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Supporting Information file

An efficient and one-pot synthesis of fused imidazo-heterocycles *via* copper-catalyzed C−H functionalization

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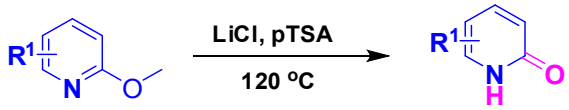
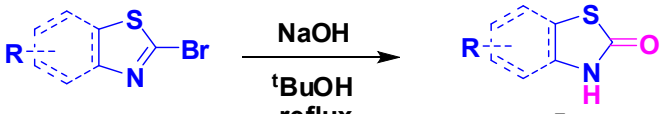
***General procedure for the synthesis of pyridin-2(1H)-ones 1*:** A solution of 2-methoxy pyridines (1 mmol) in DMF (2 ml) was treated with lithium chloride (5 mmol) and pTSA (5 mmol), heated at 120 °C for 30 min, cooled to room temperature, quenched with water (5 ml), and extracted with ethyl acetate (2 X 5 ml). The combined extracts were washed with water (2 X 5 ml) and saturated aqueous brine (2 X 5 ml), dried (Na_2SO_4), and concentrated in vacuo to give the desired products pyridin-2(1H)-ones **1** in 99% yield.



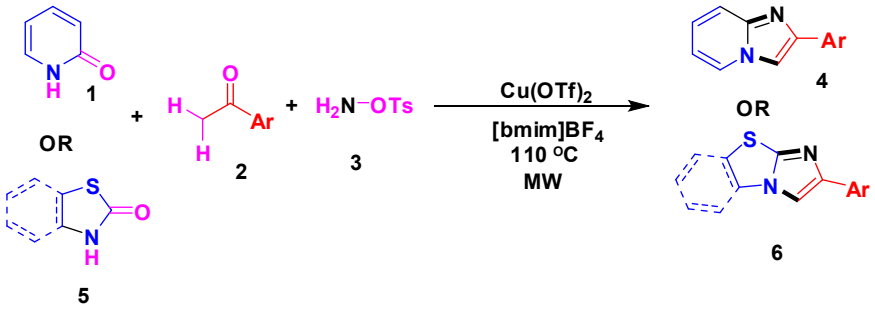
1

***General procedure for the synthesis of thiazol/benzo[d]thiazol-2(3H)-ones 5*:**
A mixture of 2-bromothiazole/benzthiazole (20 mmol, 1.8 mL) and sodium hydroxide (60 mmol, 2.4 g) in tert-butyl alcohol (20 mL) was refluxed for overnight. After the reaction was complete, the solvent was removed in vacuo. The residue was dissolved in water (30 mL), acidified to pH 2 adding HCl (1 M) and extracted with EtOAc (3×30 mL). The organic phase was dried over Na_2SO_4, filtered and the solvent was removed in vacuo. The residue was purified by flash chromatography (hexanes – EtOAc) to yield the desired products thiazol/benzo[d]thiazol-2(3H)-ones **5** (80%).



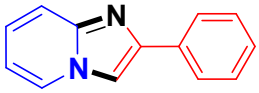
5

***General procedure for the synthesis of compounds (IHs) 4 or 6*:** A sealed 10 mL glass tube containing acetophenone **2** and O-tosylhydroxylamine **3**, $Cu(OTf)_2$ (20 mol %), and 2 mL of $[bmim]BF_4$ was placed in the cavity of a microwave reactor and irradiated at 110 °C (temperature monitored by built in infrared sensor), power 150W and pressure 25–30 psi for 2 min. Then the pyridin-2(1H)-one or thiazol/benzo[d]thiazol-2(3H)-ones **1** or **5** was added to the reaction mixture at room temperature and subjected to microwave irradiation for 10 min at 110 °C. After completion of the reaction, the reaction mixture brought to room temperature and extracted with ether (2 X 5 ml). The organic layer was washed with brine solution and dried over Na_2SO_4. The combined organic layers were evaporated and purified through column chromotography (10%-20% ethyl acetate/petroleum ethers) to afford required products **4** or **6**. The residual ionic liquid containing copper triflate was dried under vacuum and reused for subsequent cycles. The obained products were characterized by IR, NMR and mass spectroscopy.



Characterization Data of All Compounds

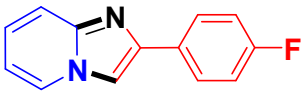
2-phenylimidazo[1,2-a]pyridine (4a, Scheme 3)



4a 80%

Light yellow solid; Mp 131-133 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.76 (td, *J* = 1.10 Hz, *J* = 6.94 Hz, 1H), 7.13-7.18 (m, 1H), 7.29 (tt, *J* = 1.22 Hz, *J* = 6.68 Hz, 1H), 7.43 (t, *J* = 7.70 Hz, 2H), 7.63 (dd, *J* = 0.73 Hz, *J* = 9.04 Hz, 1H), 7.84 (s, 1H), 7.94-7.98 (m, 2H), 8.09 (dt, *J* = 1.10 Hz, *J* = 6.84 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 108.1, 112.3, 117.4, 124.5, 125.5, 125.9, 127.9, 128.6, 133.6, 145.6, 145.7 ppm; IR (KBr) ν = 520, 743, 1244, 1366, 1631, 2927 cm^{-1} ; MS-ESI: m/z = 195 $[M+H]^+$; HRMS (ESI) calc. $C_{13}H_{11}N_2$ $[M+H]^+$: 195.09190, found: 195.09146.

2-(4-fluorophenyl)imidazo[1,2-a]pyridine (4b, Scheme 3)

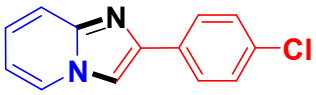


4b 82%

Light yellow solid; Mp 147-149 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.79 (t, *J* = 6.86 Hz, 1H), 7.13 (t, *J* = 8.54 Hz, 1H), 7.18 (t, *J* = 7.93 Hz, 1H), 7.63 (d, *J* = 9.00 Hz, 1H), 7.83 (s, 1H), 7.90-7.95 (m, 2H), 8.12 (d, *J* = 6.86 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 107.7, 112.4, 115.5 (d, $_2J_{C-F}$ = 21.9 Hz), 117.3, 124.7, 125.5, 127.8 (d, $_3J_{C-F}$ = 8.2 Hz), 129.8 (d, $_4J_{C-F}$ = 2.7 Hz), 145.4, 145.5,

162.6 (d, $_1J_{C-F}$ = 246.9 Hz) ppm; IR (KBr) ν = 530, 742, 1239, 1745, 2928 cm^{-1}; MS-ESI: m/z = 235 $[M+Na]^+$; HRMS (ESI) calc. $C_{13}H_{10}N_2F$ $[M+H]^+$: 213.08280, found: 213.08157.

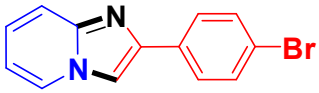
2-(4-chlorophenyl)imidazo[1,2-a]pyridine (4c, Scheme 3)



4c 82%

Light yellow solid; Mp 197-199 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.79 (t, *J* = 6.71 Hz, 1H), 7.18 (t, *J* = 8.24 Hz, 1H), 7.40 (d, *J* = 8.24 Hz, 2H), 7.62 (d, *J* = 9.00 Hz, 1H), 7.83 (s, 1H), 7.88 (d, *J* = 9.00 Hz, 2H), 8.10 (d, *J* = 6.71 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 108.1, 112.6, 117.5, 124.9, 125.5, 127.2, 128.8, 132.2, 133.6, 144.6, 145.6 ppm; IR (KBr) ν = 525, 741, 1244, 1470, 1659, 2911 cm^{-1} ; MS-ESI: m/z = 229 $[M+1]^+$; HRMS (ESI) calc. $C_{13}H_{10}N_2Cl$ $[M+H]^+$: 229.05325, found: 229.05190.

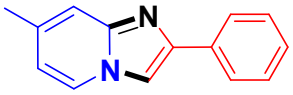
2-(4-bromophenyl)imidazo[1,2-a]pyridine (4d, Scheme 3)



4d 81%

White solid; Mp 206-208 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.76 (t, *J* = 7.2 Hz, 1H), 7.15–7.20 (m, 1H), 7.53 (d, *J* = 8.6 Hz, 2H), 7.61 (d, *J* = 9.6 Hz, 1H), 7.78 – 7.84 (m, 3H), 8.09 (d, *J* = 6.8 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 108.1, 112.6, 117.5, 121.8, 124.9, 125.5, 127.5, 131.8, 132.6, 144.6, 145.7 ppm; IR (KBr) ν = 542, 741, 1244, 1465, 1741, 2924 cm^{-1} ; MS-ESI: m/z = 273 $[M+H]^+$; HRMS (ESI) calc. $C_{13}H_{10}N_2Br$ $[M+H]^+$: 273.00274, found: 287.00124.

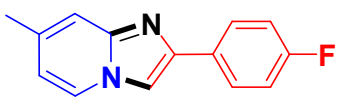
7-methyl-2-phenylimidazo[1,2-a]pyridine (4e, Scheme 3)



4e 80%

White solid; Mp 160-162 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.40 (s, 3H), 6.61 (dd, *J* = 1.37 Hz, *J* = 7.01 Hz, 1H), 7.32 (tt, *J* = 1.22 Hz, *J* = 6.25 Hz, 1H), 7.39 (s, 1H), 7.43 (t, *J* = 7.62 Hz, 2H), 7.78 (s, 1H), 7.94 (d, *J* = 7.17 Hz, 2H), 7.99 (d, *J* = 7.01 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.3, 107.4, 115.0, 115.8, 124.7, 125.9, 127.7, 128.6, 133.8, 135.5, 145.4, 146.0 ppm; IR (KBr) ν = 600, 719, 783, 1025, 1072, 1361, 1436, 1470, 1501, 1639 cm^{-1}; MS-ESI: m/z = 209 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{13}N_2$ $[M+H]^+$: 209.10787, found: 209.10663.

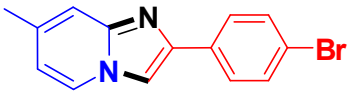
2-(4-fluorophenyl)-7-methylimidazo[1,2-a]pyridine (4f, Scheme 3)



4f 84%

White solid; Mp 148-150 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.40 (s, 3H), 6.33 (s, 1H), 6.48 (d, *J* = 3.66 Hz, 1H), 6.60 (d, *J* = 6.71 Hz, 1H), 7.11 (td, *J* = 1.83 Hz, *J* = 8.85 Hz, 2H), 7.37 (s, 1H), 7.72 (s, 1H), 7.97-8.00 (m, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.3, 107.1, 115.1, 115.5 (d, $_2J_{C\text{-}F}$ = 21.7 Hz), 115.7, 124.7, 127.5 (d, $_3J_{C\text{-}F}$ = 8.1 Hz), 130.0 (d, $_4J_{C\text{-}F}$ = 2.7 Hz), 135.7, 144.5, 146.1, 162.5 (d, $_1J_{C\text{-}F}$ = 247.0 Hz), ppm; IR (KBr) ν = 526, 784, 1022, 1173, 1249, 1472, 1584 cm^{-1}; MS-ESI: m/z = 227 $[M+1]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_2F$ $[M+H]^+$: 227.09845, found: 227.09718.

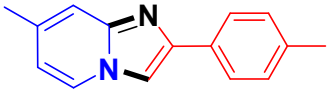
2-(4-bromophenyl)-7-methylimidazo[1,2-a]pyridine (4g, Scheme 3)



4g 82%

White solid; Mp 206-208 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.39 (s, 3H), 6.67 (dd, *J* = 1.37 Hz, *J* = 6.86 Hz, 1H), 7.36 (s, 1H), 7.53 (d, *J* = 8.54 Hz, 2H), 7.74 (s, 1H), 7.79 (d, *J* = 8.54 Hz, 2H), 7.96 (d, *J* = 6.86 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.3, 107.6, 115.2, 115.8, 121.6, 124.7, 127.4, 131.7, 132.7, 135.9, 144.2, 146.0 ppm; IR (KBr): ν = 504, 732, 784, 824, 1005, 1066, 1249, 1369, 1472, 1642 cm^{-1}; MS-ESI: m/z = 287 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_2Br$ $[M+H]^+$: 287.01839, found: 287.01682.

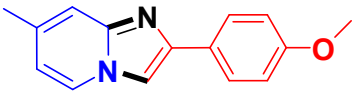
7-methyl-2-p-tolylimidazo[1,2-a]pyridine (4h, Scheme 3)



4h 76%

White solid; Mp 146-148 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.37 (s, 6H), 6.56 (dd, *J* = 0.94 Hz, *J* = 7.93 Hz, 1H), 7.23 (d, *J* = 7.93 Hz, 2H), 7.35 (s, 1H), 7.69 (s, 1H), 7.82 (d, *J* = 8.12 Hz, 2H), 7.93 (d, *J* = 6.79 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.2, 21.3, 107.0, 114.8, 115.7, 124.6, 125.8, 129.3, 131.0, 135.3, 137.5, 145.6, 146.0 ppm; IR (KBr) ν = 522, 780, 1017, 1169, 1242, 1480, 1601 cm^{-1} ; MS-ESI: m/z = 223 $[M+H]^+$; HRMS (ESI) calc. $C_{15}H_{15}N_2$ $[M+H]^+$: 223.12352, found: 223.12231.

2-(4-methoxyphenyl)-7-methylimidazo[1,2-a]pyridine (4i, Scheme 3)



4i 74%

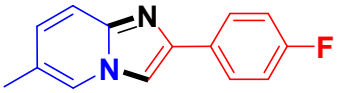
White solid; Mp 163-165 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.40 (s, 3H), 3.85 (s, 3H), 6.48 (d, *J* = 5.09 Hz, 1H), 6.59 (dd, *J* = 1.13 Hz, *J* = 6.79 Hz, 1H), 6.96 (d, *J* = 8.68 Hz, 2H), 7.70 (s, 1H), 7.86 (d, *J* = 8.87 Hz, 2H), 7.97 (d, *J* = 6.79 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.3, 55.2, 106.5, 114.0, 115.6, 115.6, 124.5, 126.6, 127.1, 135.3, 145.4, 146.0, 159.4 ppm; IR (KBr) ν = 525, 782, 1020, 1172, 1245, 1483, 1606 cm^{-1} ; MS-ESI: m/z = 239 $[M+H]^+$; HRMS (ESI) calc. $C_{15}H_{15}N_2O$ $[M+H]^+$: 239.11844, found: 239.11697.

6-methyl-2-phenylimidazo[1,2-a]pyridine (4j, Scheme 3)

4j 74%

White solid; Mp 172-174 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.31 (s, 3H), 7.01 (dd, *J* = 1.52 Hz, *J* = 9.15 Hz, 1H), 7.31 (t, *J* = 9.15 Hz, 1H), 7.42 (t, *J* = 1.52 Hz, 2H), 7.53 (d, *J* = 9.15 Hz, 1H), 7.76 (s, 1H), 7.88 (s, 1H), 7.94 (d, *J* = 8.54 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.0, 107.8, 116.6, 121.9, 123.2, 125.8, 127.7, 128.6, 129.8, 133.7, 144.6, 145.3 ppm; IR (KBr) ν = 508, 704, 730, 798, 820, 1413, 1501, 1621 cm^{-1}; MS-ESI: m/z = 209 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{13}N_2$ $[M+H]^+$: 209.10732, found: 209.10684.

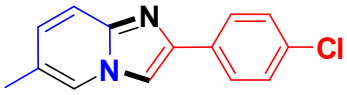
2-(4-fluorophenyl)-7-methylimidazo[1,2-a]pyridine (4k, Scheme 3)



4k 77%

White solid; Mp 192-194 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.32 (s, 3H), 7.02 (dd, *J* = 1.37 Hz, *J* = 6.86 Hz, 1H), 7.11 (td, *J* = 7.29 Hz, *J* = 7.29 Hz, 2H), 7.52 (t, *J* = 7.29 Hz, 1H), 7.71 (d, *J* = 7.29 Hz, 1H), 7.88-7.92 (m, 3H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.0, 107.4, 115.5 (d, $_{2}J_{C\text{-}F}$ = 21.7 Hz), 116.7, 122.0, 123.2, 127.5 (d, $_{3}J_{C\text{-}F}$ = 8.1 Hz), 127.9, 130.1 (d, $_{4}J_{C\text{-}F}$ = 21.7 Hz), 144.6, 144.7, 162.5 (d, $_{1}J_{C\text{-}F}$ = 21.7 Hz) ppm; IR (KBr) ν = 522, 703, 736, 805, 840, 1087, 1150, 1221, 1481, 1601 cm^{-1} ; MS-ESI: m/z = 227 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_2F$ $[M+H]^+$: 227.09790, found: 227.09757.

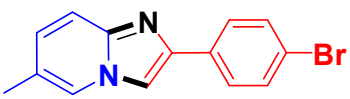
2-(4-chlorophenyl)-6-methylimidazo[1,2-a]pyridine (4l, Scheme 3)



4l 77%

White solid; Mp 212-214 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.32 (s, 3H), 7.03 (dd, *J* = 1.51 Hz, *J* = 9.06 Hz, 1H), 7.39 (d, *J* = 8.49 Hz, 2H), 7.52 (d, *J* = 9.25 Hz, 1H), 7.76 (s, 1H), 7.84-7.91 (m, 3H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.0, 107.8, 116.8, 122.1, 123.2, 127.0, 128.0, 128.8, 132.4, 133.4, 144.3, 144.7 ppm; IR (KBr) ν = 510, 733, 803, 834, 1091, 1207, 1414, 1469, 1539 cm^{-1} ; MS-ESI: m/z = 243 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_2Cl$ $[M+H]^+$: 243.06835, found: 287.06834.

2-(4-bromophenyl)-6-methylimidazo[1,2-a]pyridine (4m, Scheme 3)



4m 75%

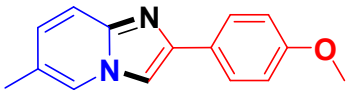
White solid; Mp 212-214 °C;; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.32 (s, 3H), 7.03 (dd, *J* = 1.52 Hz, *J* = 9.15 Hz, 1H), 7.50-7.56 (m, 3H), 7.76 (s, 1H), 7.81 (d, *J* = 8.54 Hz, 2H), 7.89 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.1, 107.9, 116.7, 121.6, 122.2, 123.2, 127.4, 131.7, 132.8, 144.3, 144.7 ppm; IR (KBr) ν = 505, 728, 808, 838, 1096, 1213, 1421, 1482, 1547 cm^{-1}; MS-ESI: m/z = 287 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_2Br$ $[M+H]^+$: 287.01784, found: 287.01757.

6-methyl-2-p-tolylimidazo[1,2-a]pyridine (4n, Scheme 3)

4n 72%

White solid; Mp 202-204 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.31 (s, 3H), 2.38 (s, 3H), 7.00 (dd, *J* = 1.37 Hz, *J* = 9.15 Hz, 1H), 7.23 (d, *J* = 8.08 Hz, 2H), 7.52 (d, *J* = 9.15 Hz, 1H), 7.74 (s, 1H), 7.83 (d, *J* = 8.08 Hz, 2H), 7.88 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.0, 21.2, 107.4, 116.5, 121.8, 123.2, 125.7, 127.6, 129.3, 130.9, 137.5, 144.5, 145.4 ppm; IR (KBr) ν = 510, 706, 733, 802, 824, 1417, 1510, 1603 cm^{-1}; MS-ESI: m/z = 223 $[M+H]^+$, 245 $[M+Na]^+$; HRMS (ESI) calc. $C_{15}H_{15}N_2$ $[M+H]^+$: 223.12358, found: 223.12290 and calc. $C_{15}H_{15}N_2$ $[M+Na]^+$: 245.10540, found: 223.10476.

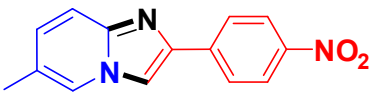
2-(4-methoxyphenyl)-6-methylimidazo[1,2-a]pyridine (4o, Scheme 3)



4o 69%

Yellow solid; Mp 175-177 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.31 (s, 3H), 3.85 (s, 3H), 6.97 (d, *J* = 8.85 Hz, 2H), 7.01 (dd, *J* = 1.52 Hz, *J* = 9.15 Hz, 1H), 7.53 (d, *J* = 9.30 Hz, 1H), 7.69 (s, 1H), 7.87 (d, *J* = 8.85 Hz, 2H), 7.89 (br s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.0, 55.2, 106.8, 114.0, 116.5, 121.7, 123.1, 126.6, 127.1, 127.5, 144.6, 145.3, 159.3 ppm; IR (KBr) ν = 515, 711, 738, 807, 829, 1423, 1516, 1612 cm^{-1}; MS-ESI: m/z = 239 $[M+H]^+$; HRMS (ESI) calc. $C_{15}H_{15}N_2O$ $[M+H]^+$: 239.11789, found: 239.11766.

6-methyl-2-(4-nitrophenyl)imidazo[1,2-a]pyridine (4p, Scheme 3)

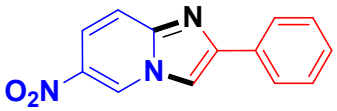


4p 76%

Yellow solid; Mp 238-240 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.35 (s, 3H), 7.09 (d, *J* = 8.85 Hz, 1H), 7.55 (d, *J* = 9.15 Hz, 1H), 7.91 (s, 1H), 7.94 (s, 1H), 8.09 (d, *J* = 8.69 Hz, 2H), 8.28 (d, *J* = 8.69 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 18.1, 109.6, 117.1, 122.9, 123.4, 124.1, 126.2, 128.9, 140.3, 142.9, 145.1, 147.0 ppm; IR (KBr) ν = 521, 748, 819, 849, 1107, 1223, 1426, 1481,

1548 cm^{-1}; MS-ESI: m/z = 254 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_3O_2$ $[M+H]^+$: 254.09240, found: 254.09217.

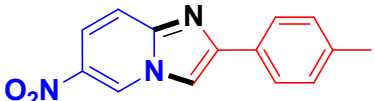
6-nitro-2-phenylimidazo[1,2-a]pyridine (4q, Scheme 3)



4q 52%

Yellow solid; Mp 171-173 °C; ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 7.46 (d, *J* = 9.44 Hz, 3H), 7.67 (d, *J* = 10.00 Hz, 1H), 7.97 (t, *J* = 8.12 Hz, 3H), 8.26 (s, 1H), 9.55 (d, *J* = 1.88 Hz, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 110.0, 114.7, 117.3, 124.7, 126.0, 127.3, 128.8, 131.3, 135.3, 143.8, 146.8 ppm**;** IR (KBr) ν = 509, 702, 722, 791, 812, 1419, 1508, 1631 cm^{-1}; MS-ESI: m/z = 240 $[M+H]^+$; HRMS (ESI) calc. $C_{13}H_{10}N_3O_2$ $[M+H]^+$: 240.07736, found: 240.07684.

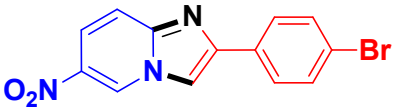
6-nitro-2-(p-tolyl)imidazo[1,2-a]pyridine (4r, Scheme 3)



4r 50%

Light yellow solid; Mp 201-203 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.40 (s, 3H), 7.26 (d, *J* = 7.93 Hz, 3H), 7.68 (d, *J* = 10.00 Hz, 1H), 7.85 (d, *J* = 8.12 Hz, 1H), 7.95 (d, *J* = 7.93 Hz, 1H), 8.06 (s, 1H), 9.34 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.0, 109.8, 115.9, 118.6, 125.8, 128.6, 129.2, 136.7, 138.7, 142.8, 144.9, 148.5 ppm**;** ; IR (KBr) ν = 515, 718, 732, 821, 839, 1441, 1523, 1626 cm^{-1}; MS-ESI: m/z = 254 $[M+H]^+$; HRMS (ESI) calc. $C_{14}H_{12}N_3O_2$ $[M+H]^+$: 254.09301, found: 254.09264.

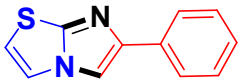
2-(4-bromophenyl)-6-nitroimidazo[1,2-a]pyridine (4s, Scheme 3)



4s 56%

Yellow solid; Mp 212-214 °C; ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 7.47 (q, *J* = 7.47 Hz, 1H), 7.59 (t, *J* = 7.62 Hz, 1H), 7.63-7.69 (m, 1H), 7.87-8.07 (m, 3H), 8.43 (dd, *J* = 7.17 Hz, *J* = 13.88 Hz, 1H), 9.74 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 110.1, 110.4, 115.2, 117.9, 125.1, 126.1, 126.7, 127.6, 130.7, 144.2, 147.4 ppm**;** IR (KBr): ν = 521, 754, 802, 840, 1025, 1078, 1261, 1382, 1491, 1664 cm^{-1}; MS-ESI: m/z = 318 $[M+H]^+$; HRMS (ESI) calc. $C_{13}H_9N_3O_2Br$ $[M+H]^+$: 317.98763, found: 317.98721.

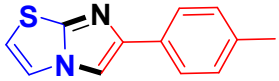
6-phenylimidazo[2,1-b]thiazole (6a, Scheme 4)



6a 86%

White solid; Mp 148-150 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.83 (d, *J* = 4.34 Hz, 1H), 7.30 (d, *J* = 7.36 Hz, 1H), 7.37-7.46 (m, 3H), 7.75 (s, 1H), 7.83 (d, *J* = 7.17 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 107.8, 112.4, 118.4, 125.1, 127.3, 128.6, 134.0, 147.8, 150.1 ppm; IR (KBr) ν = 502, 641, 721, 826, 993, 1064, 1181, 1388, 1466, 1522 cm^{-1}; MS-ESI: m/z = 201 $[M+H]^+$; HRMS (ESI) calc. $C_{11}H_9N_2S$ $[M+H]^+$: 201.04810, found: 201.04783.

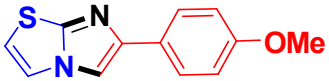
6-p-tolylimidazo[2,1-b]thiazole (6b, Scheme 4)



6b 80%

White solid; Mp 147-149 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.37 (s, 3H), 6.81 (d, *J* = 4.34 Hz, 1H), 7.21 (d, *J* = 7.93 Hz, 2H), 7.42 (d, *J* = 4.34 Hz, 1H), 7.71 (s, 2H), 7.73 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.2, 107.4, 112.2, 118.4, 125.1, 129.3, 131.2, 137.1, 148.0 ppm; IR (KBr) ν = 640, 709, 830, 1017, 1177, 1240, 1406, 1461, 1541 cm^{-1}; MS-ESI: m/z = 215 $[M+H]^+$; HRMS (ESI) calc. $C_{12}H_{11}N_2S$ $[M+H]^+$: 215.06429, found: 215.06296.

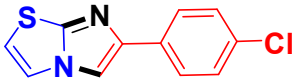
6-(4-methoxyphenyl)imidazo[2,1-b]thiazole (6c, Scheme 4)



6c 76%

Light yellow solid; Mp 154-156 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.84 (s, 3H), 6.80 (d, *J* = 4.42 Hz, 1H), 6.94 (d, *J* = 8.54 Hz, 2H), 7.41 (d, *J* = 4.42 Hz, 1H), 7.65 (s, 1H), 7.75 (d, *J* = 8.69 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.2, 106.9, 112.0, 114.0, 118.4, 126.4, 126.9, 147.8, 159.0 ppm; IR (KBr) ν = 648, 712, 835, 1021, 1180, 1243, 1408, 1466, 1542 cm^{-1} ; MS-ESI: m/z = 231 $[M+H]^+$; HRMS (ESI) calc. $C_{12}H_{11}N_2OS$ $[M+H]^+$: 231.05921, found: 231.05777.

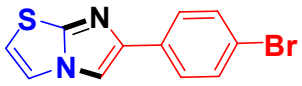
6-(4-chlorophenyl)imidazo[2,1-b]thiazole (6d, Scheme 4)



6d 88%

White solid; Mp 163-165 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.84 (d, *J* = 4.53 Hz, 1H), 7.43 (d, *J* = 4.53 Hz, 1H), 7.52 (d, *J* = 8.49 Hz, 2H), 7.71 (t, *J* = 8.49 Hz, 3H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 108.0, 112.7, 118.3, 121.0, 126.7, 131.7, 133.0, 146.7, 150.3 ppm; IR (KBr) ν = 500, 643, 725, 829, 997, 1062, 1184, 1392, 1455, 1529 cm^{-1} ; MS-ESI: m/z = 235 $[M+H]^+$.

