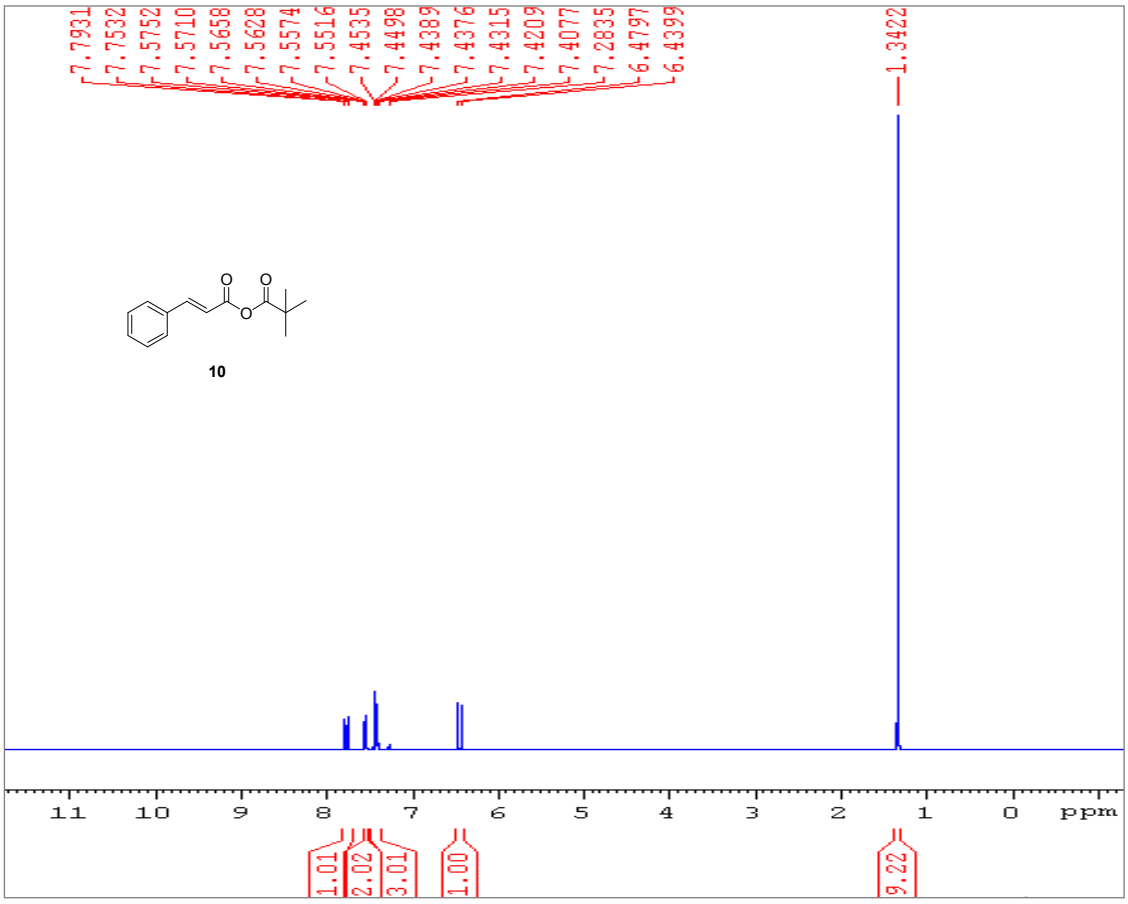
127.8216
126.5283
125.3274
124.8118
121.3676
120.7273
120.5094
120.3445
100.6208
77.3708
77.0532
76.7360
N
H
9
220
200
180
160
140
120
100
80
60
40
20
0
ppm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7.5574
7.5516
7.4535
7.4498
7.4389
7.4376
7.4315
7.4209
7.4077
7.2835
6.4797
6.4399
1.3422
O
O
O
10
11
10
9
8
7
6
5
4
3
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ppm
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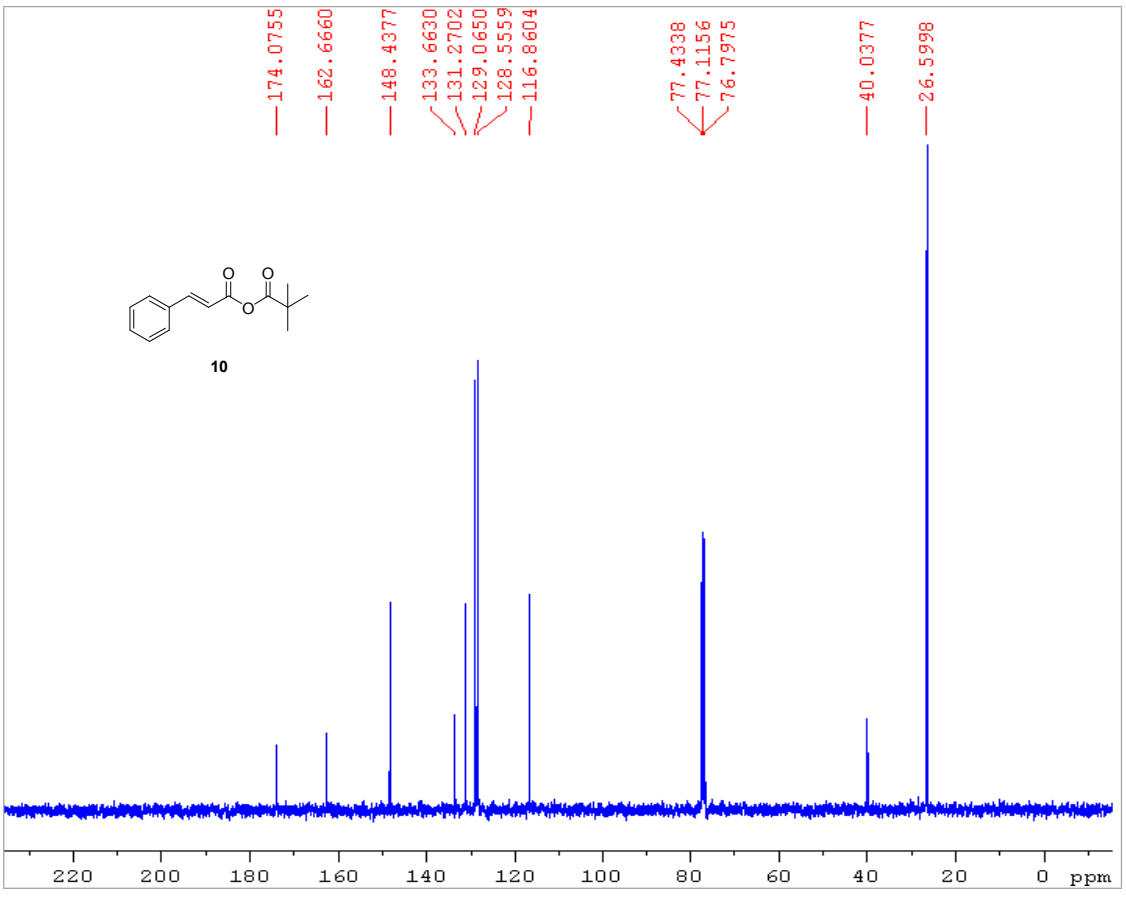
2.02
3.01
1.00
9.22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131.2702
129.0650
128.5559
116.8604
77.4338
77.1156
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40.0377
26.5998
O
O
O
10
220
200
180
160
140
120
100
80
60
40
20
0
ppm