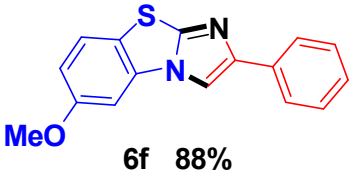
6-(4-bromophenyl)imidazo[2,1-b]thiazole (6e, Scheme 4)



6e 88%

White solid; Mp 181-183 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.83 (d, *J* = 4.42 Hz, 1H), 7.36 (d, *J* = 8.39 Hz, 2H), 7.42 (d, *J* = 4.42 Hz, 1H), 7.71 (s, 1H), 7.75 (d, *J* = 8.39 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 108.0, 112.7, 118.3, 121.0, 126.6, 131.7, 133.0, 146.7, 150.3 ppm; IR (KBr) ν = 503, 646, 728, 835, 1003, 1069, 1188, 1398, 1459, 1535 cm^{-1}.

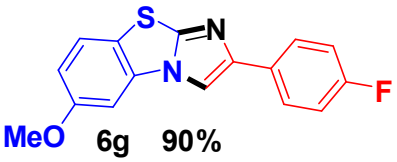
8-methoxy-2-phenyl-benzo[d]imidazo[2,1-b]thiazole (6f, Scheme 4)



6f 88%

Pale yellow solid; Mp 147-149 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.86 (s, 3H), 7.00 (dd, *J* = 2.44 Hz, *J* = 8.85 Hz, 1H), 7.20 (d, *J* = 2.44 Hz, 1H), 7.28 (tt, *J* = 1.22 Hz, *J* = 8.87 Hz, 1H), 7.41 (t, *J* = 7.47 Hz, 2H), 7.49 (d, *J* = 8.85 Hz, 1H), 7.86 (dd, *J* = 1.22 Hz, *J* = 8.39 Hz, 2H), 7.89 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.8, 106.7, 108.7, 113.0, 113.3, 125.0, 126.3, 127.3, 128.6, 131.4, 133.8, 147.1, 147.4, 157.1 ppm**;** IR (KBr): ν = 700, 841, 1020, 1047, 1212, 1255, 1328, 1511, 1615cm^{-1}; MS-ESI: m/z = 281 $[M+H]^+$; HRMS (ESI) calc. $C_{16}H_{13}N_2OS$ $[M+H]^+$: 281.07486, found: 281.07374.

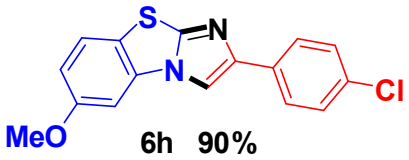
2-(4-flouro-phenyl)-8-Methoxy-benzo[d]imidazo[2,1-b]thiazole (6g, Scheme 4)



6g 90%

Pale yellow solid; Mp 193-195 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.88 (s, 3H), 7.01 (d, *J* = 8.39 Hz, 1H), 7.10 (t, *J* = 8.54 Hz, 2H), 7.22 (br s, 1H), 7.51 (d, *J* = 8.85 Hz, 1H), 7.78-7.87 (m, 3H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.9, 106.4, 108.7, 113.0, 113.4, 115.5 (d, $_{2}J_{C\text{-}F}$ = 21.7 Hz), 126.3, 126.6 (d, $_{3}J_{C\text{-}F}$ = 8.1 Hz), 130.1 (d, $_{4}J_{C\text{-}F}$ = 2.7 Hz), 131.4, 146.3, 147.5, 157.2, 162.2 (d, $_{1}J_{C\text{-}F}$ = 246.1 Hz) ppm**;** IR (KBr): ν = 516, 702, 794, 843, 1032, 1060, 1200, 1270, 1496, 1544, 1607 cm^{-1}; MS-ESI: m/z = 299 $[M+H]^+$; HRMS (ESI) calc. $C_{16}H_{12}N_2OFS$ $[M+H]^+$: 299.06544, found: 299.06367.

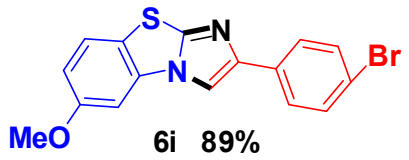
2-(4-chloro-phenyl)-8-Methoxy-benzo[d]imidazo[2,1-b]thiazole (6h, Scheme 4)



6h 90%

White solid; Mp 201-203 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.88 (s, 3H), 7.01 (dd, *J* = 2.45 Hz, *J* = 8.87 Hz, 1H), 7.21 (d, *J* = 2.45 Hz, 1H), 7.37 (d, *J* = 8.49 Hz, 2H), 7.50 (d, *J* = 8.87 Hz, 1H), 7.78 (d, *J* = 8.49 Hz, 2H), 7.89 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 55.0, 106.9, 107.9, 112.7, 125.3, 127.8, 130.2, 131.5, 131.8, 144.7, 146.4, 156.4 ppm**;** IR (KBr): ν = 730, 793, 822, 1031, 1062, 1195, 1270, 1496 cm^{-1} MS-ESI: m/z = 315 $[M+H]^+$; HRMS (ESI) calc. $C_{16}H_{12}N_2OClS$ $[M+H]^+$: 315.03534, found: 315.03490.

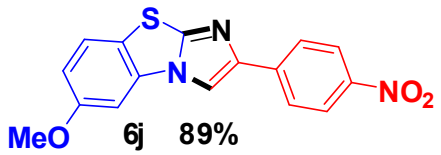
2-(4-bromo-phenyl)-8-Methoxy-benzo[d]imidazo[2,1-b]thiazole (6i, Scheme 4)



6i 89%

Pale yellow solid; Mp 197-199 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.87 (s, 3H), 7.01 (dd, *J* = 2.44 Hz, *J* = 8.85 Hz, 1H), 7.21 (d, *J* = 2.44 Hz, 1H), 7.49 (d, *J* = 8.85 Hz, 1H), 7.52 (d, *J* = 8.54 Hz, 2H), 7.71 (d, *J* = 8.54 Hz, 2H), 7.89 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.9, 106.9, 108.7, 113.1, 113.4, 120.9, 126.2, 126.5, 131.4, 131.7, 132.8, 146.0, 147.6, 157.2 ppm**;** IR (KBr): ν = 728, 789, 819, 1026, 1057, 1196, 1275, 1501 cm^{-1}; MS-ESI: m/z = 359 $[M+2H]^+$; HRMS (ESI) calc. $C_{16}H_{12}N_2OBrS$ $[M+H]^+$: 358.98482, found: 358.98436.

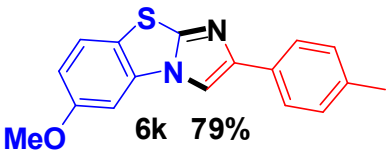
2-(4-nitro-phenyl)-8-Methoxy-benzo[d]imidazo[2,1-b]thiazole (6j, Scheme 4)



6j 89%

Yellow solid; Mp 213-215 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.89 (s, 3H), 7.04 (dd, *J* = 2.44 Hz, *J* = 8.85 Hz, 1H), 7.23 (d, *J* = 2.44 Hz, 1H), 7.54 (d, *J* = 8.85 Hz, 1H), 7.99 (d, *J* = 9.00 Hz, 2H), 8.05 (s, 1H), 8.26 (d, *J* = 9.00 Hz, 2H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.9, 89.2, 108.9, 113.4, 113.7, 117.3, 122.2, 124.2, 125.2, 131.7, 134.0, 140.2, 146.6, 157.7 ppm**;** IR (KBr): ν = 717, 853, 1029, 1058, 1200, 1267, 1342, 1511, 1601 cm^{-1}; MS-ESI: m/z = 326 $[M+H]^+$; HRMS (ESI) calc. $C_{16}H_{12}N_3O_3S$ $[M+H]^+$: 326.05998, found: 326.05956.

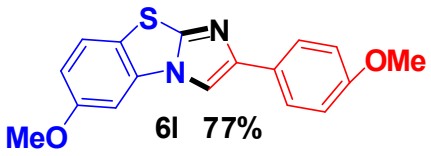
8-Methoxy-2-p-tolyl-benzo[d]imidazo[2,1-b]thiazole (6k, Scheme 4)



6k 79%

White solid; Mp 157-159 ^{o}C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.37 (s, 3H), 3.85 (s, 3H), 6.98 (dd, *J* = 2.44 Hz, *J* = 8.85 Hz, 1H), 7.18 (d, *J* = 2.44 Hz, 1H),7.22 (d, *J* = 7.93 Hz, 2H), 7.46 (d, *J* = 8.85 Hz, 1H), 7.74 (d, *J* = 8.08 Hz, 2H), 7.84 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.2, 55.8, 106.3, 108.6, 112.9, 113.2, 124.8, 126.3, 129.3, 131.1, 131.3, 137.0, 147.2, 147.3, 157.0 ppm**;** IR (KBr): ν = 731, 793, 823, 1029, 1060, 1190, 1267, 1496, 1548 cm^{-1}; MS-ESI: m/z = 295 $[M+H]^+$; HRMS (ESI) calc. $C_{17}H_{15}N_2OS$ $[M+H]^+$: 295.08996, found: 295.08950.

8-Methoxy-2-(4-methoxy-phenyl)- benzo[d]imidazo[2,1-b]thiazole (6l, Scheme 4)



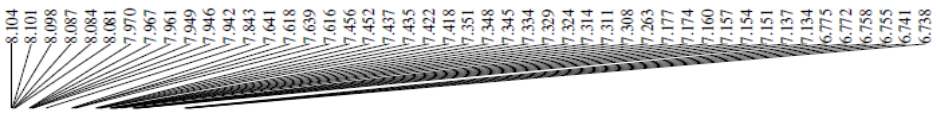
6l 77%

White solid; Mp 188-190 ^{o}C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.85 (s, 3H), 3.86 (s, 3H), 6.95 (d, *J* = 8.69 Hz, 2H), 6.99 (dd, *J* = 2.44 Hz, *J* = 8.69 Hz, 1H), 7.20 (d, *J* = 2.28 Hz, 1H), 7.47 (d, *J* = 8.85 Hz, 1H), 7.78 (d, *J* = 8.69 Hz, 2H), 7.80 (s, 1H) ppm; ^{13}C NMR (75 MHz, $CDCl_3$): δ 55.2, 55.8, 105.7, 108.7, 112.9, 113.2, 114.0, 126.2, 126.4, 126.7, 131.3, 147.1, 147.1, 157.0, 159.0 ppm**;** IR (KBr): ν = 703, 794, 840, 1030, 1241, 1269, 1496, 1546, 1610 cm^{-1}; MS-ESI: m/z = 311 $[M+H]^+$; HRMS (ESI) calc. $C_{17}H_{15}N_2O_2S$ $[M+H]^+$: 311.08487, found: 311.08405.

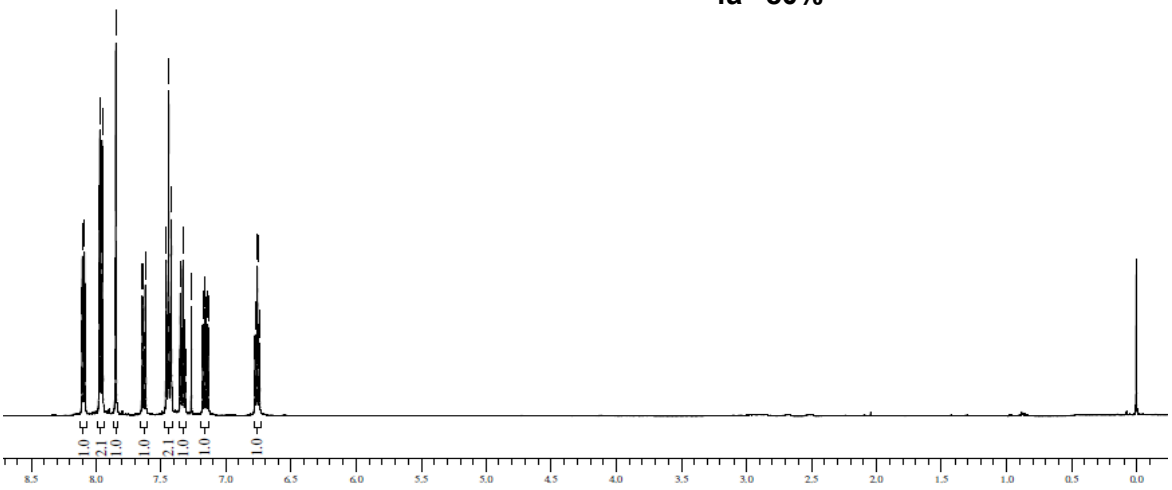
^{1}H NMR, ^{13}C NMR and HRMS spectra

Compound 4a

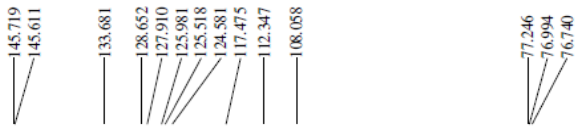
^{1}H NMR (300 MHz, $CDCl_3$)

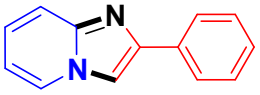


4a 80%

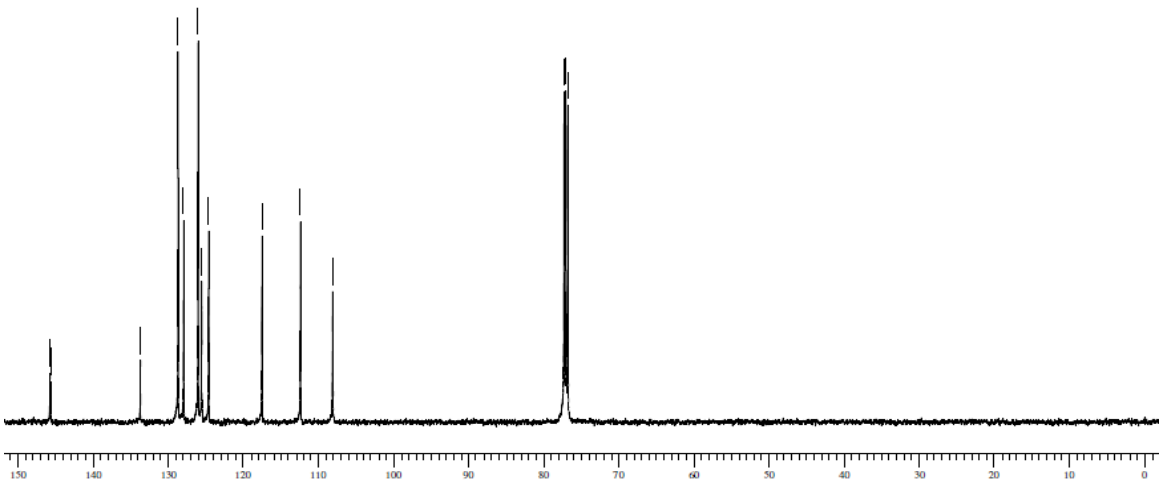


^{13}C NMR (75 MHz, $CDCl_3$)

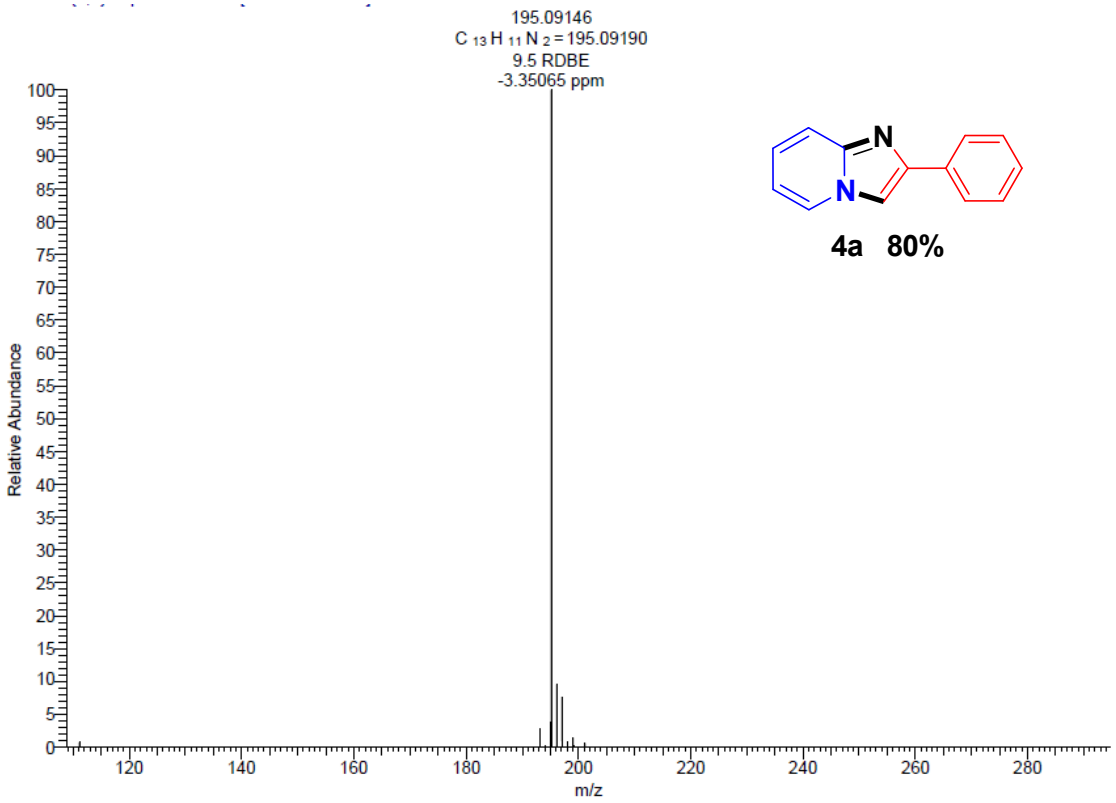




4a 80%



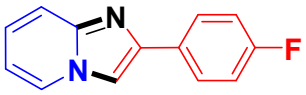
HRMS (ESI)



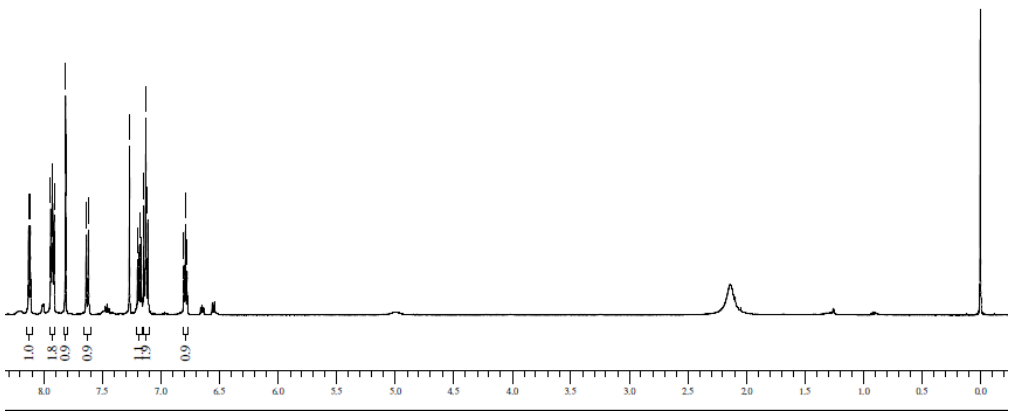
4a 80%

Compound 4b

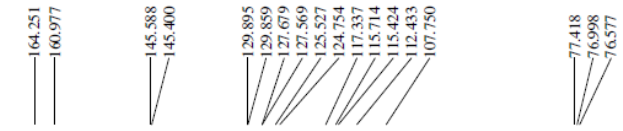
^{1}H NMR (300 MHz, $CDCl_3$)

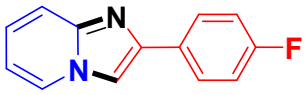


4b 82%

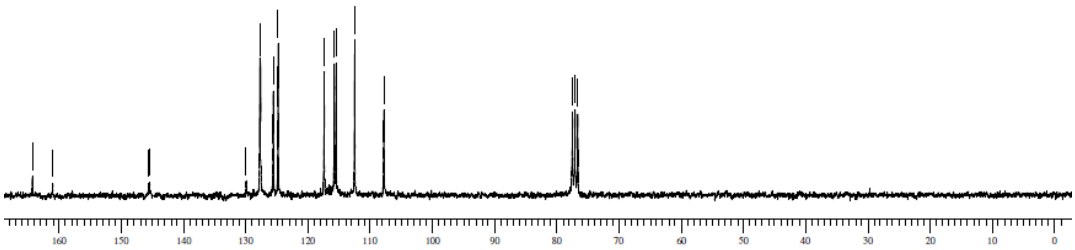


^{13}C NMR (75 MHz, $CDCl_3$)

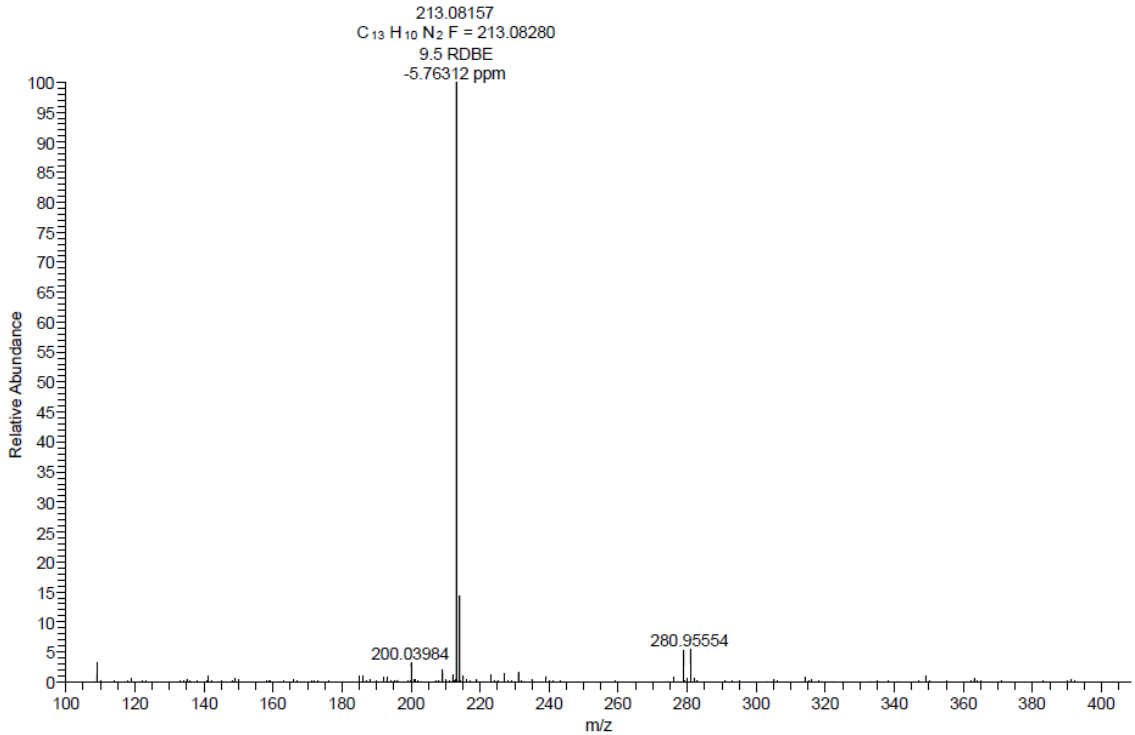




4b 82%

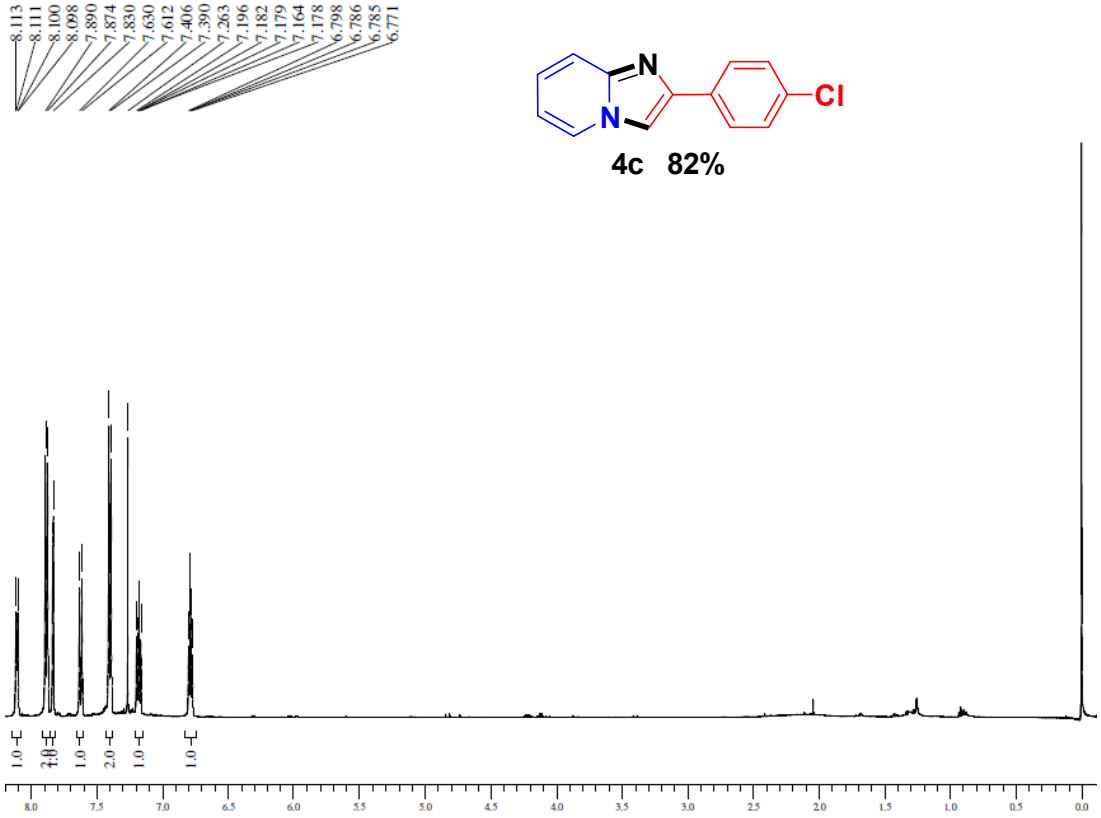


HRMS (ESI)

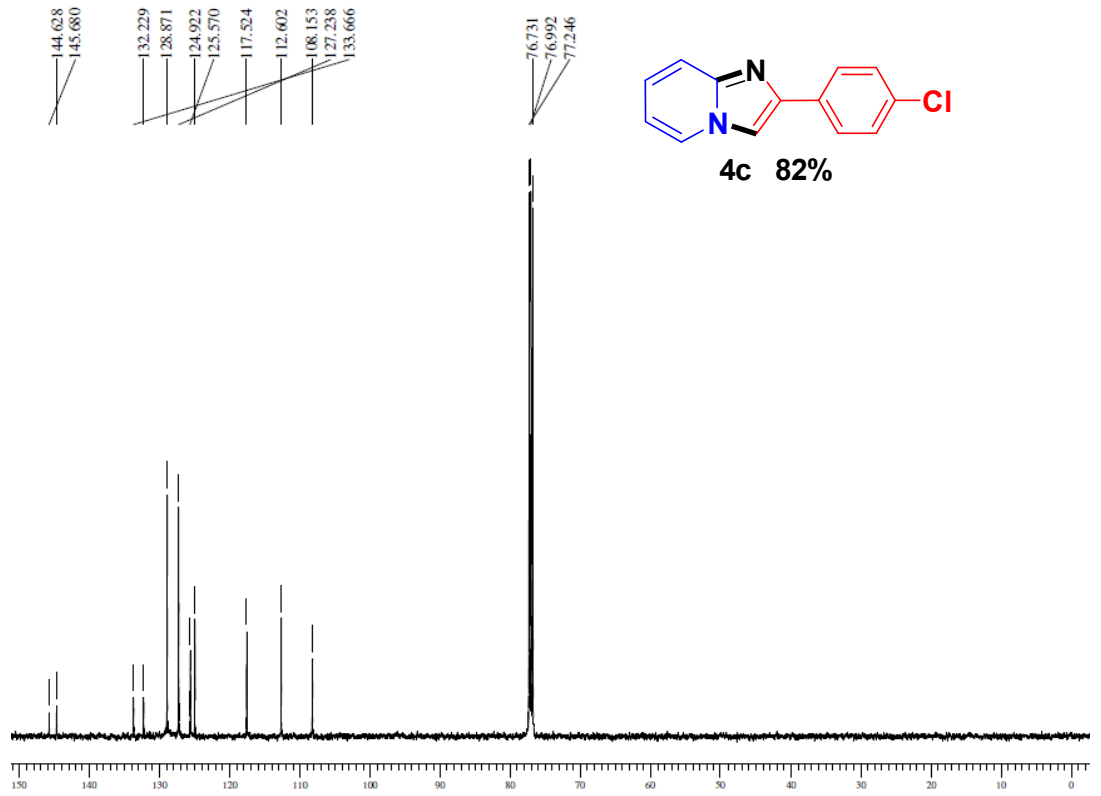


Compound 4c

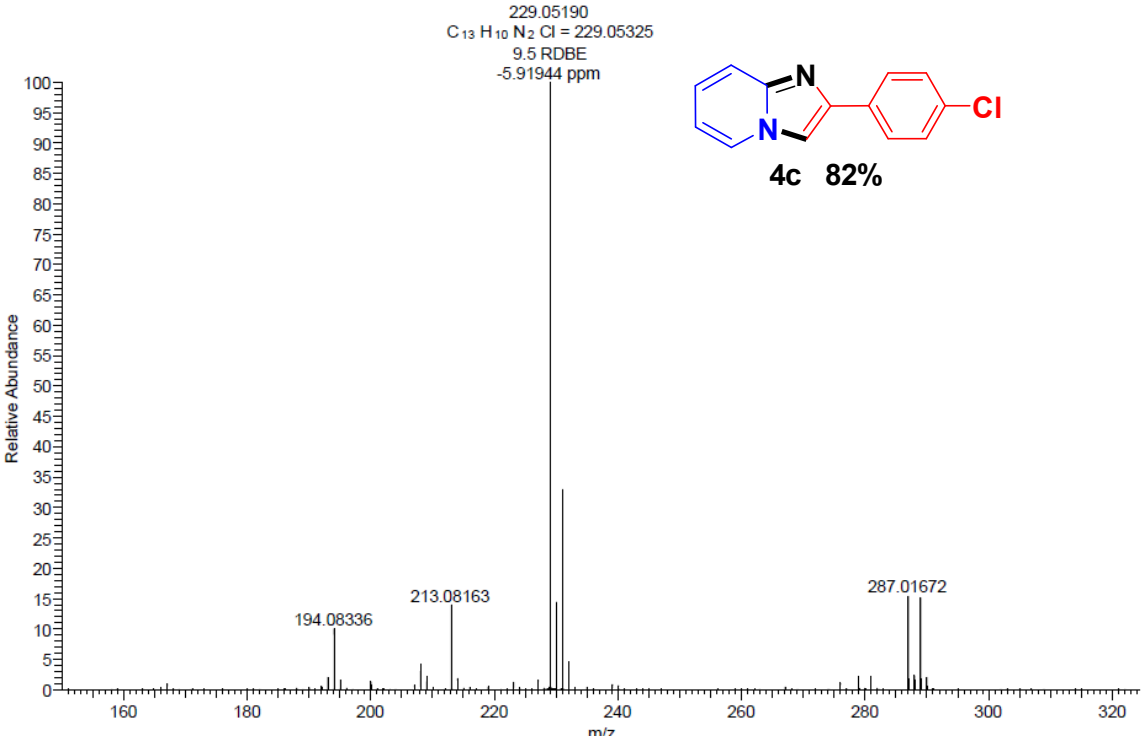
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



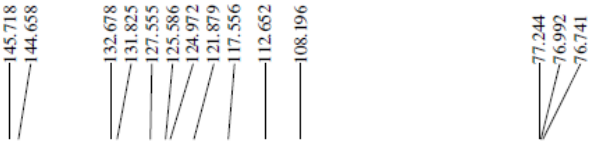
HRMS (ESI)

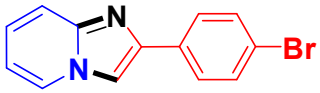


4c 82%

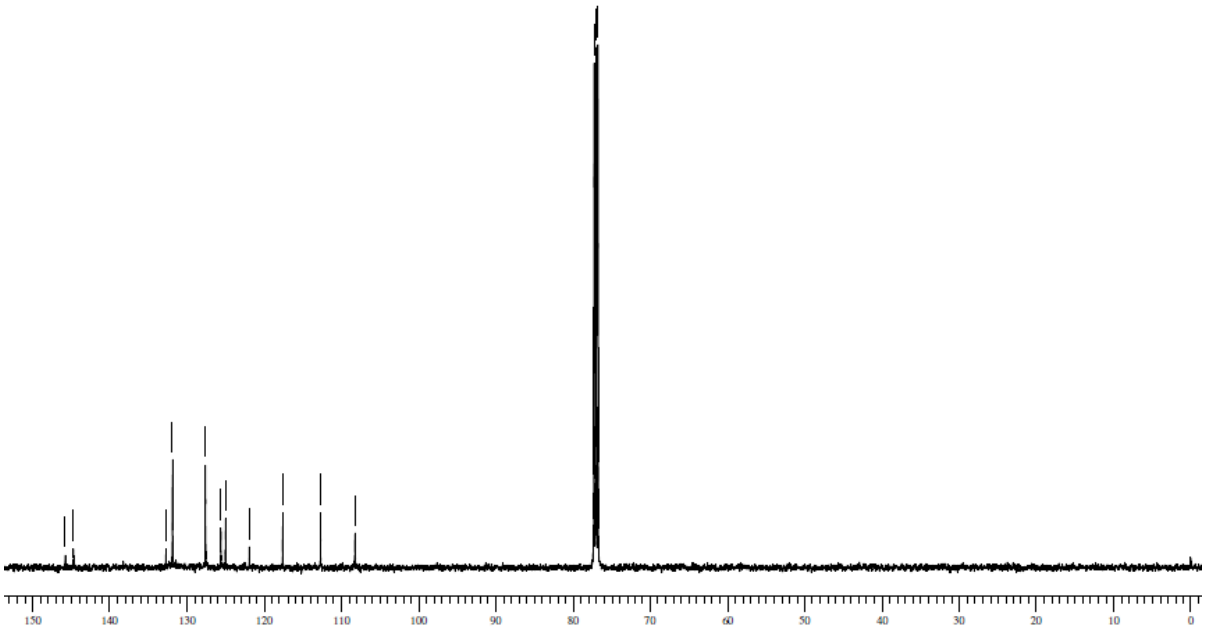
Compound 4d

^{13}C NMR (75 MHz, $CDCl_3$)

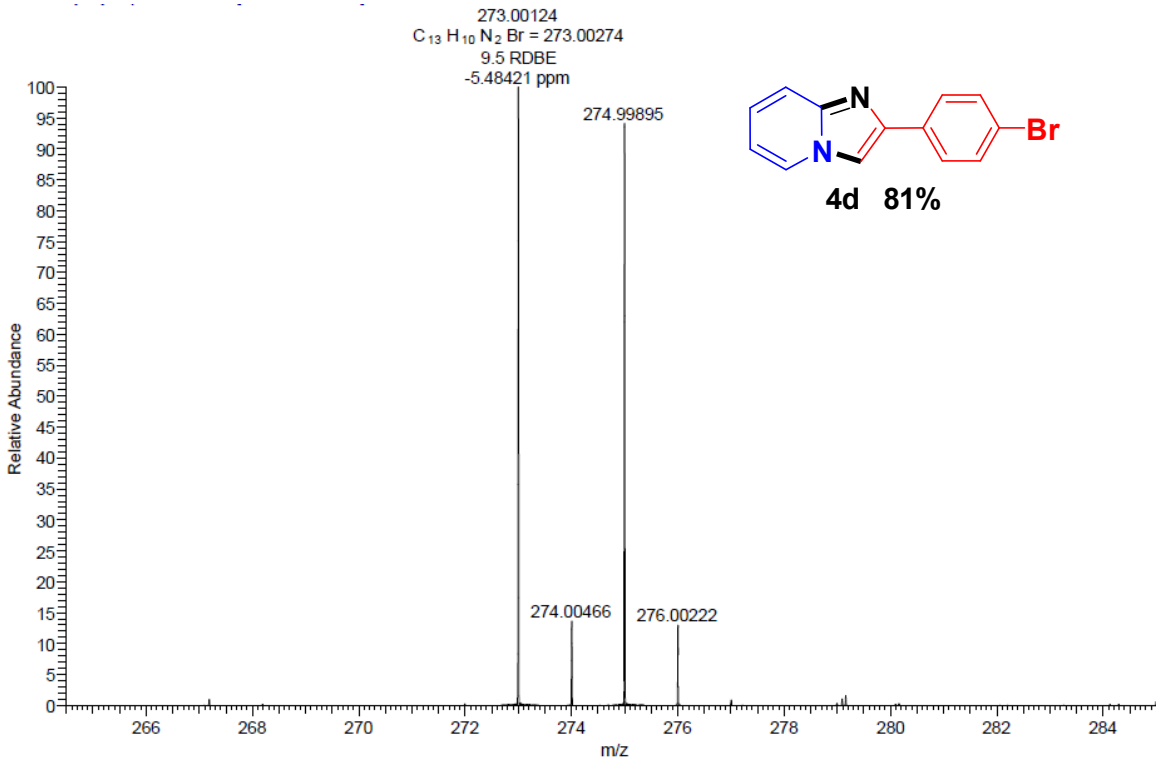




4d 81%

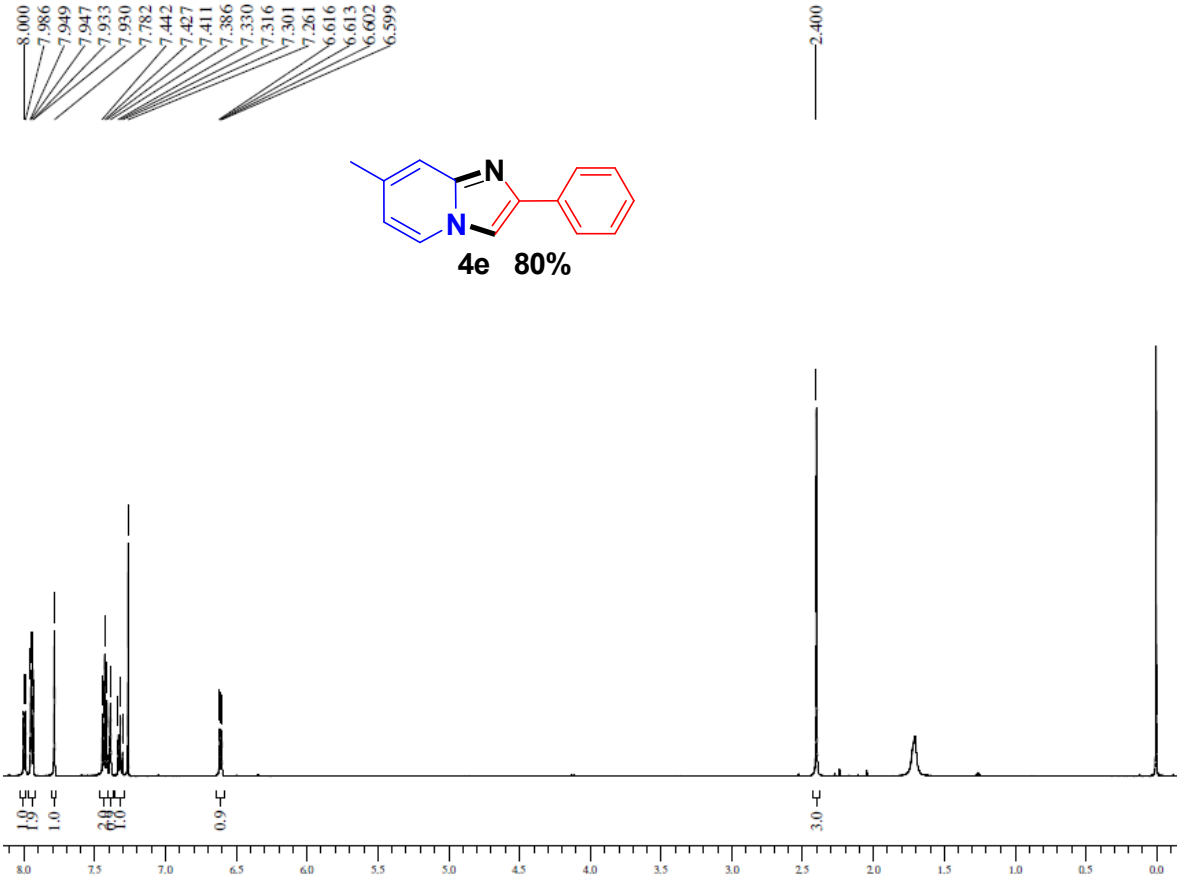


HRMS (ESI)

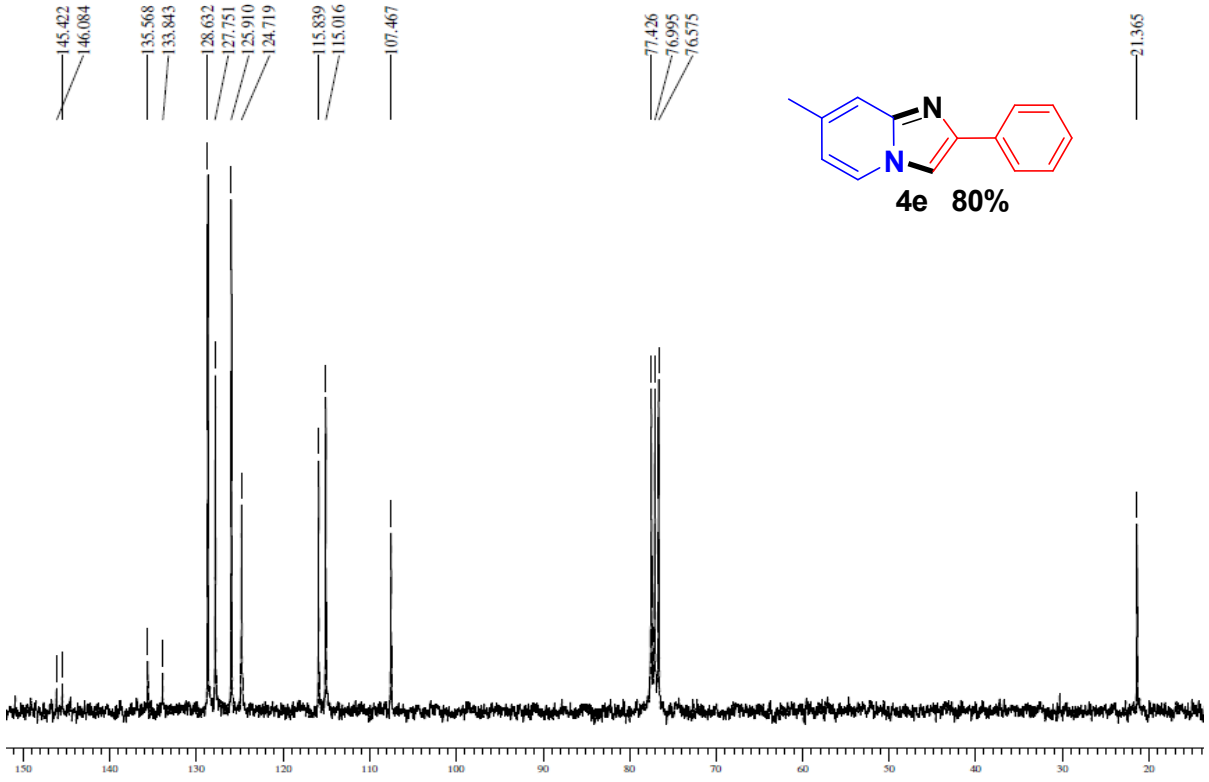


Compound 4e

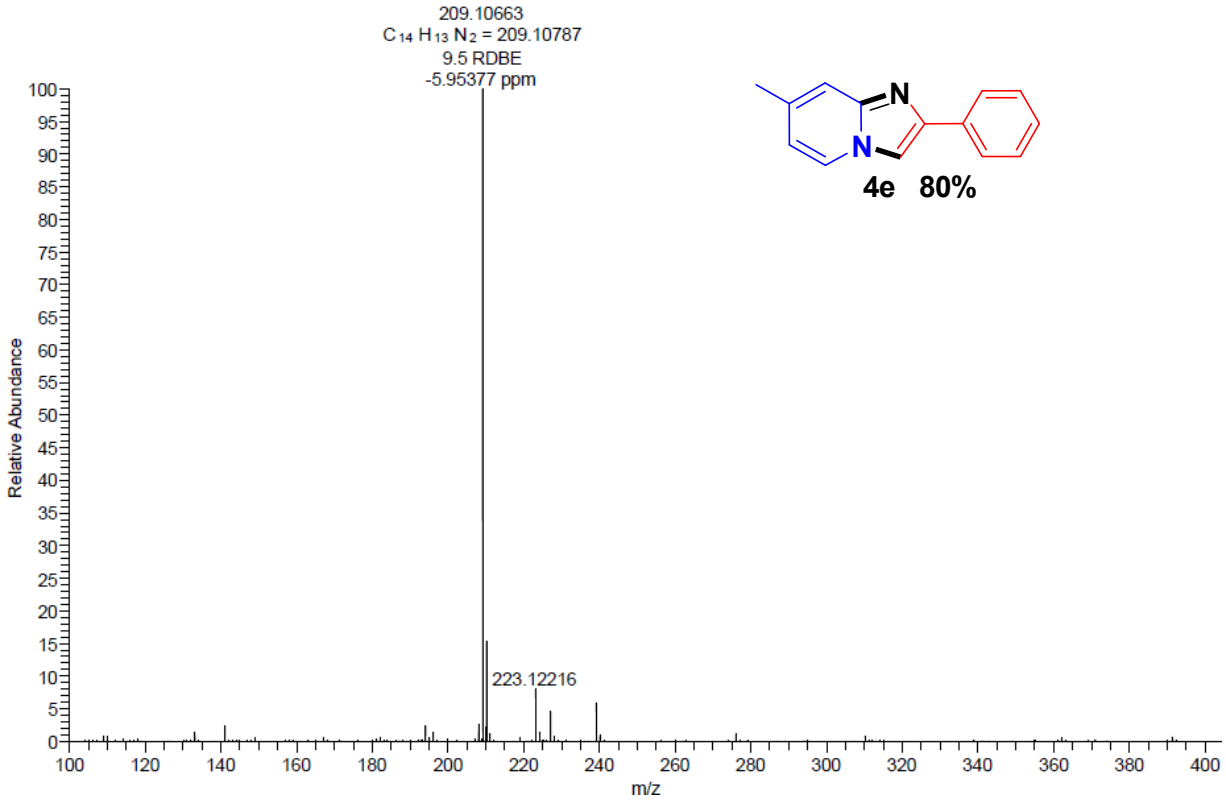
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

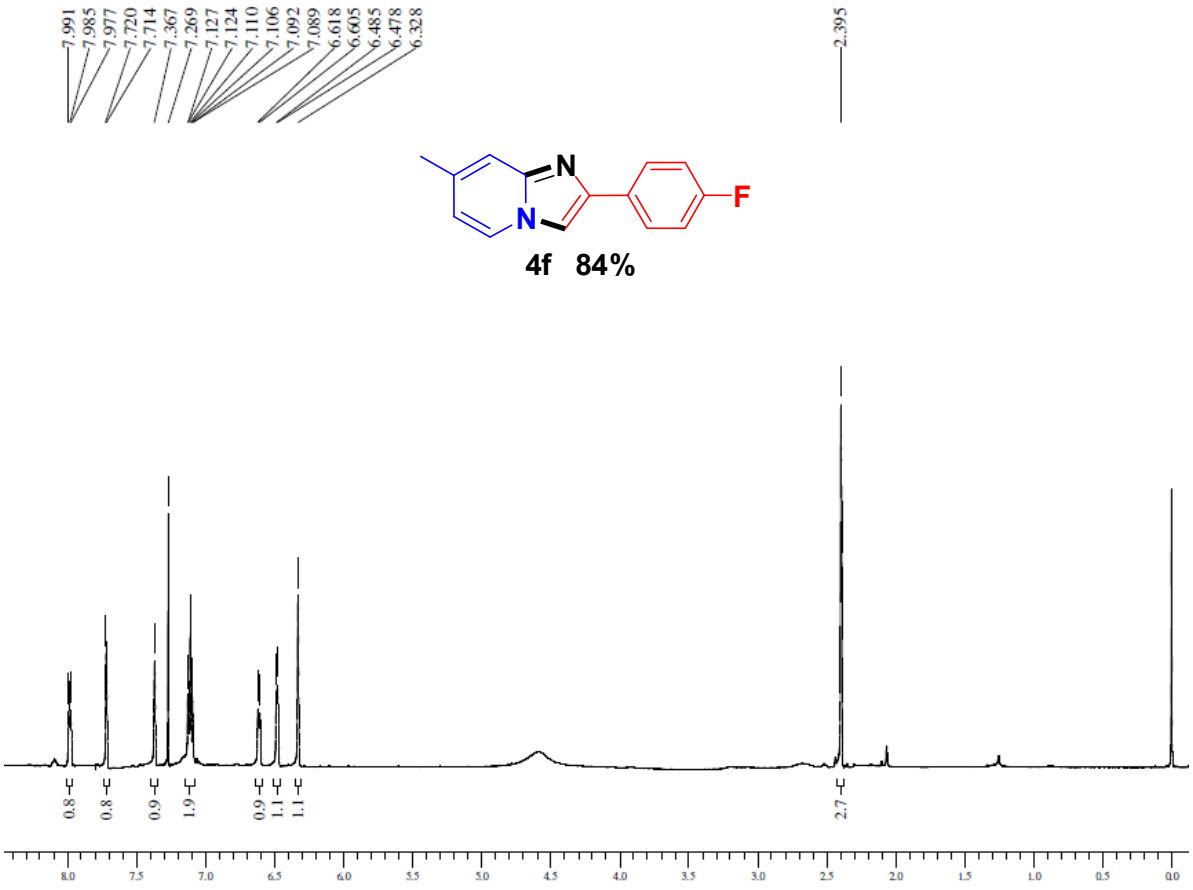


HRMS (ESI)

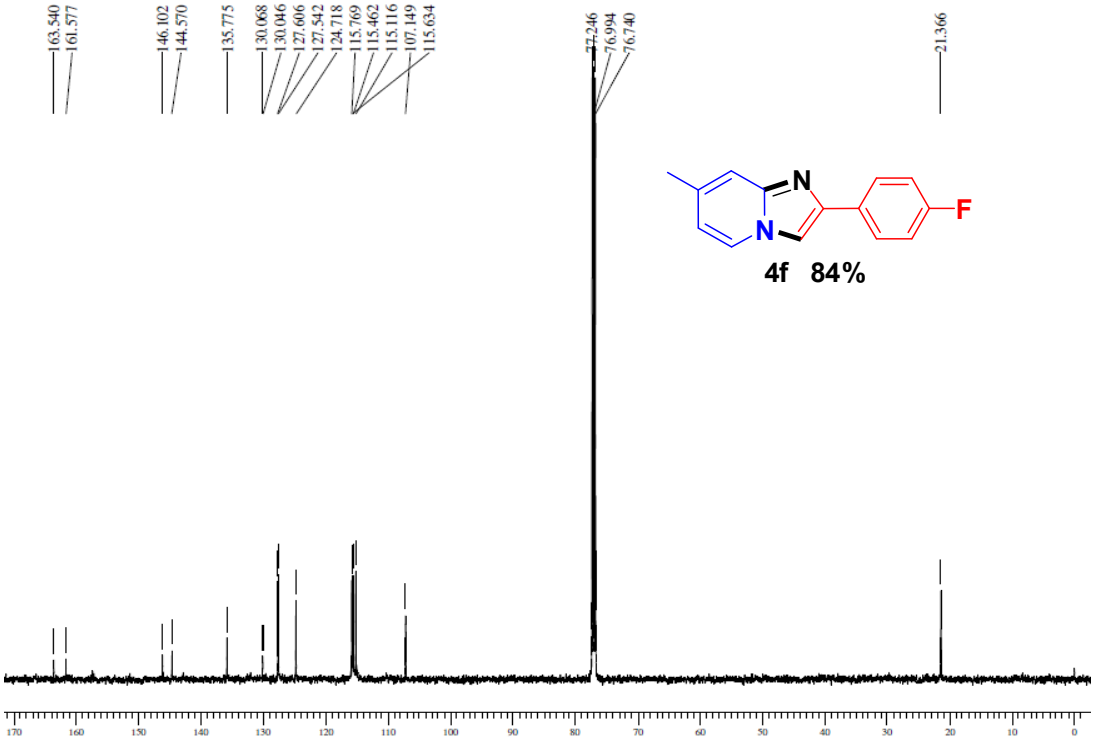


Compound 4f

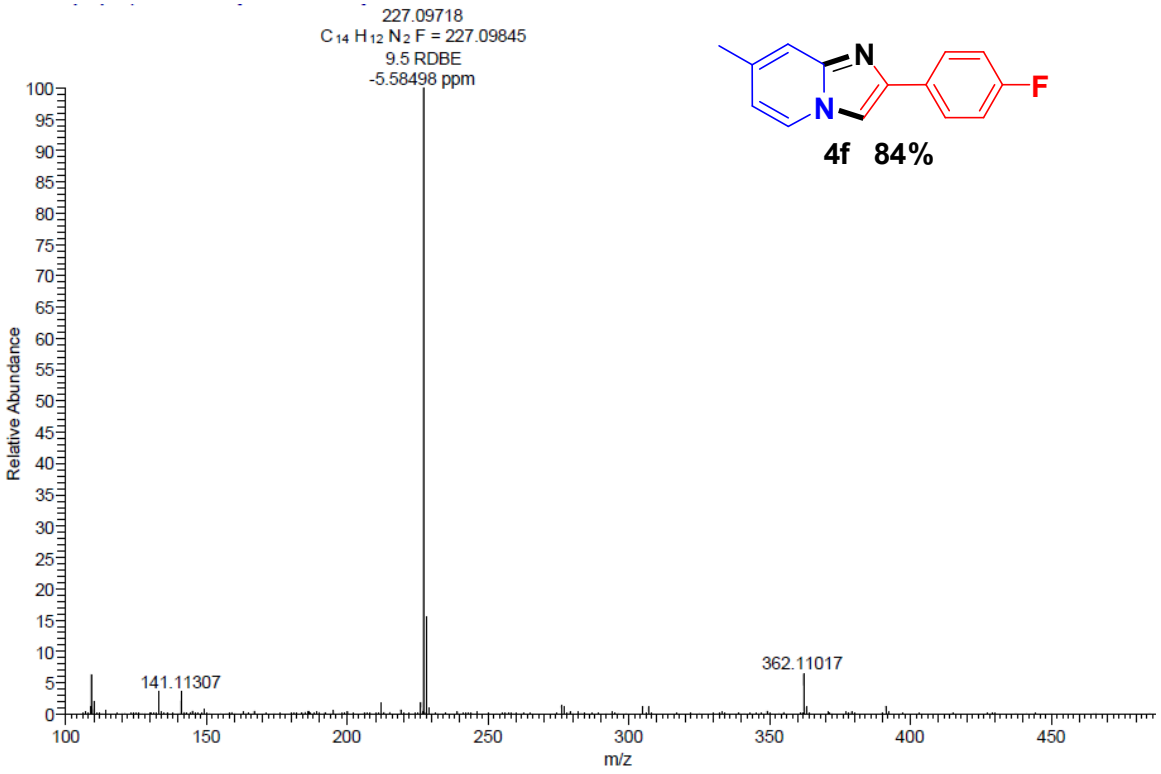
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

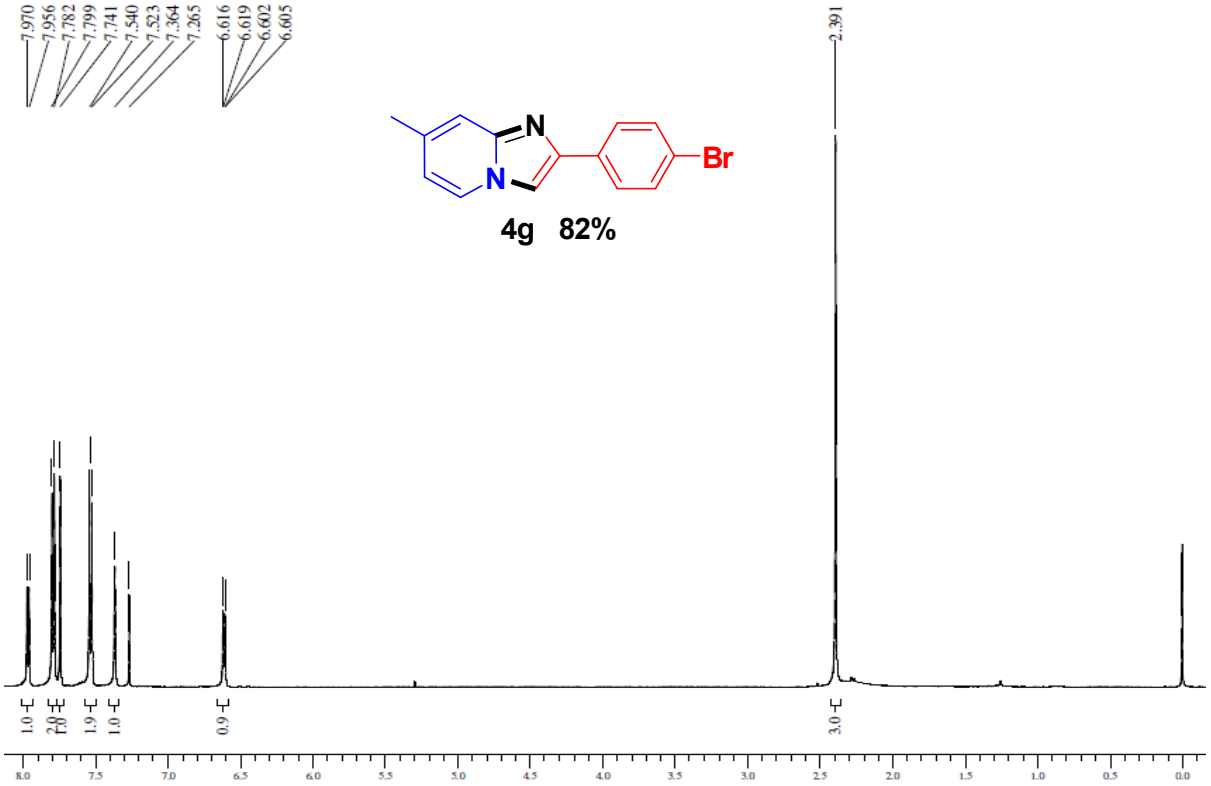


HRMS (ESI)

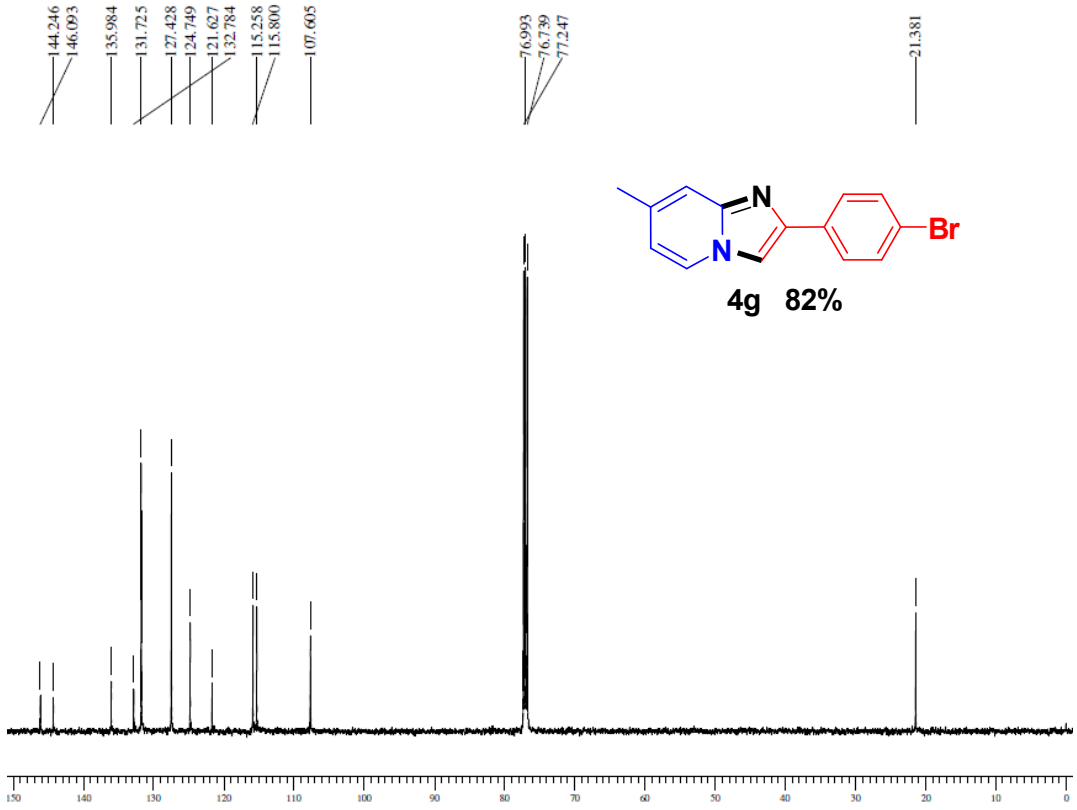


Compound 4g

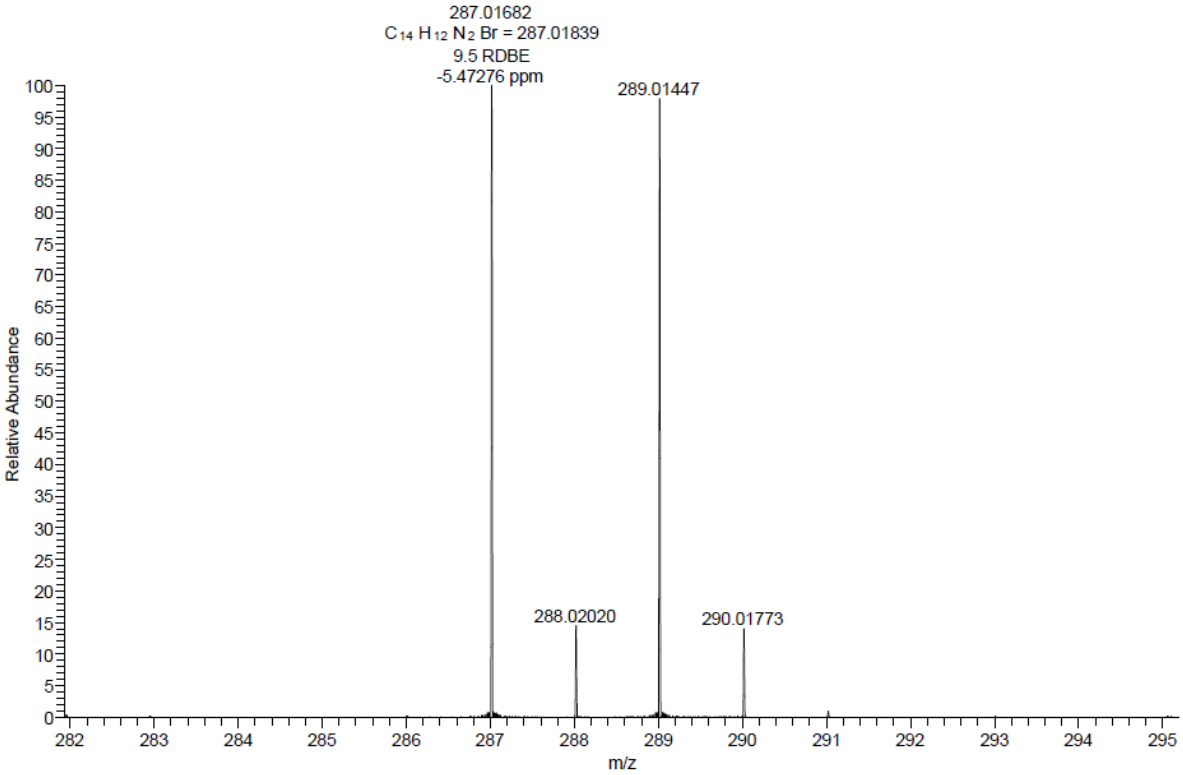
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

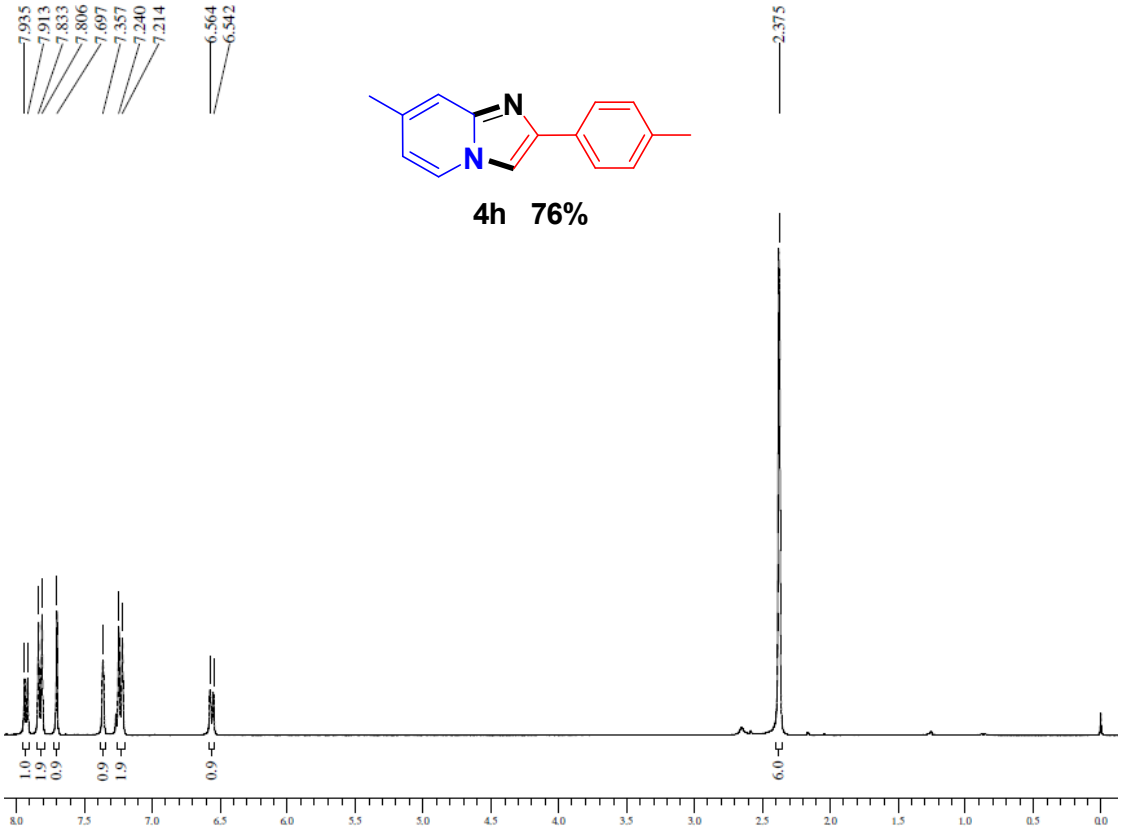


HRMS (ESI)

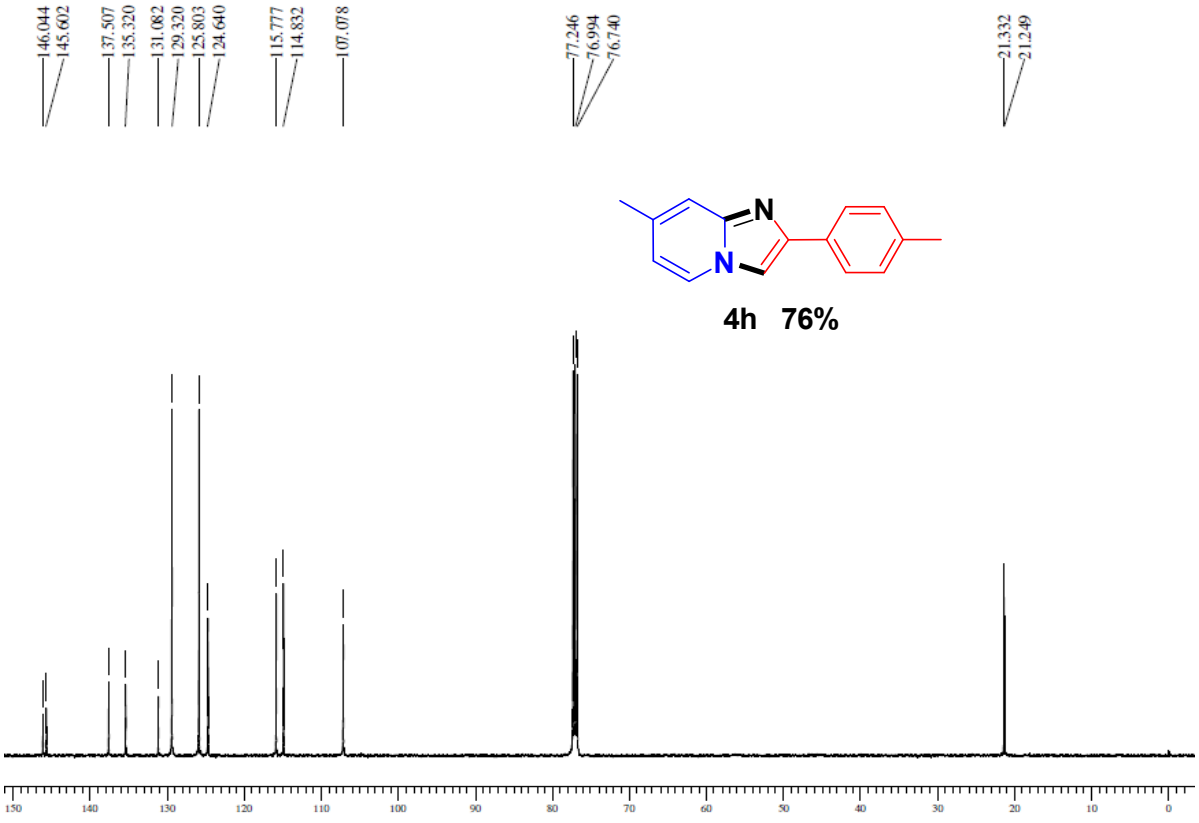


Compound 4h

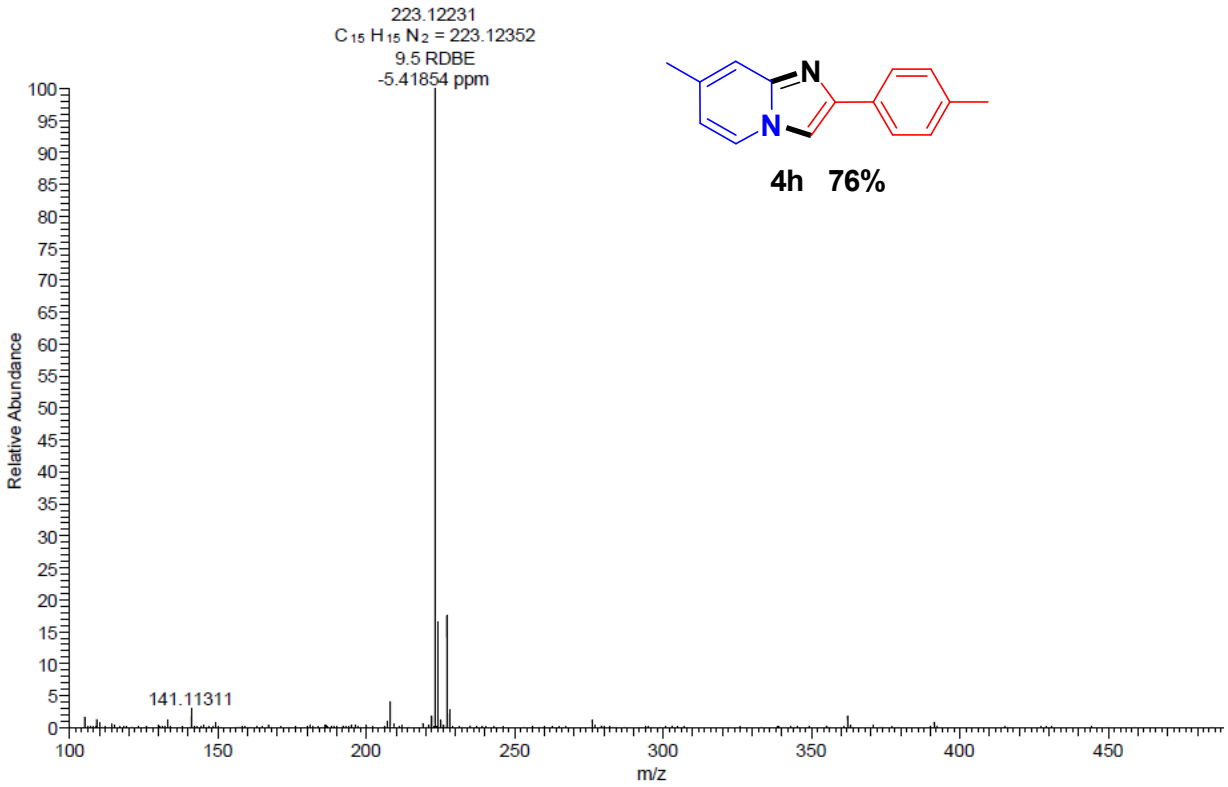
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



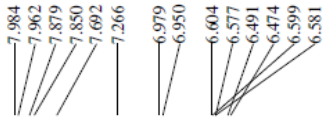
HRMS (ESI)

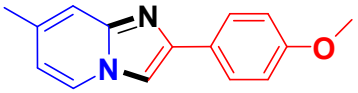


4h 76%

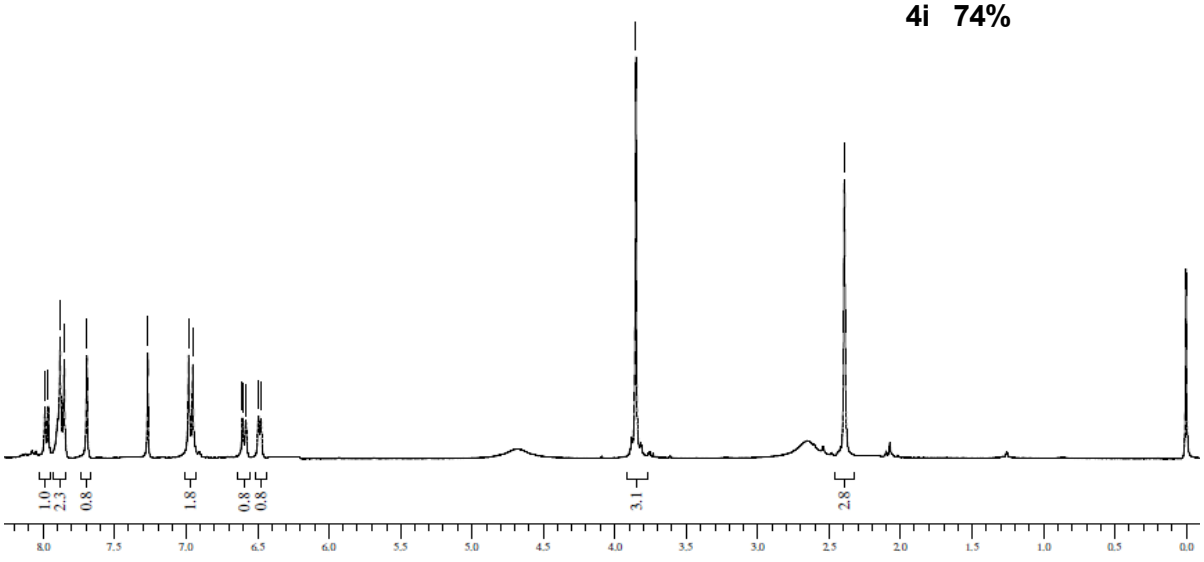
Compound 4i

^{1}H NMR (300 MHz, $CDCl_3$)

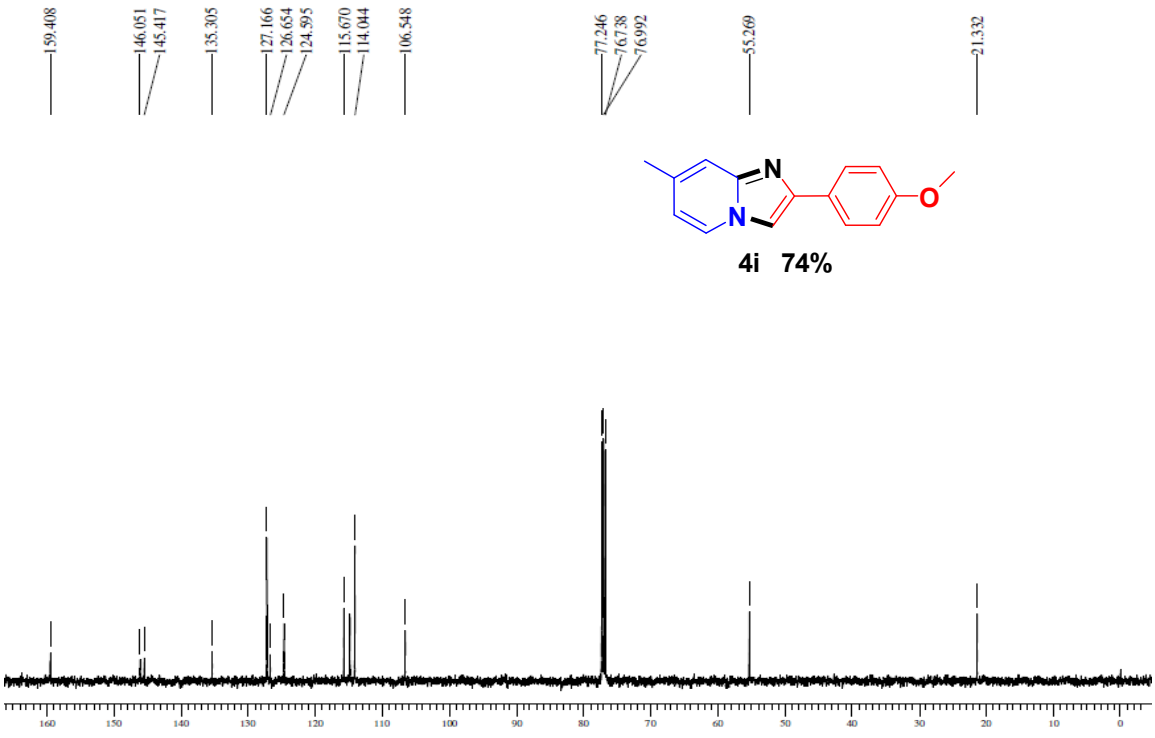




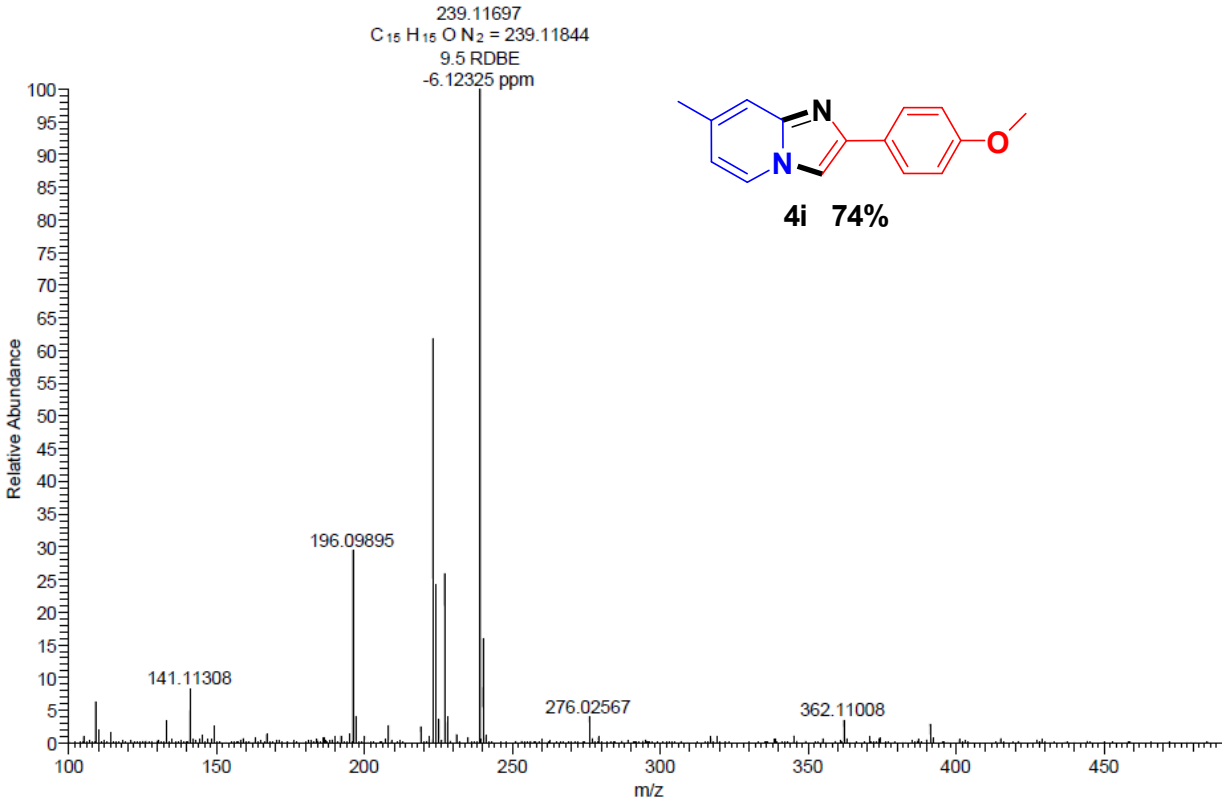
4i 74%



^{13}C NMR (75 MHz, $CDCl_3$)

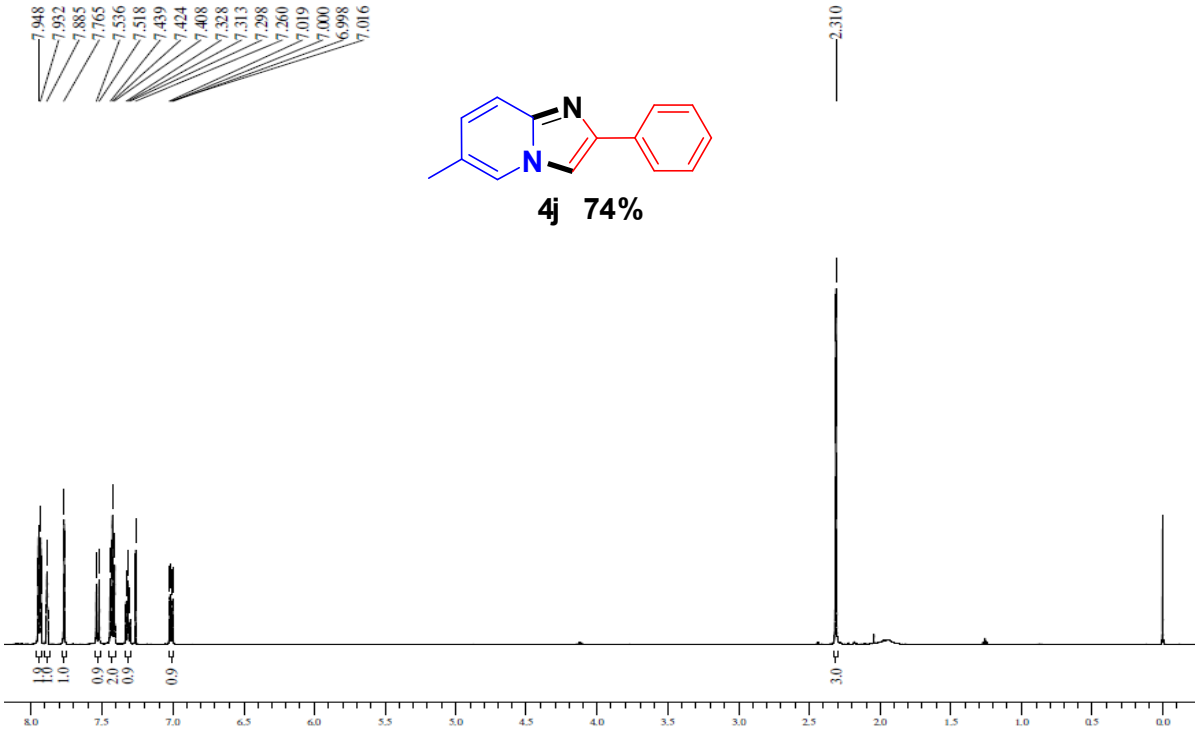


HRMS (ESI)

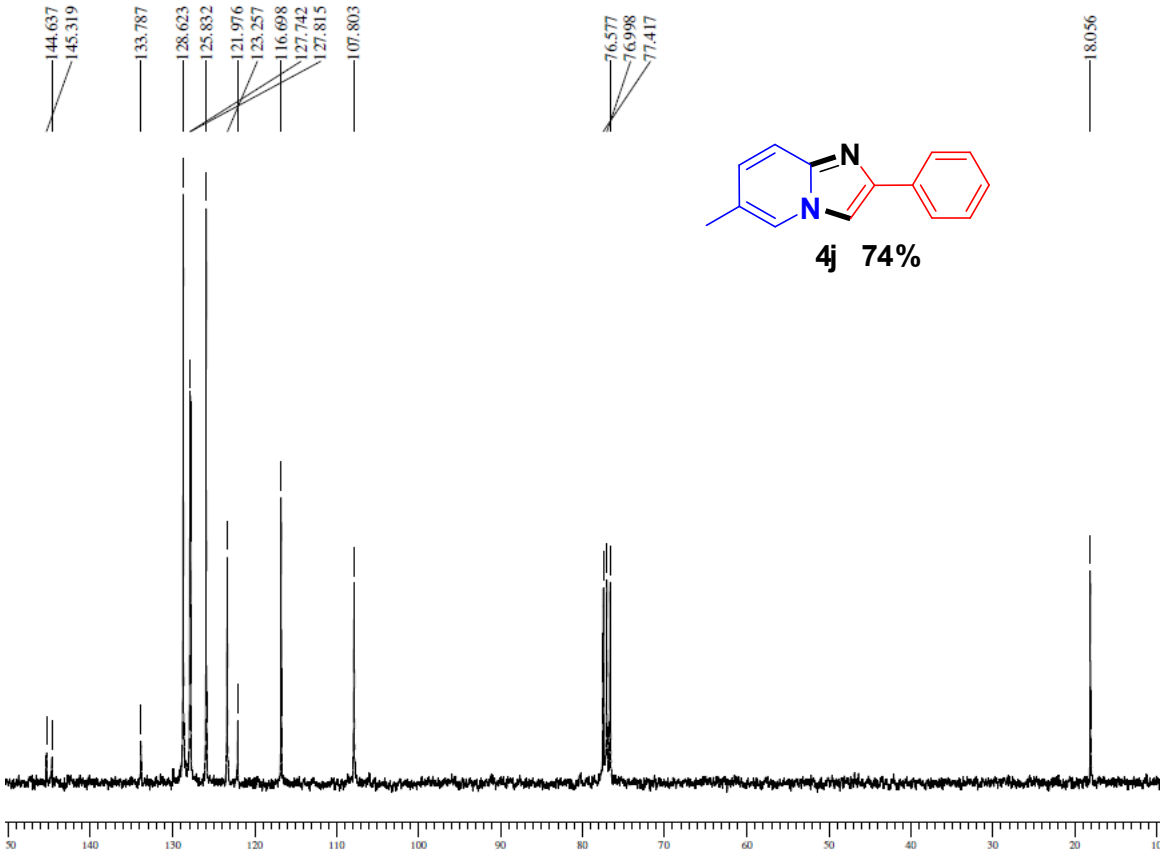


Compound 4j

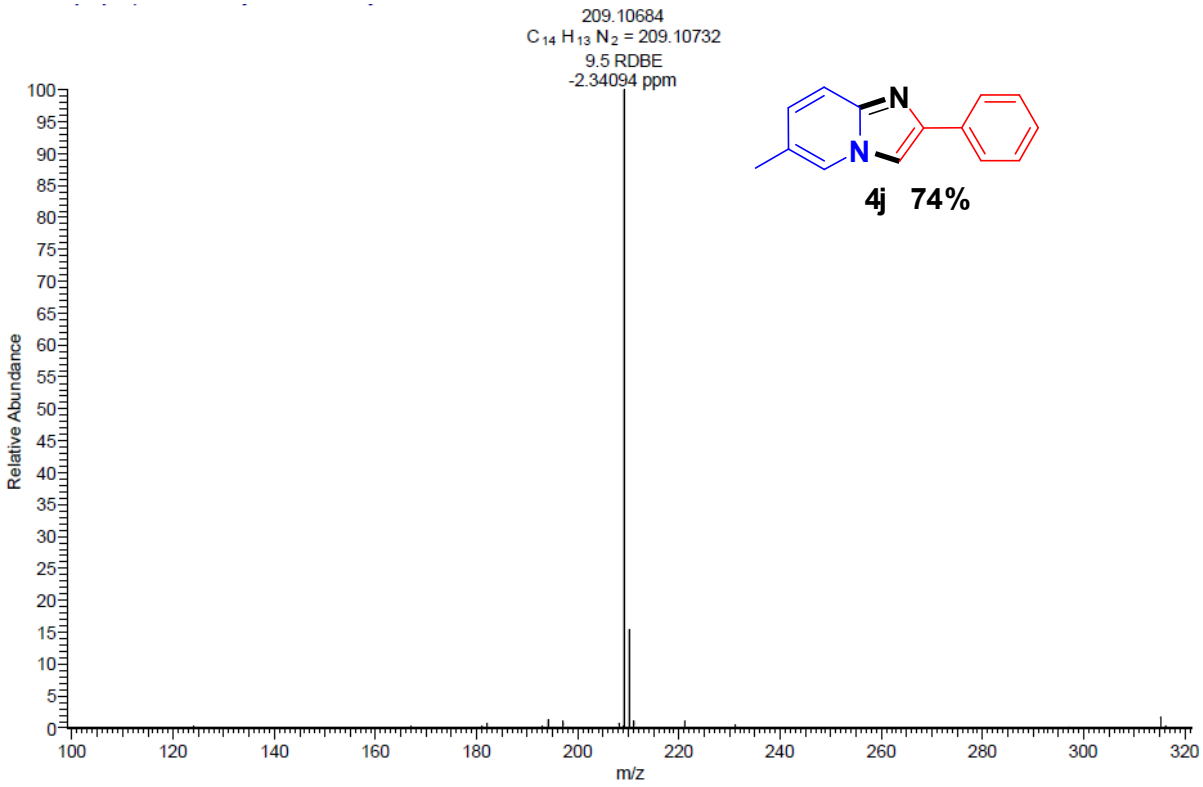
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

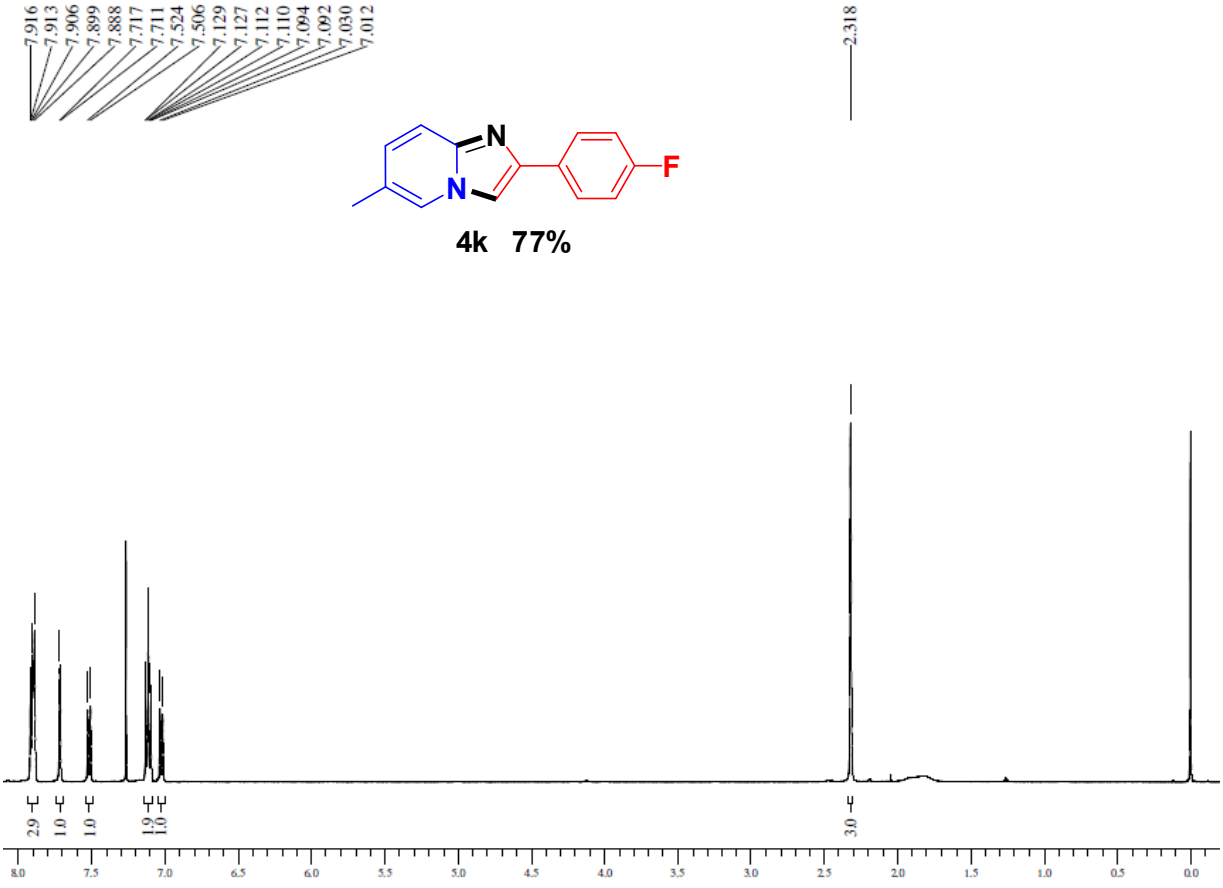


HRMS (ESI)

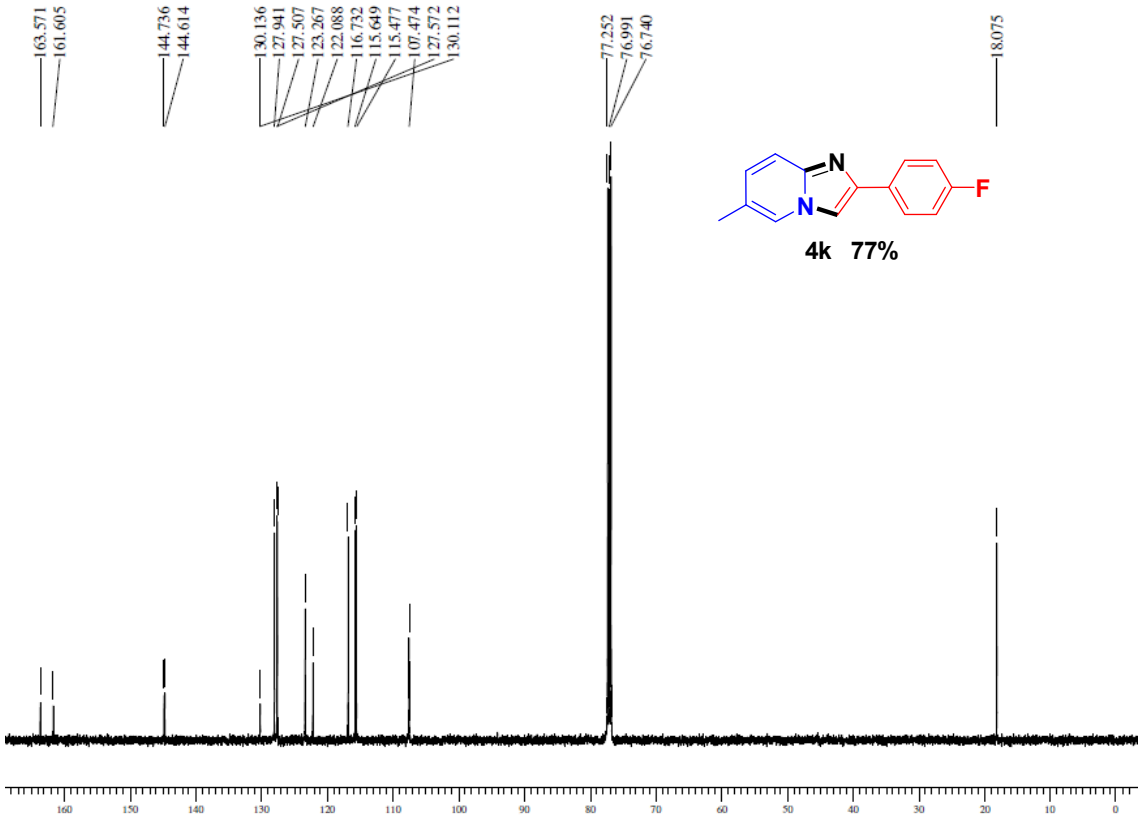


Compound 4k

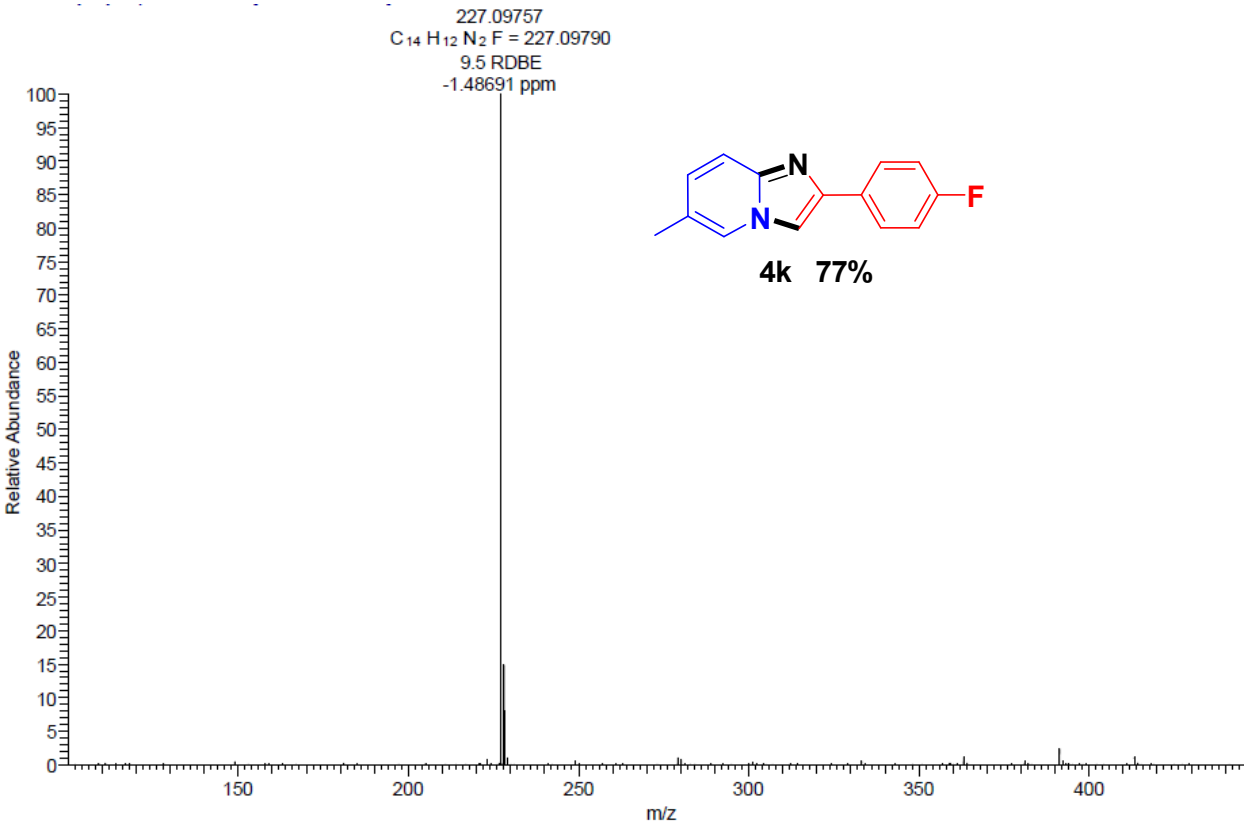
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

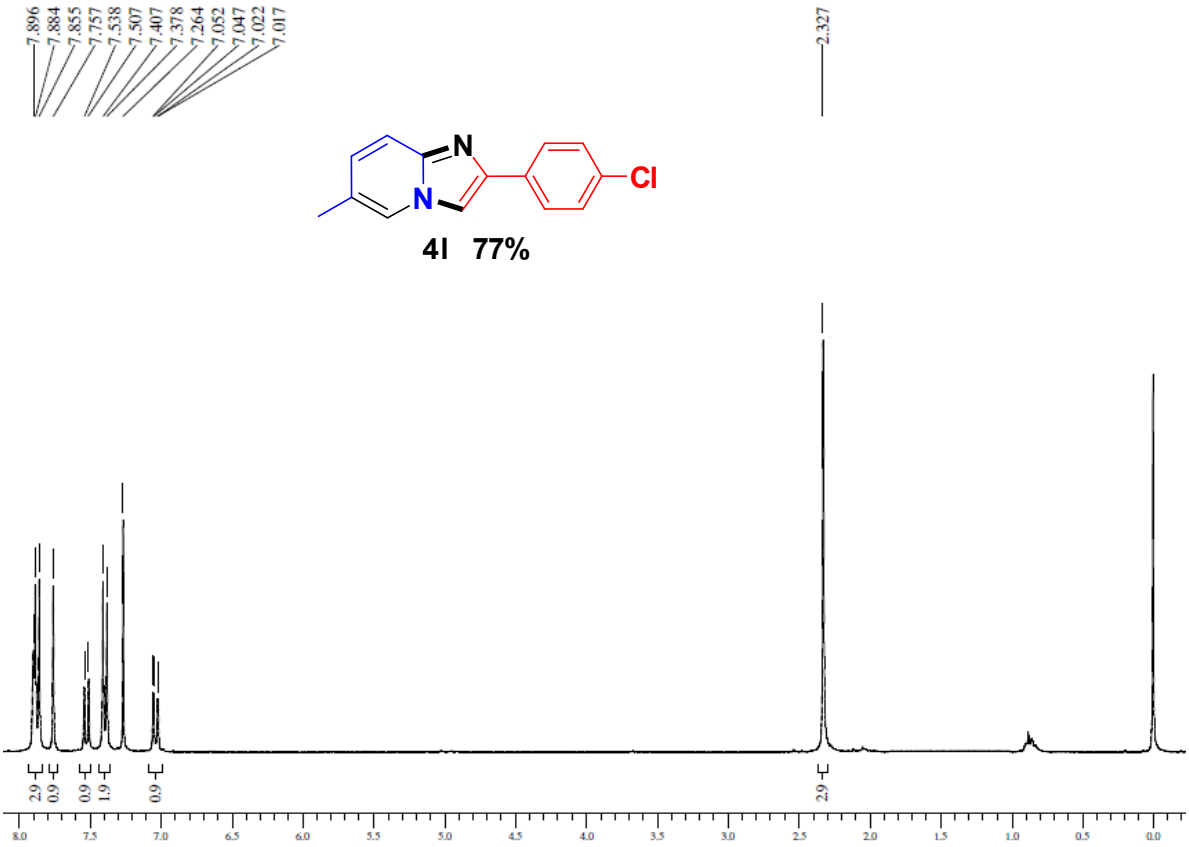


HRMS (ESI)

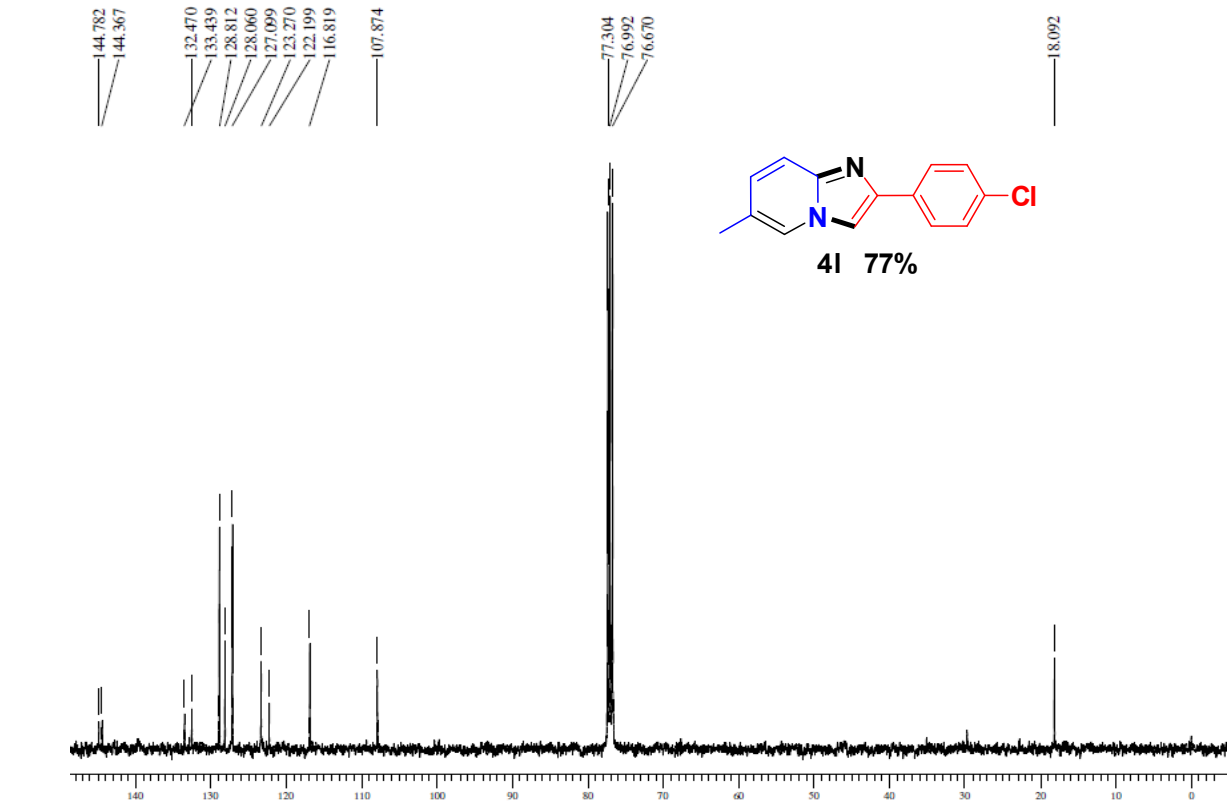


Compound 4l

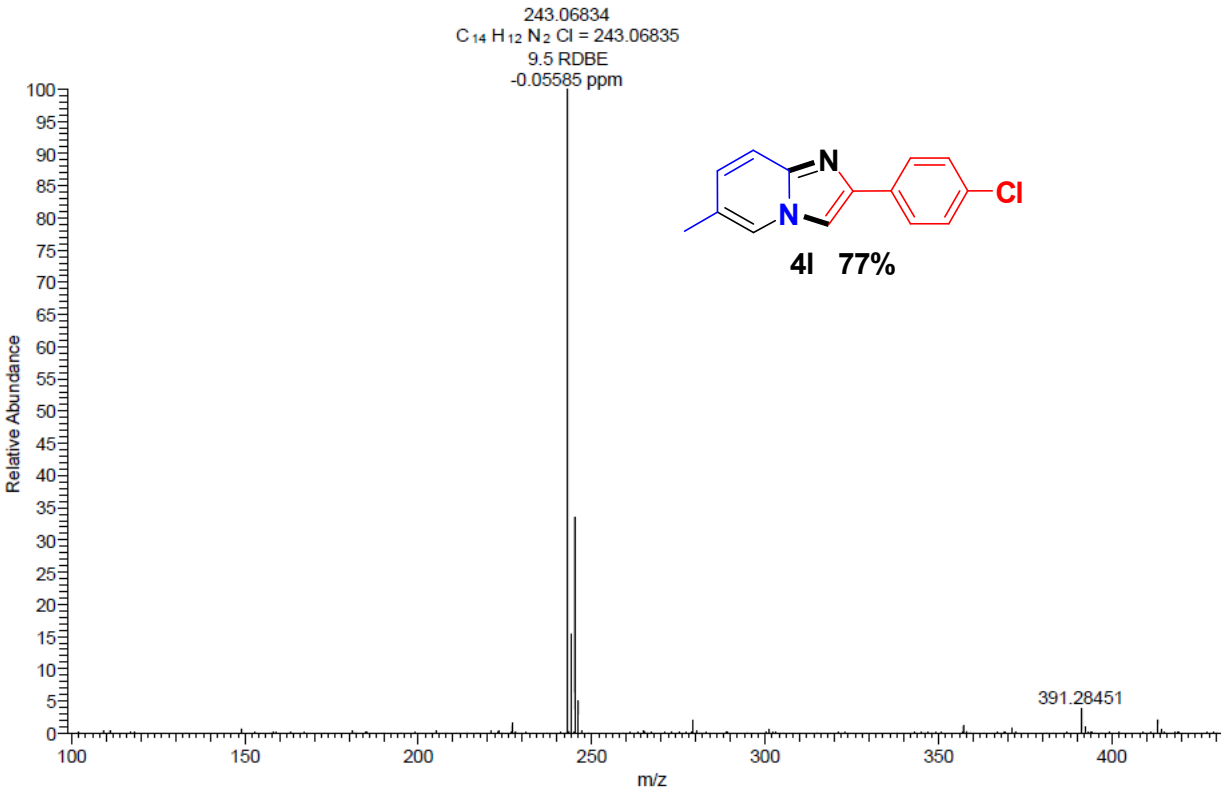
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



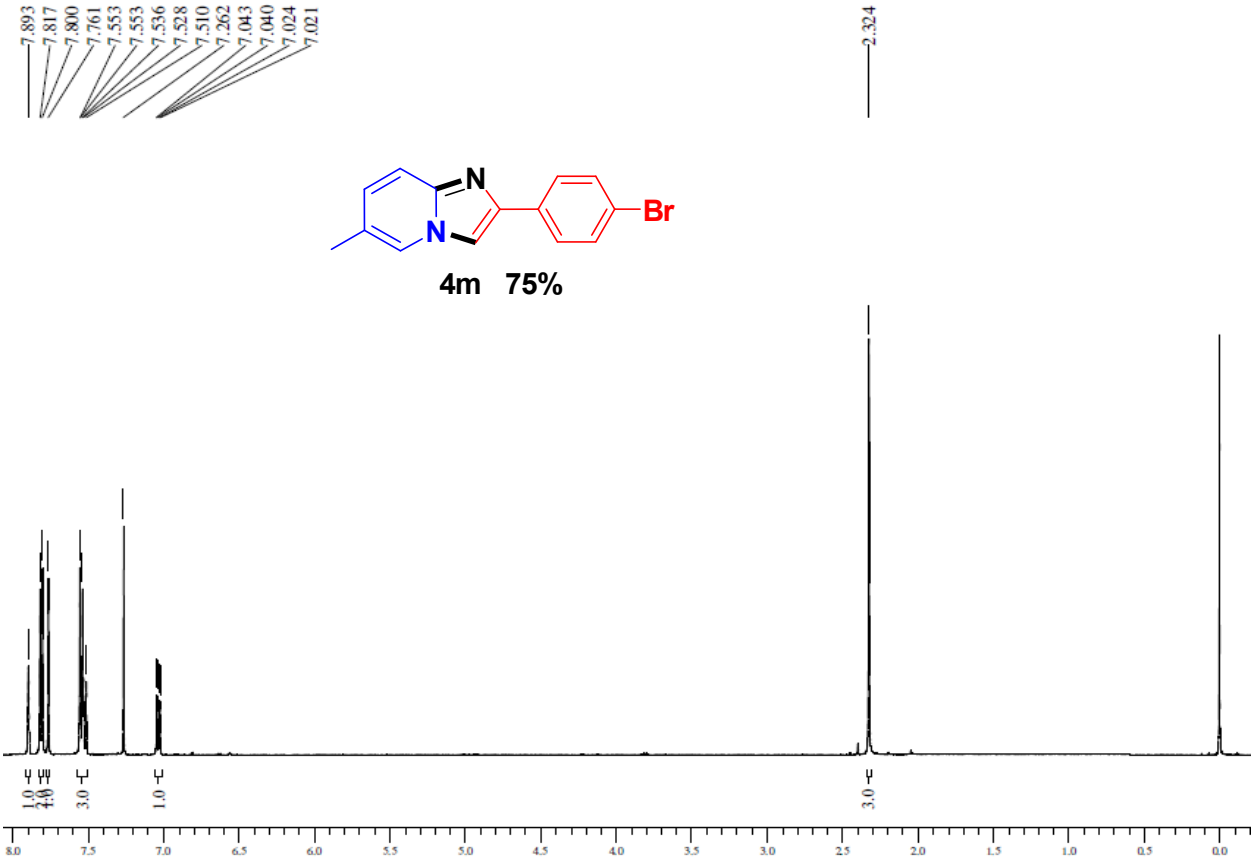
HRMS (ESI)



4l 77%

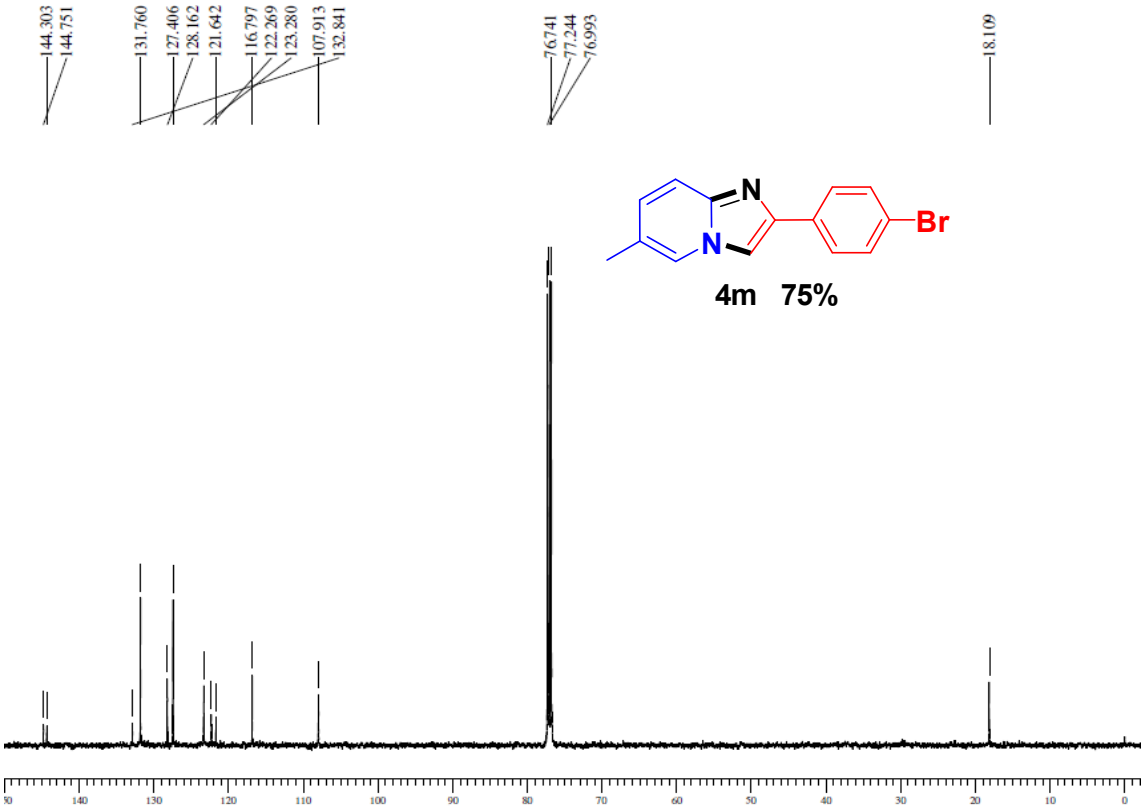
Compound 4m

^{1}H NMR (300 MHz, $CDCl_3$)

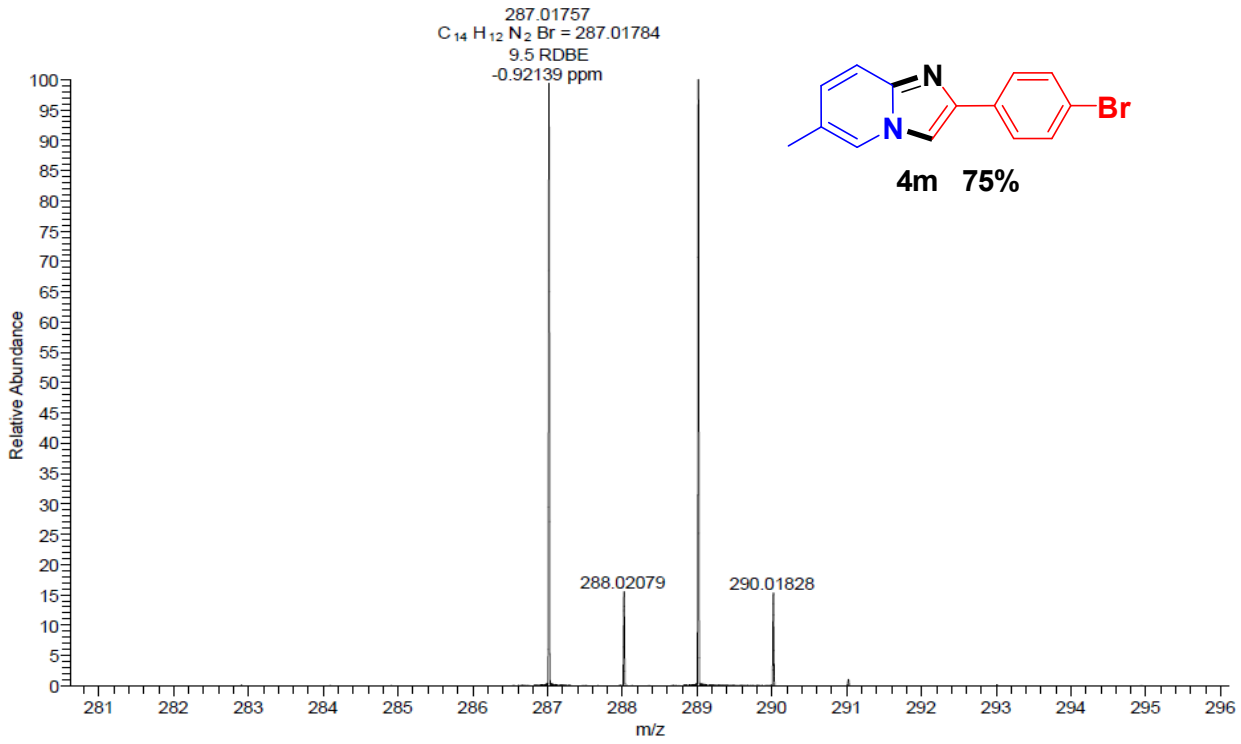


4m 75%

^{13}C NMR (75 MHz, $CDCl_3$)

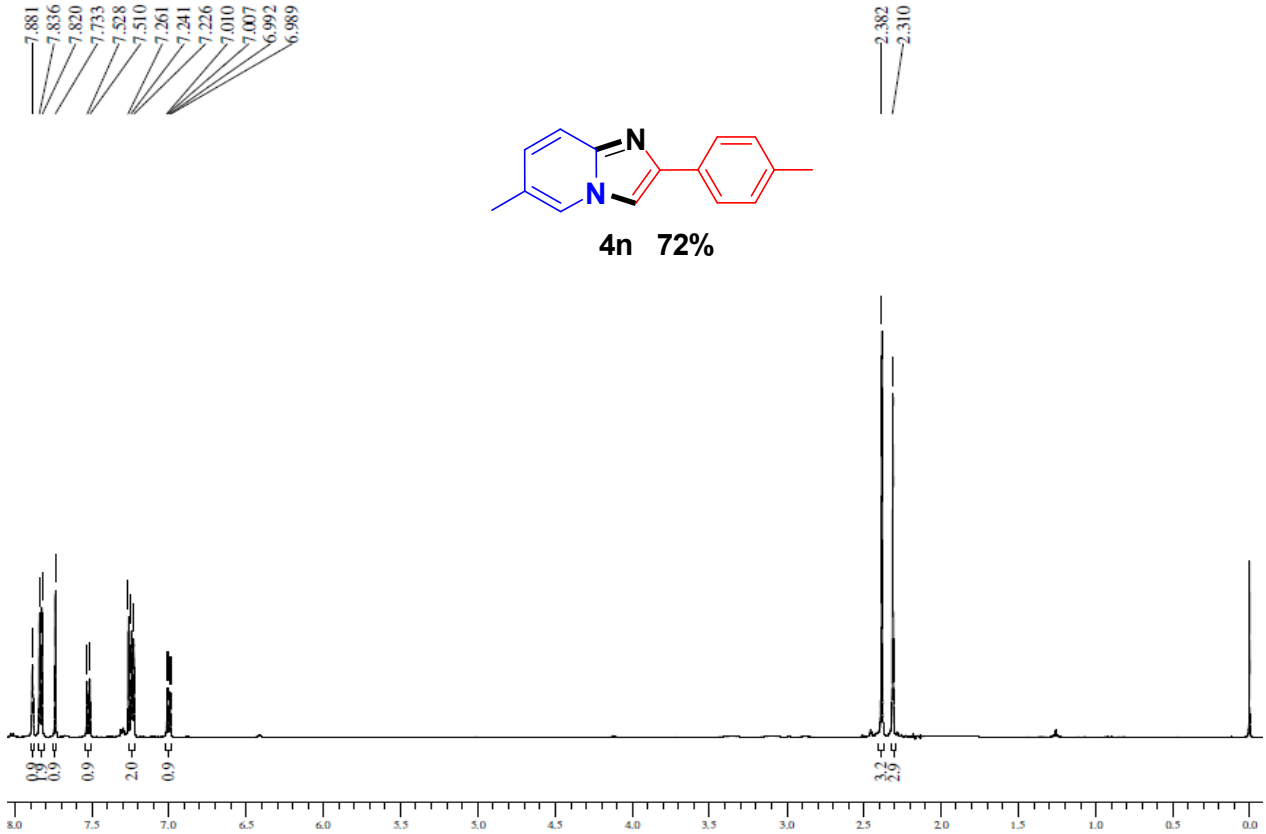


HRMS (ESI)

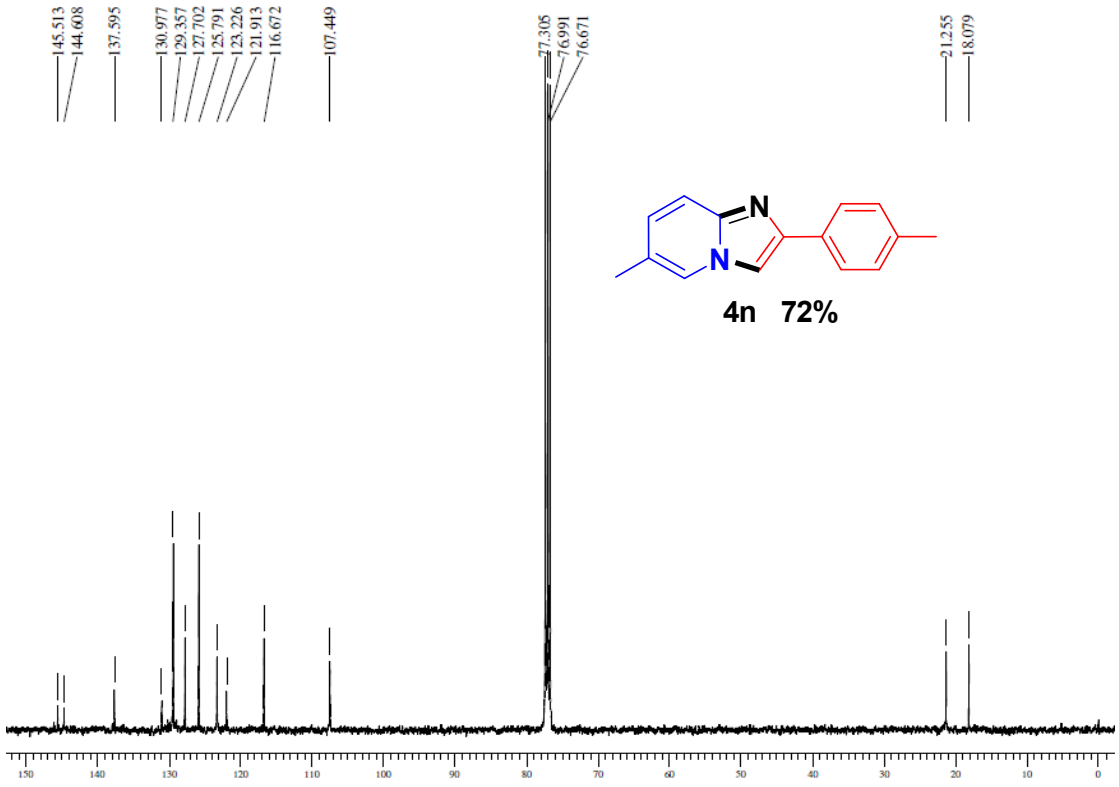


Compound 4n

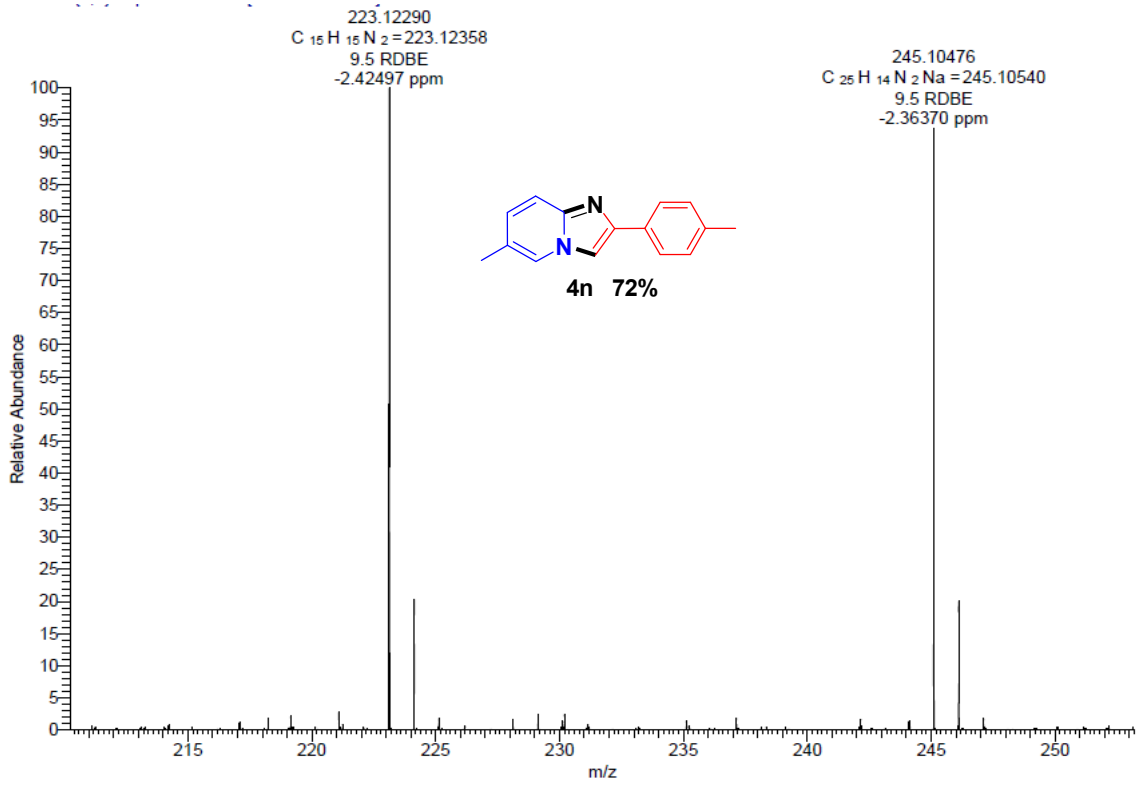
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

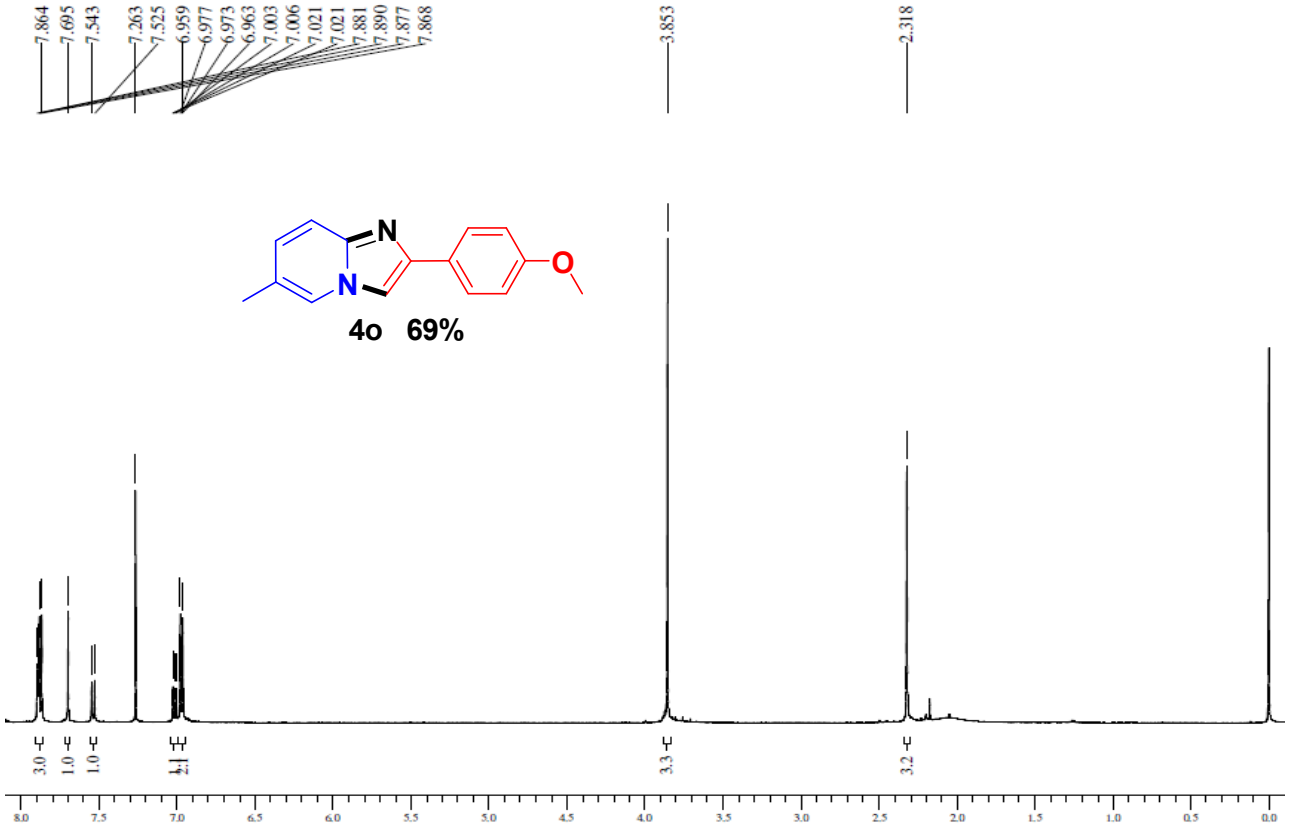


HRMS (ESI)

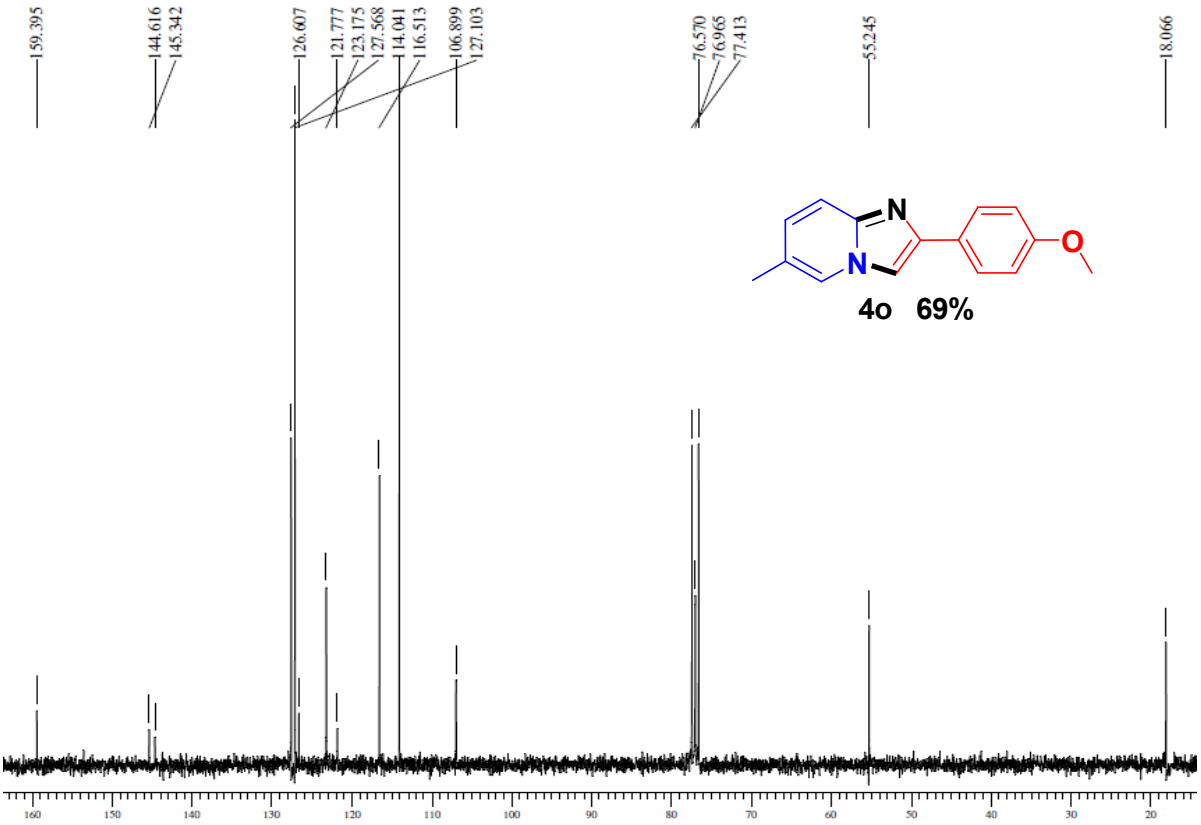


Compound 4o

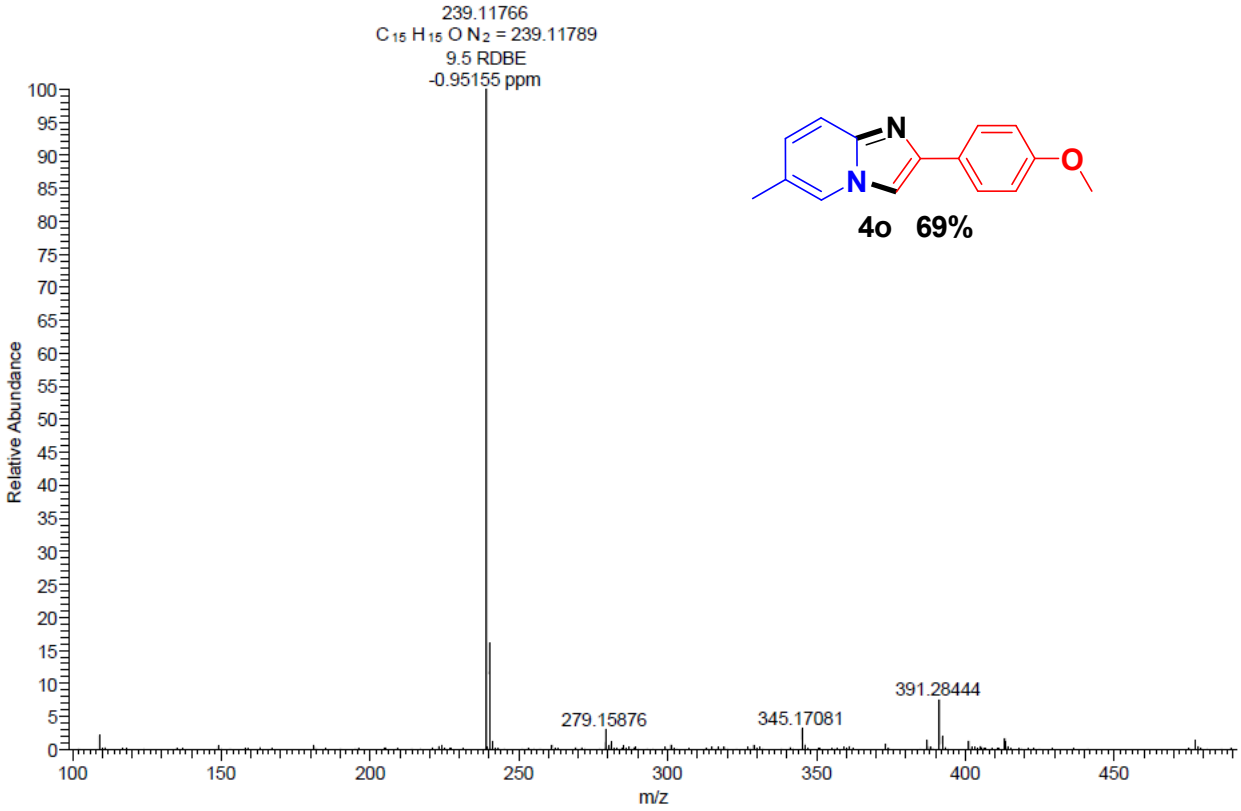
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

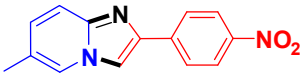


HRMS (ESI)

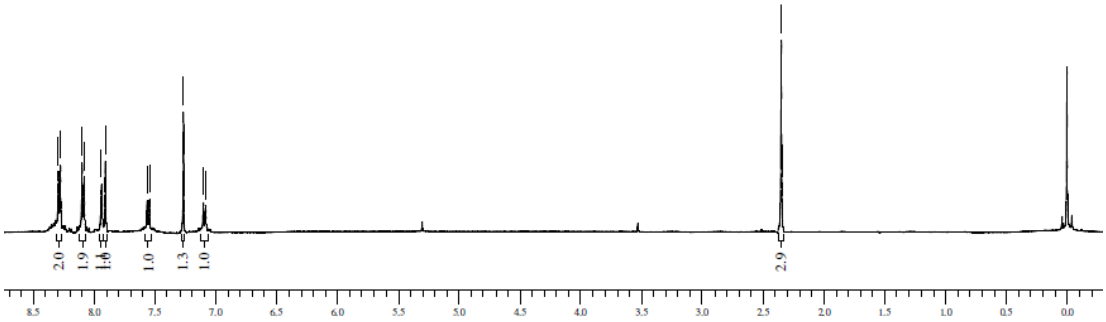


Compound 4p

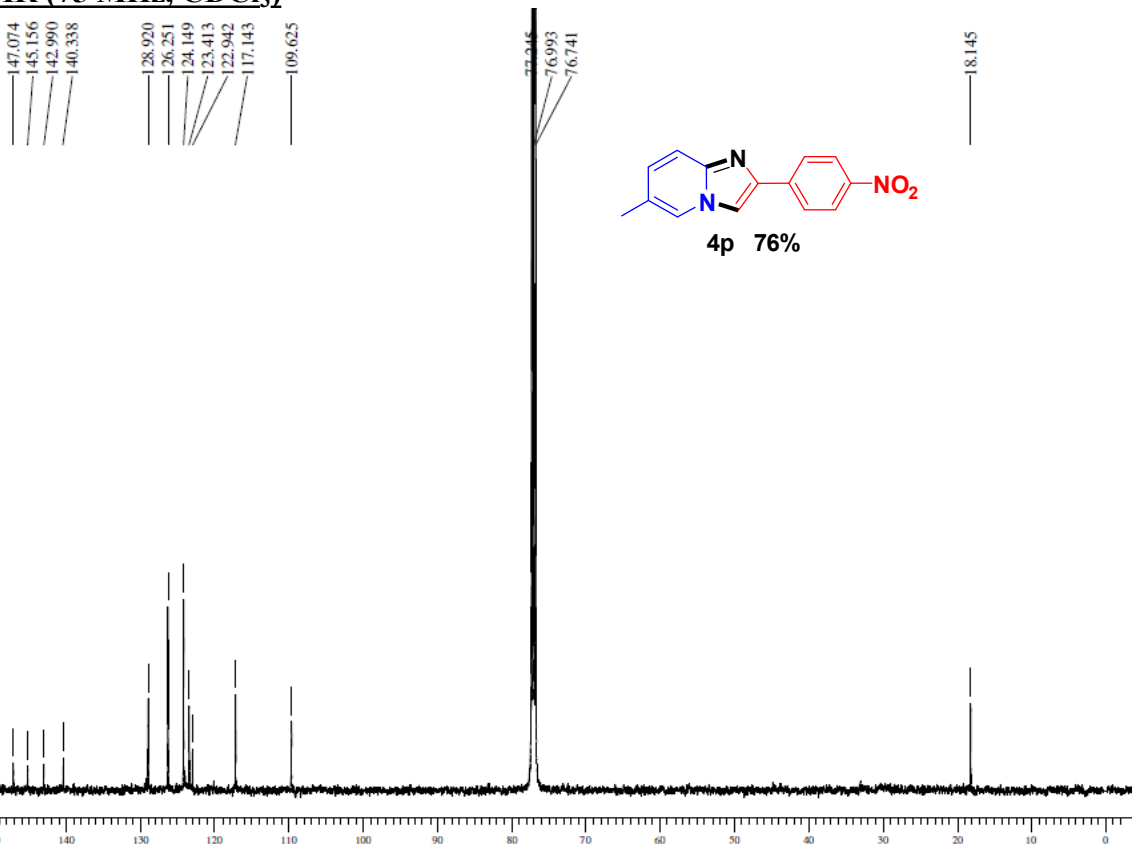
^{1}H NMR (300 MHz, $CDCl_3$)



4p 76%

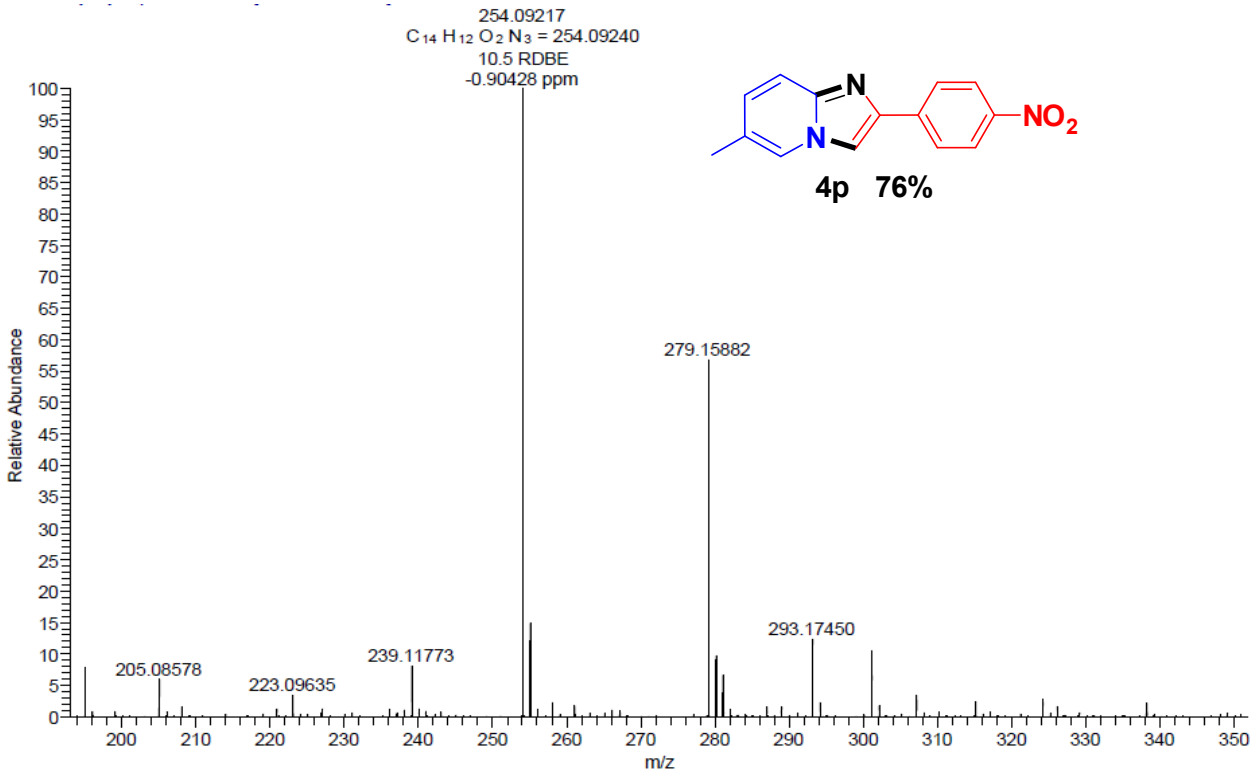


^{13}C NMR (75 MHz, $CDCl_3$)



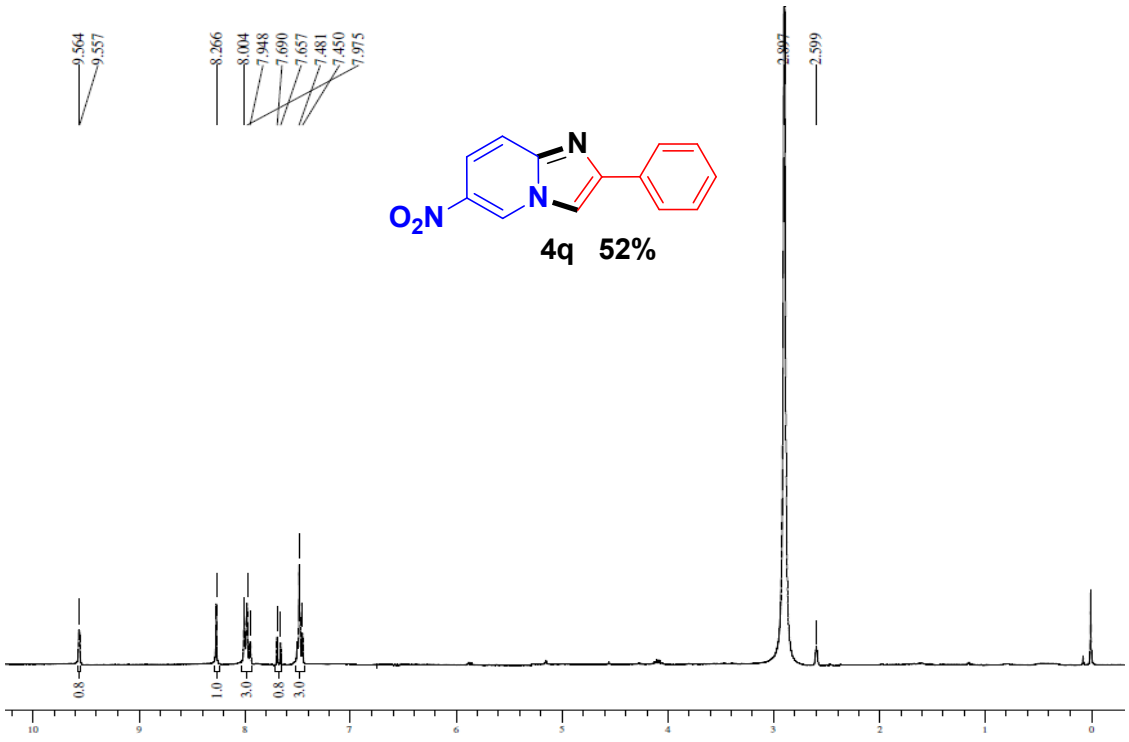
4p 76%

HRMS (ESI)

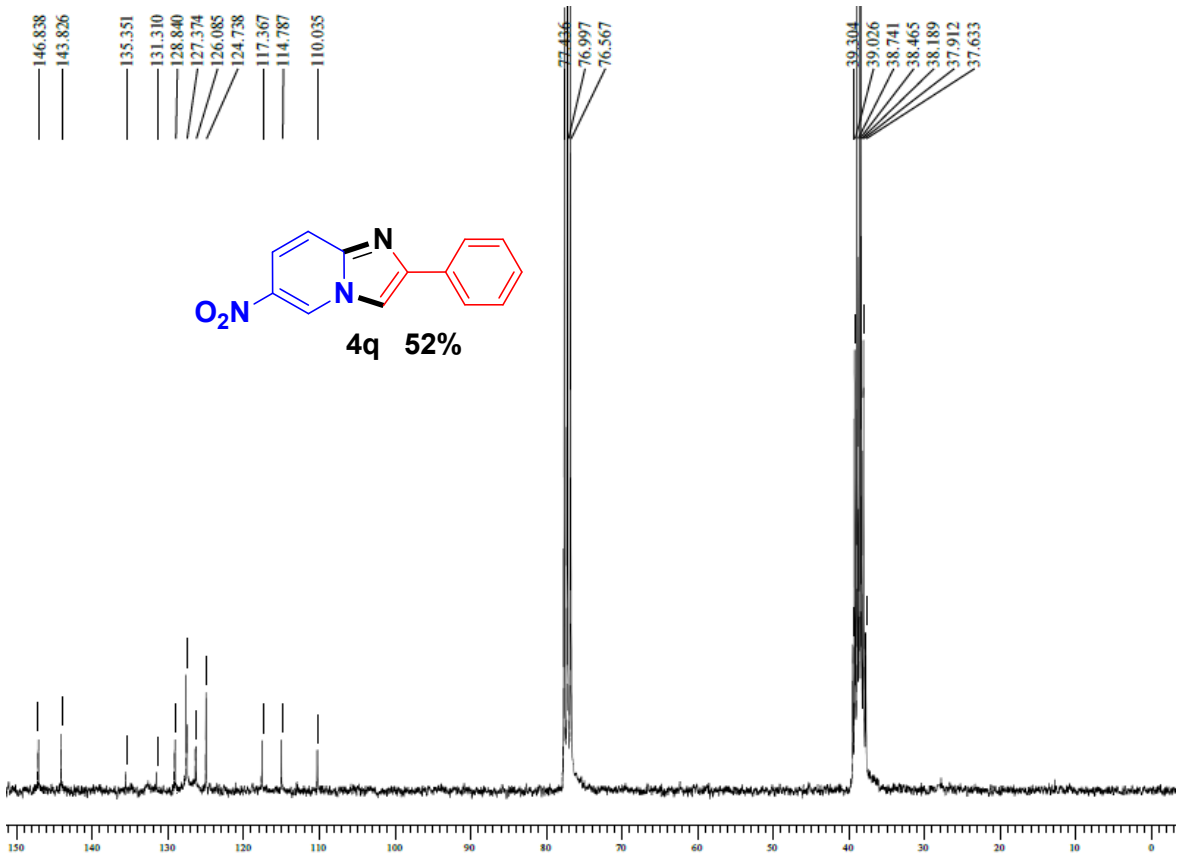


Compound 4q

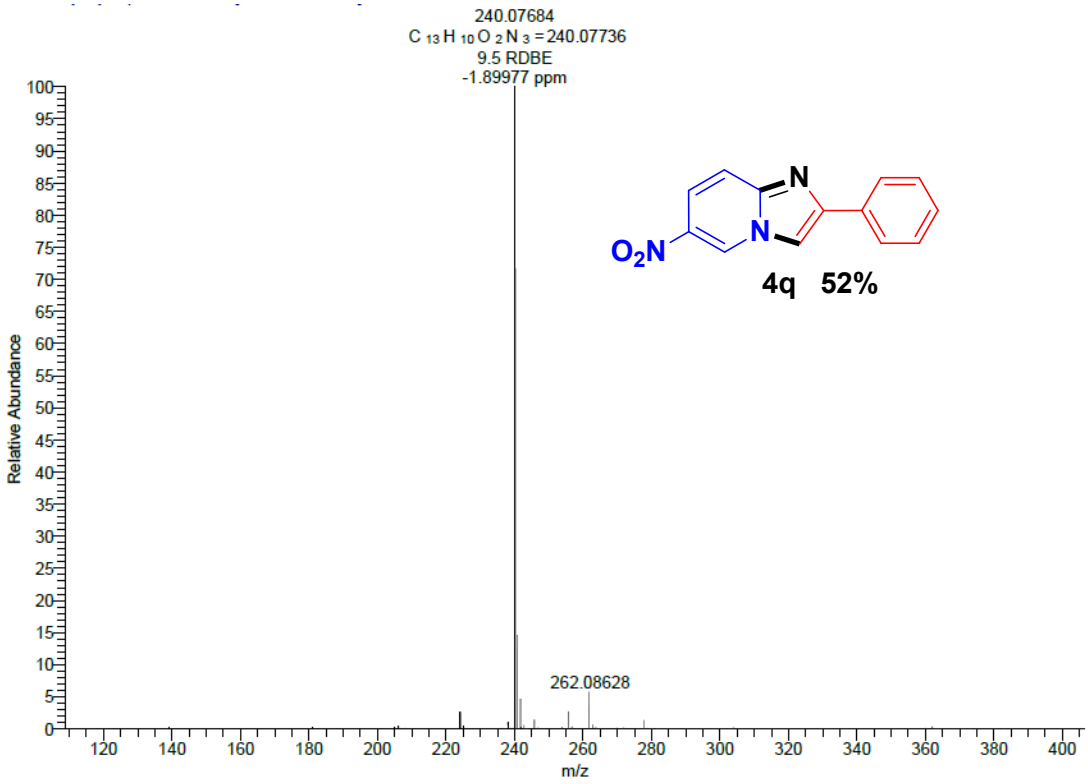
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

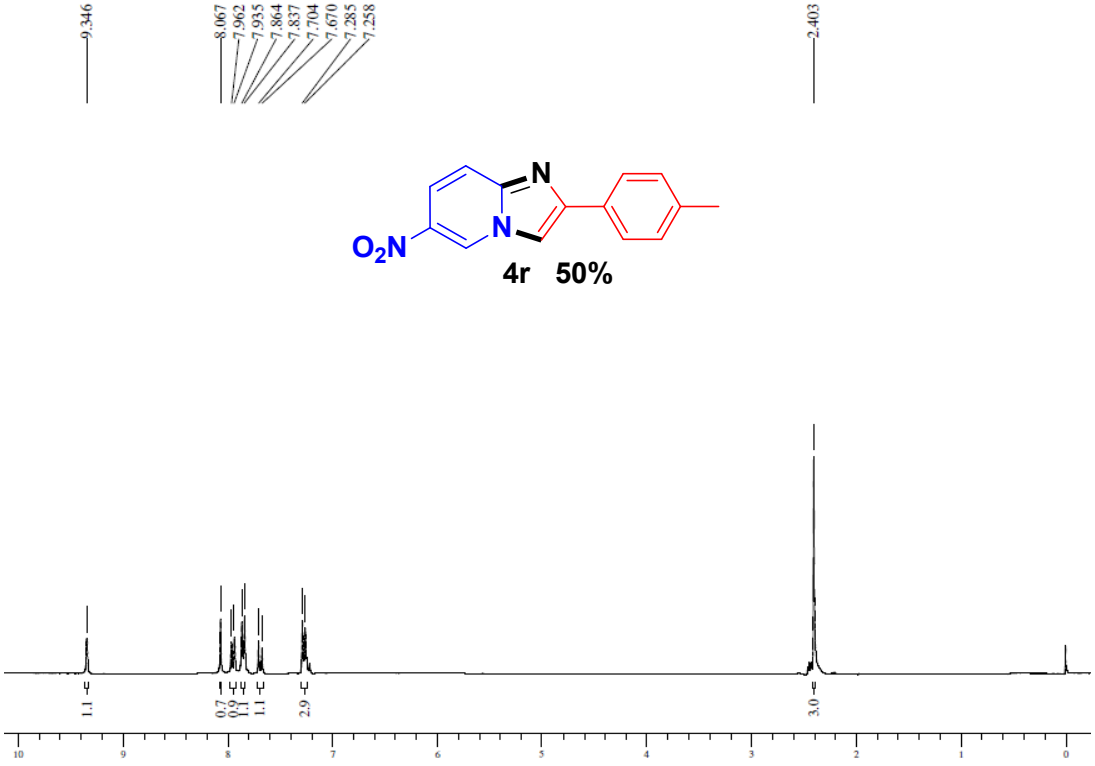


HRMS (ESI)

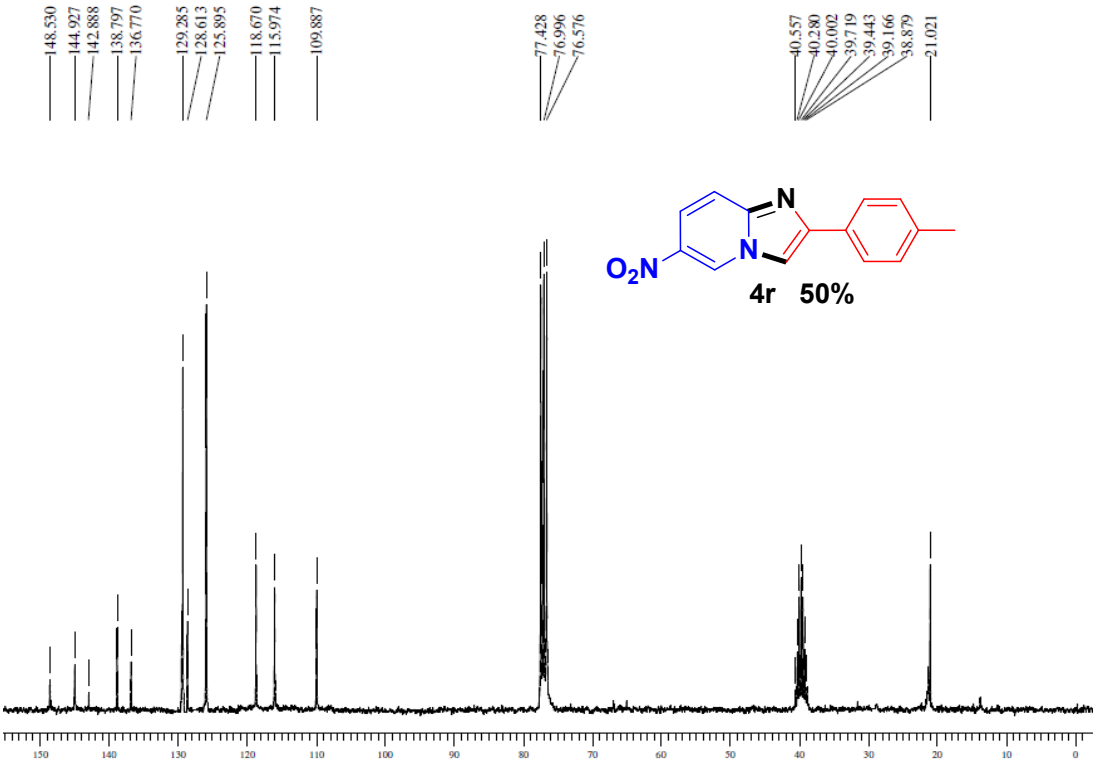


Compound 4r

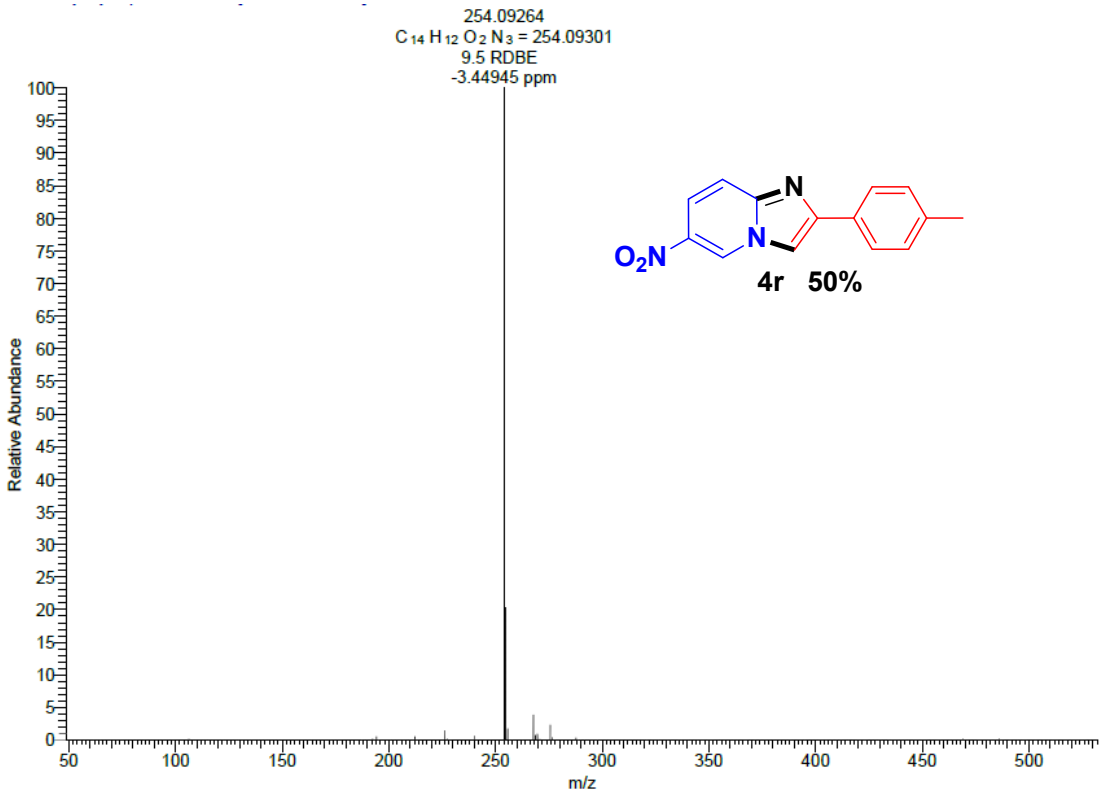
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

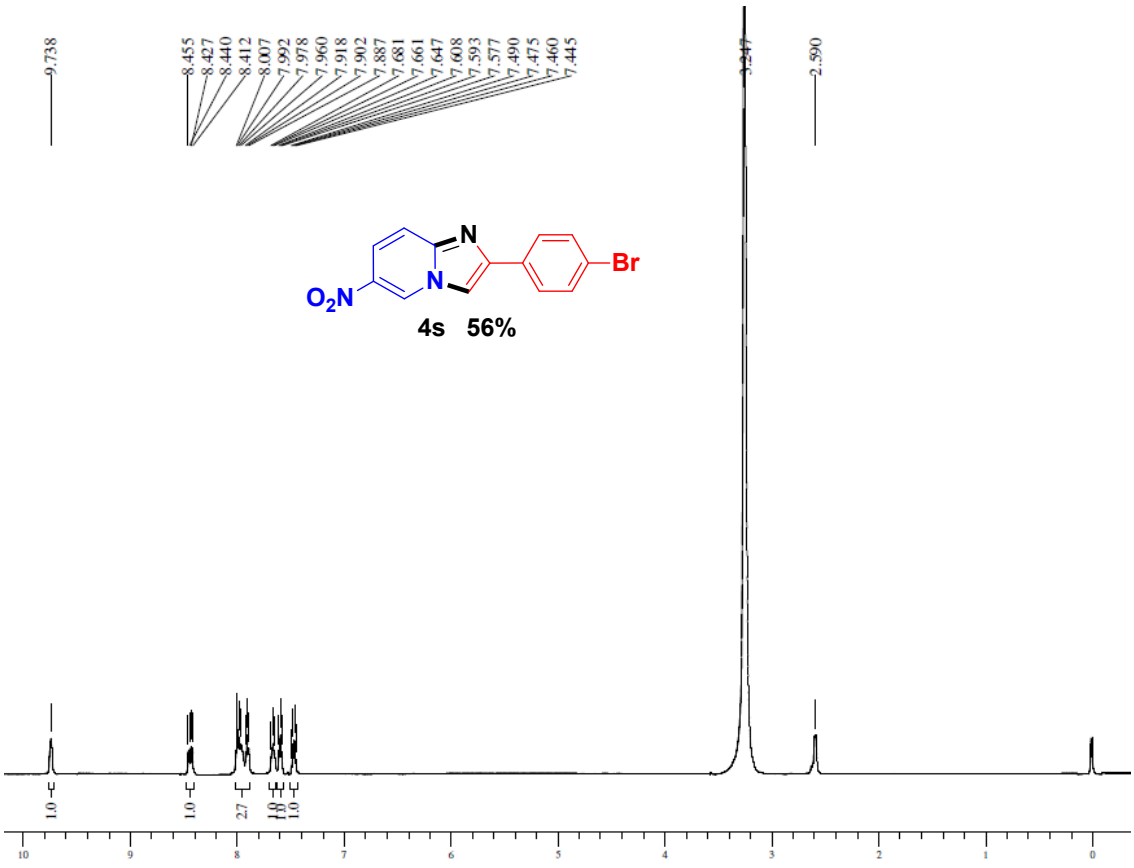


HRMS (ESI)

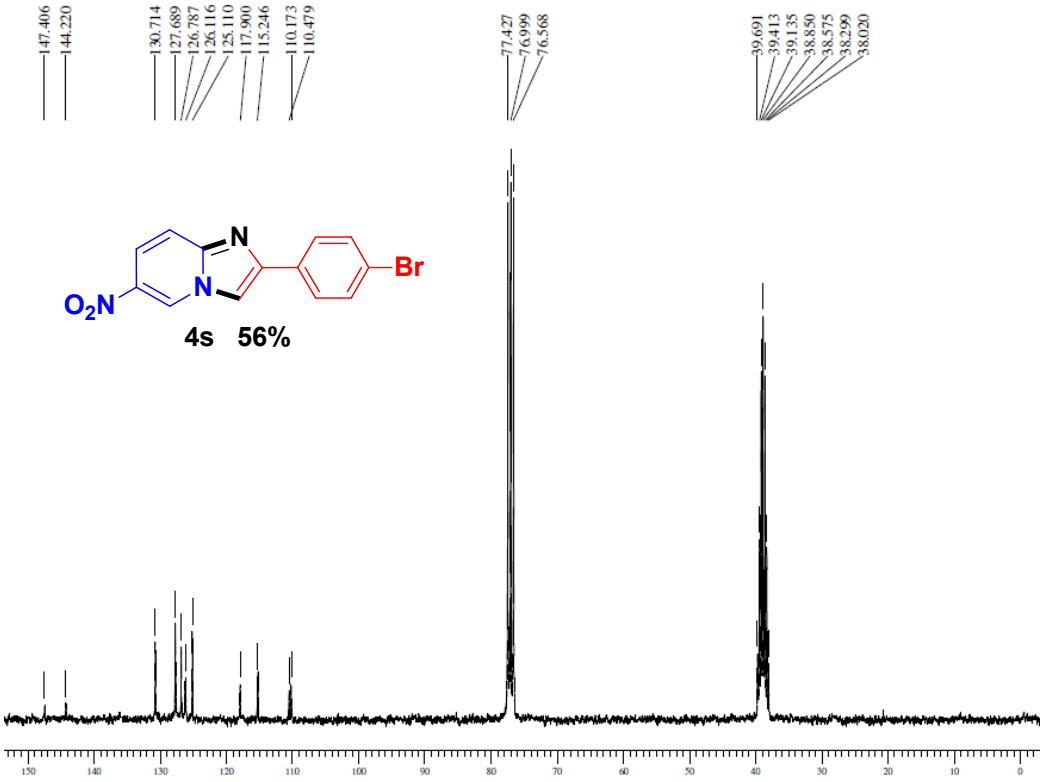


Compound 4s

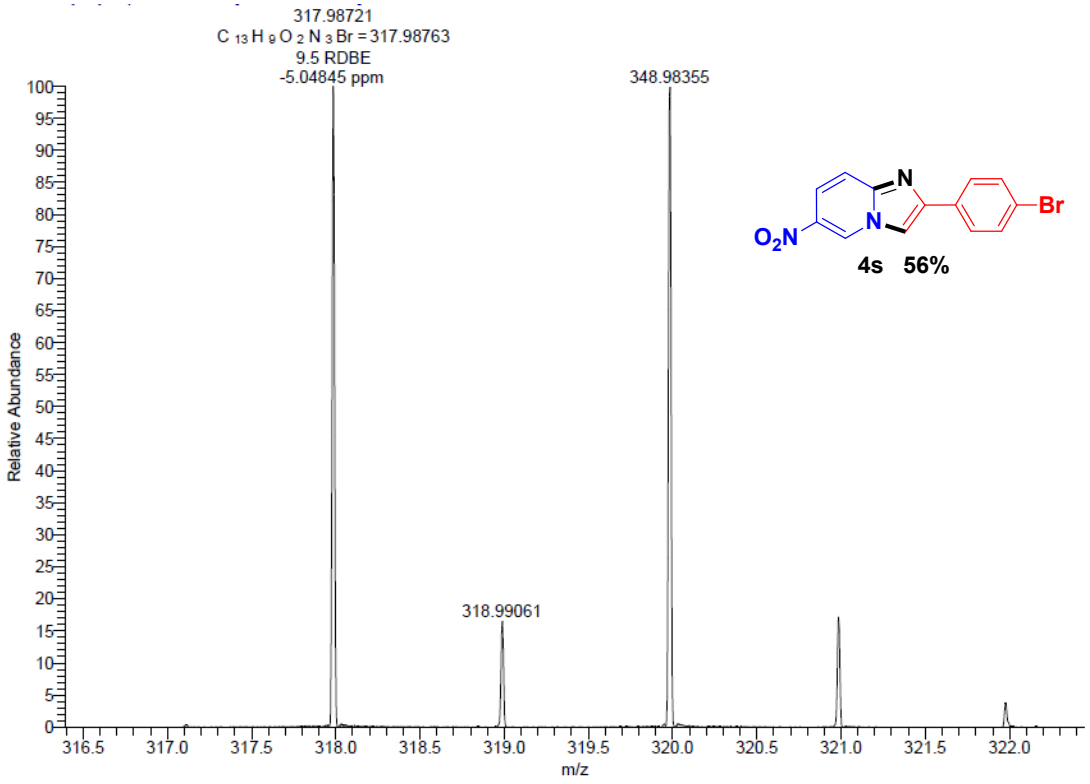
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

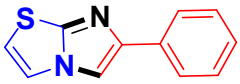


HRMS (ESI)

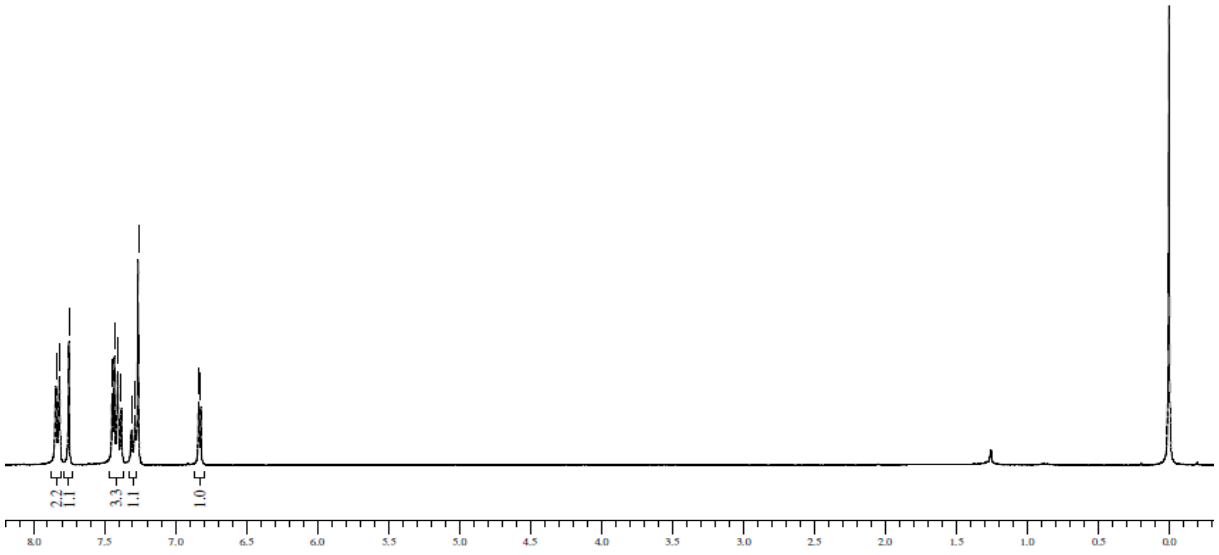


Compound 6a

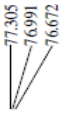
^{1}H NMR (300 MHz, $CDCl_3$)

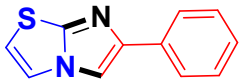


6a 86%

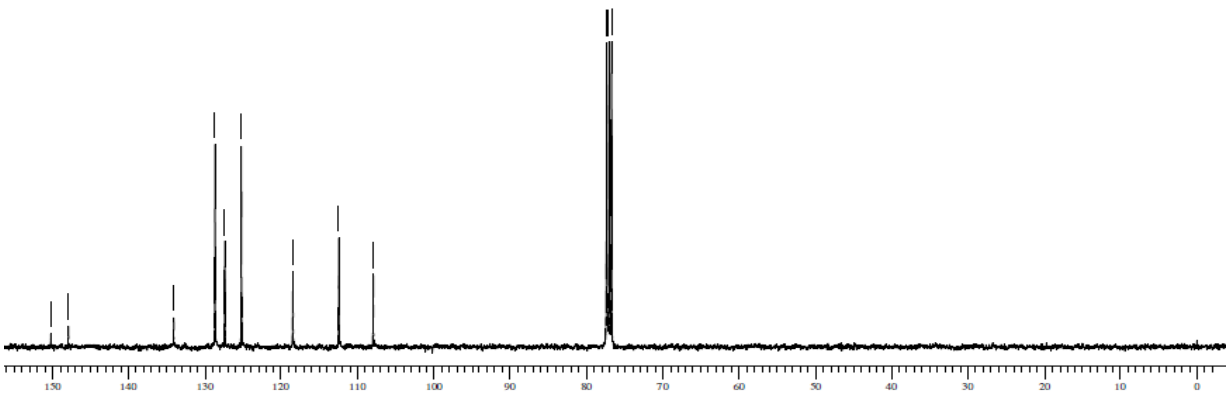


^{13}C NMR (75 MHz, $CDCl_3$)

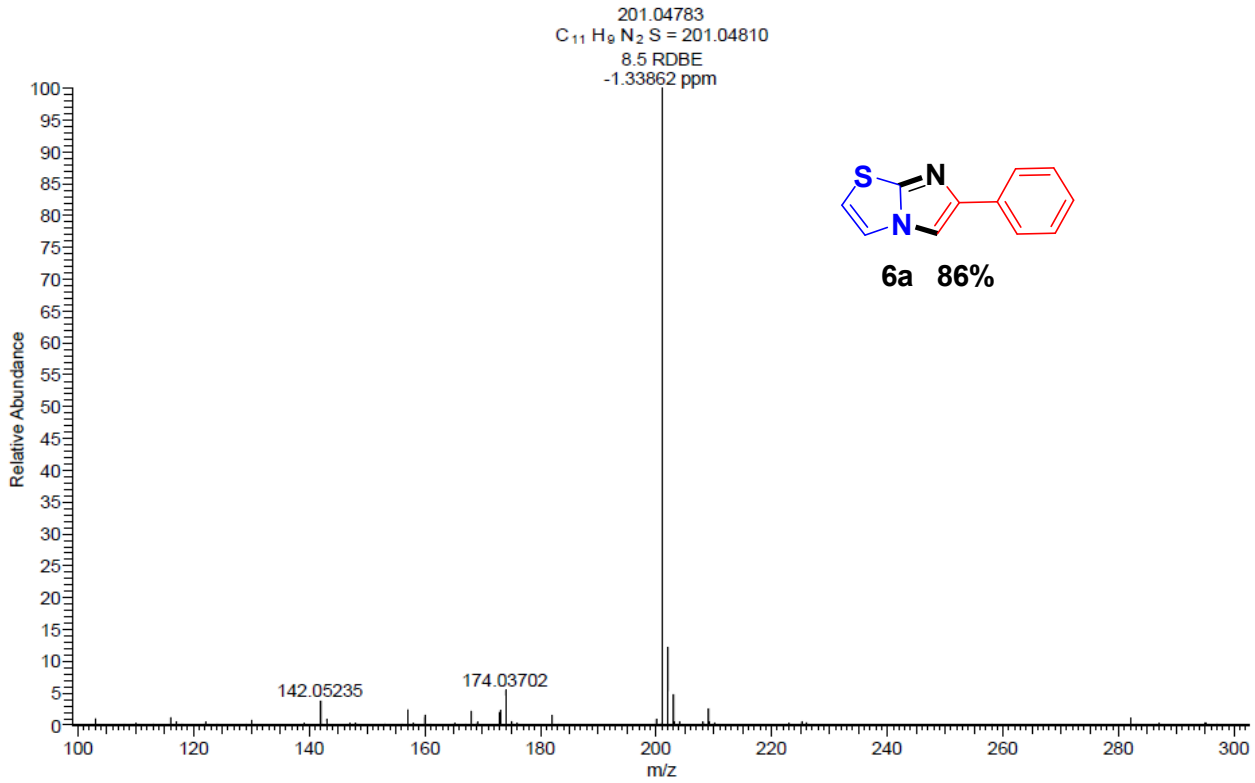




6a 86%

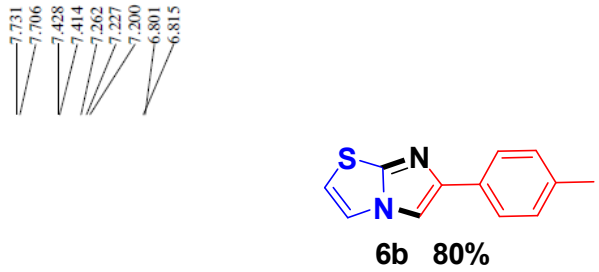


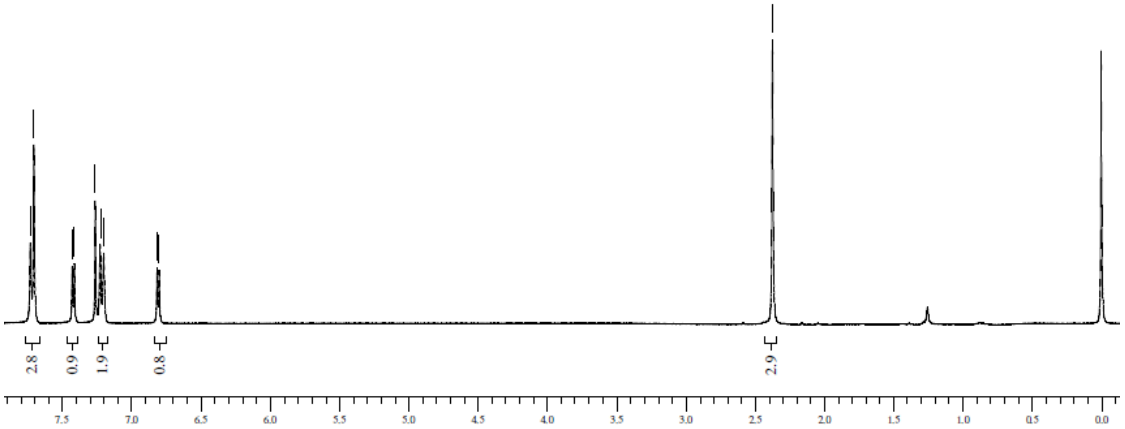
HRMS (ESI)



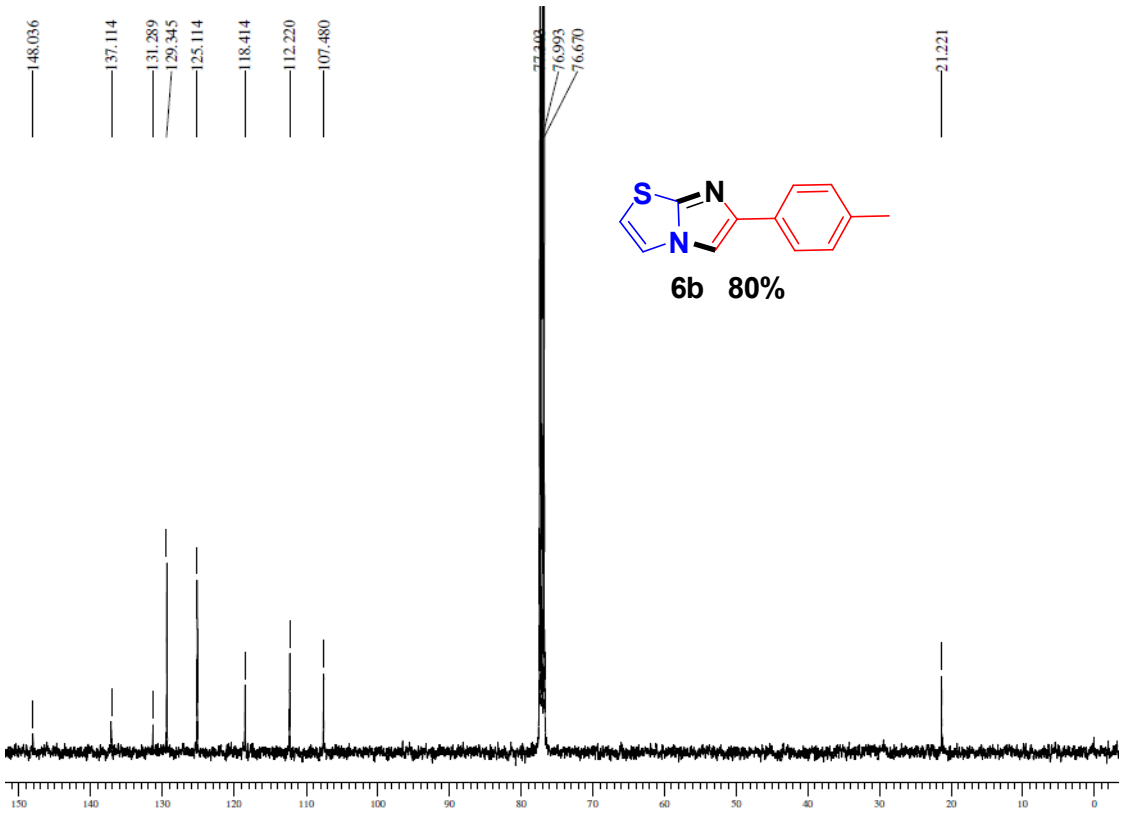
Compound 6b

^{1}H NMR (300 MHz, $CDCl_3$)

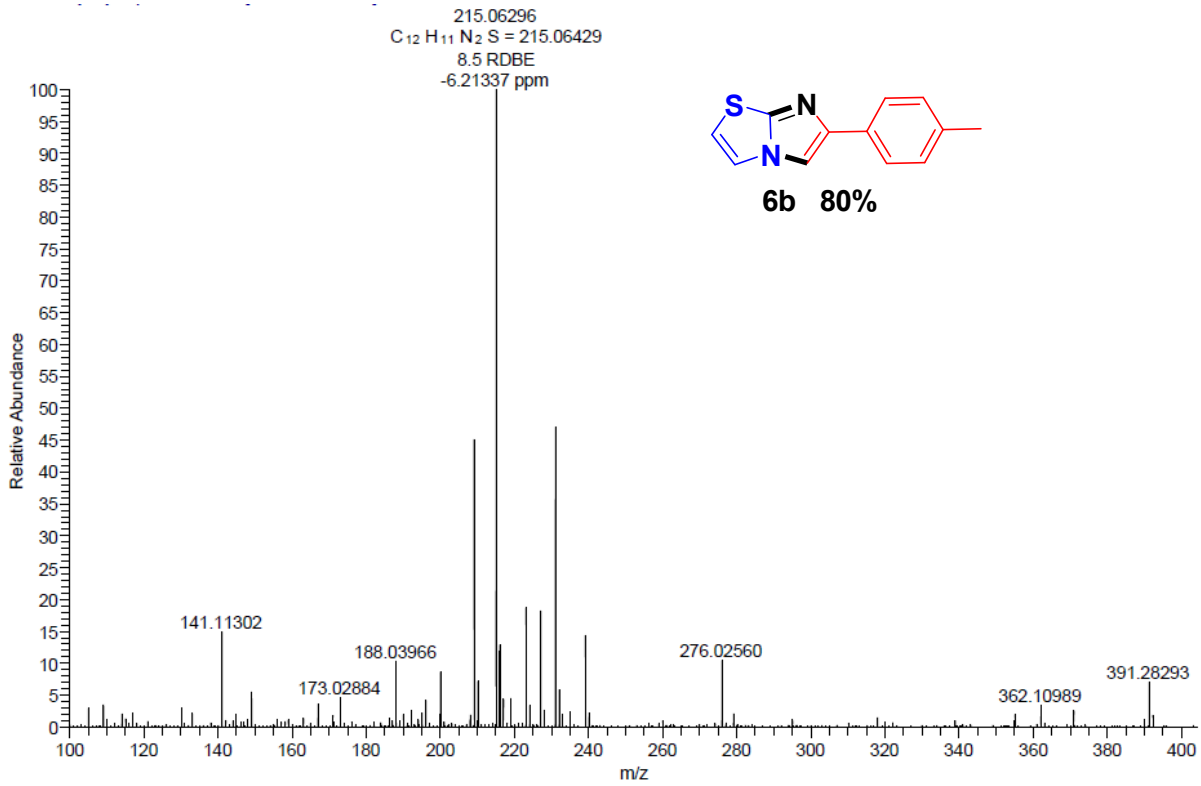




^{13}C NMR (75 MHz, $CDCl_3$)

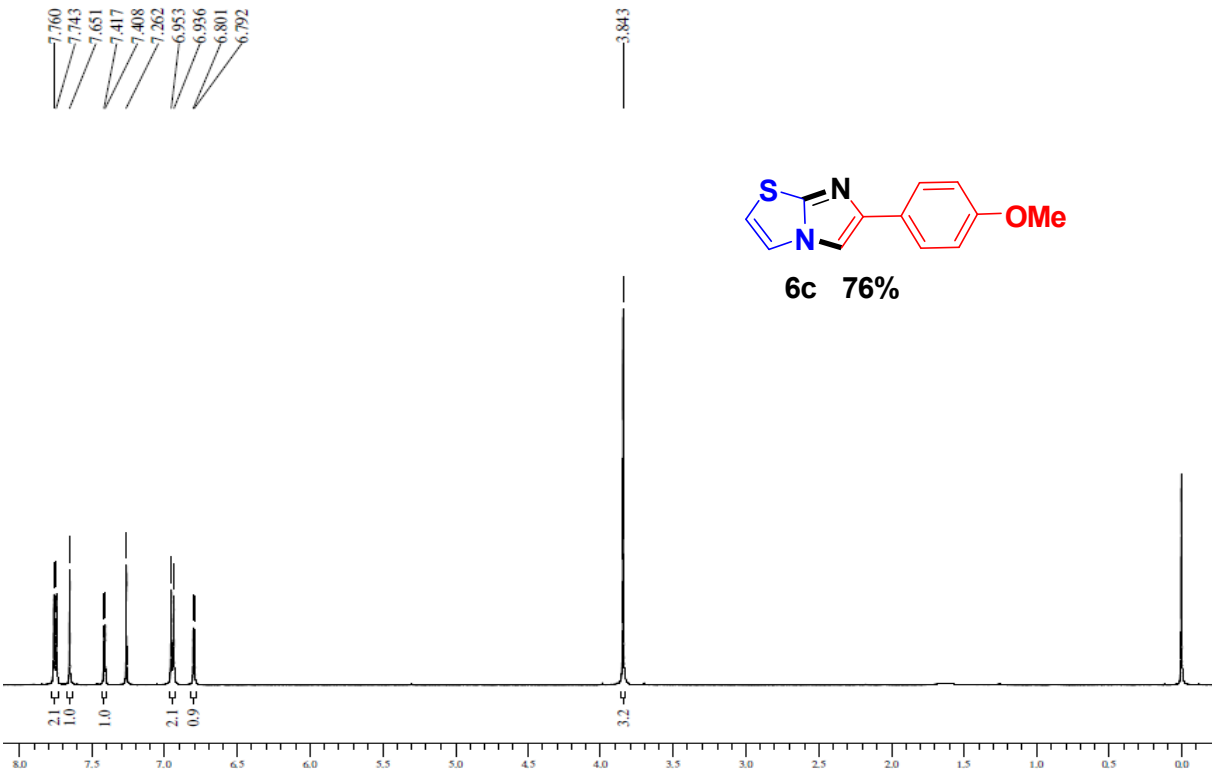


HRMS (ESI)

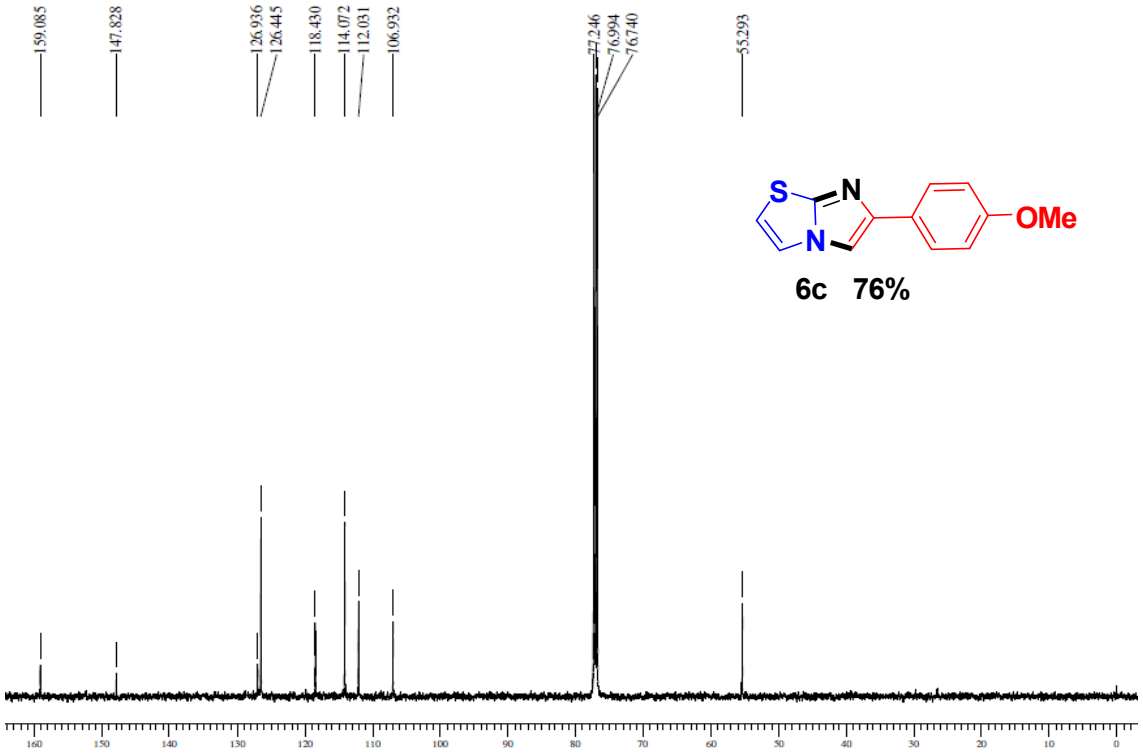


Compound 6c

^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



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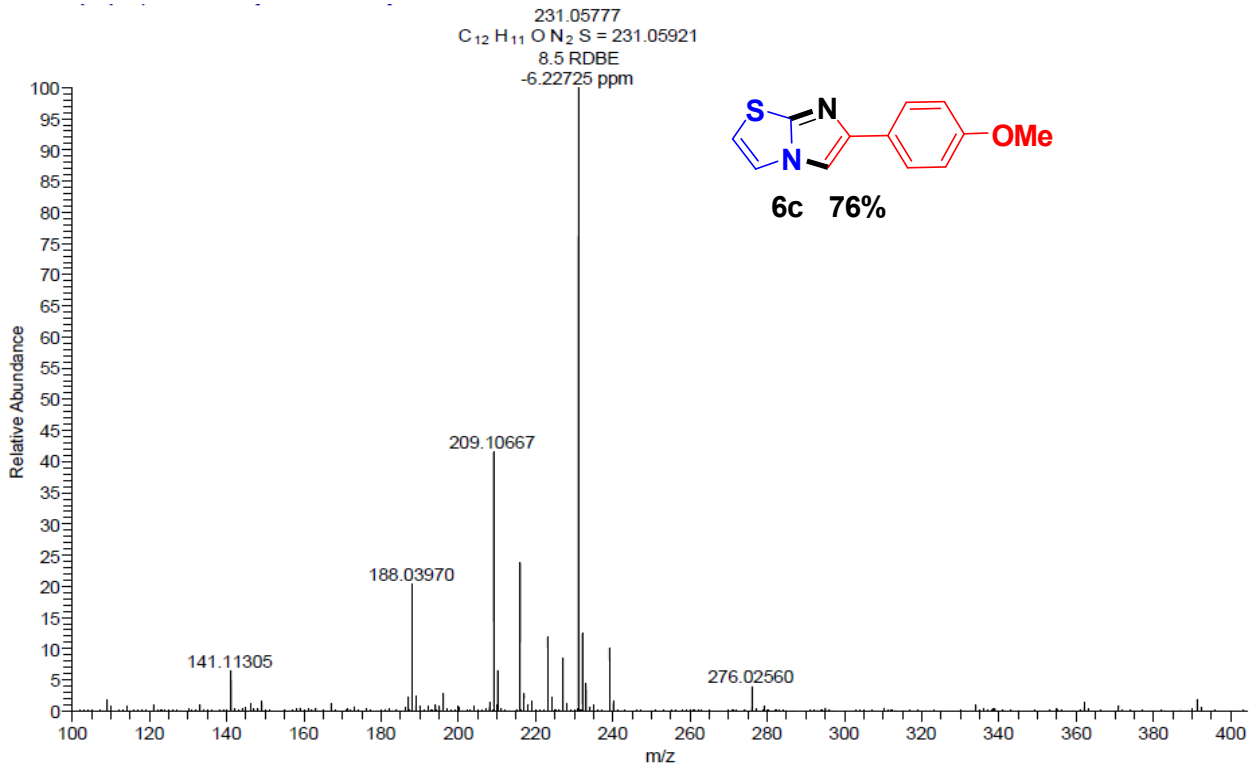
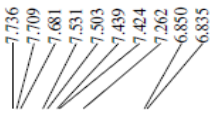
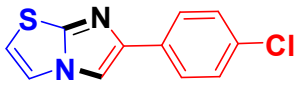


6c 76%

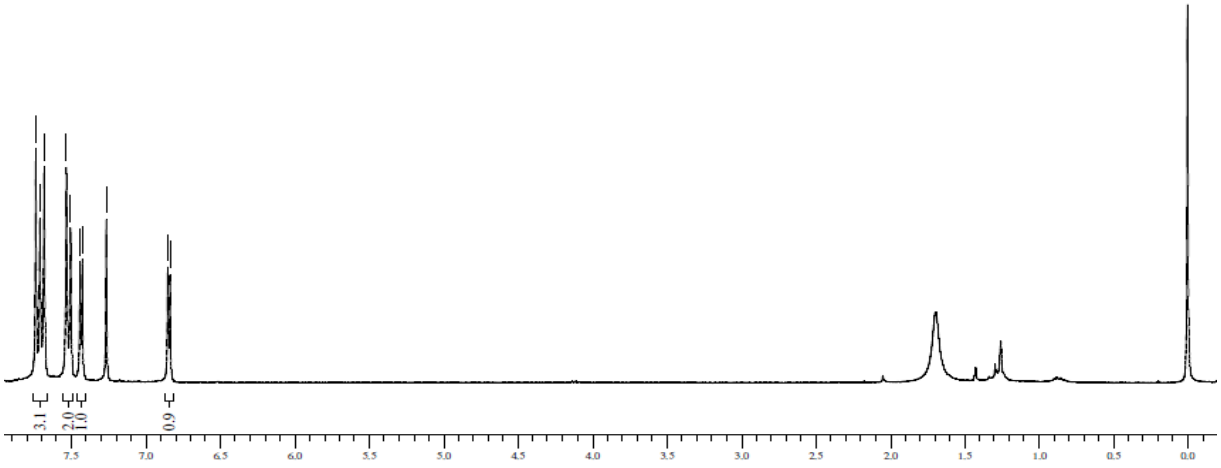
Compound 6d

^{1}H NMR (300 MHz, $CDCl_3$)

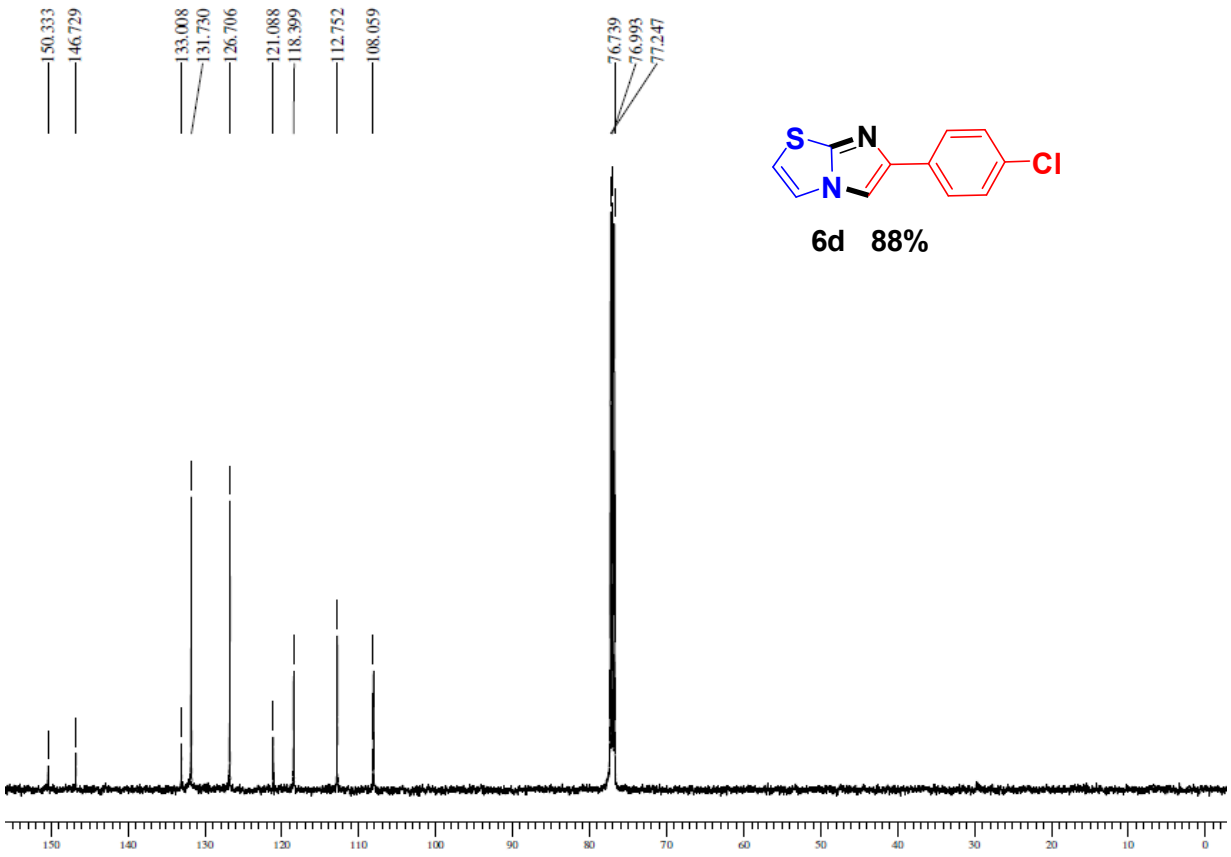




6d 88%

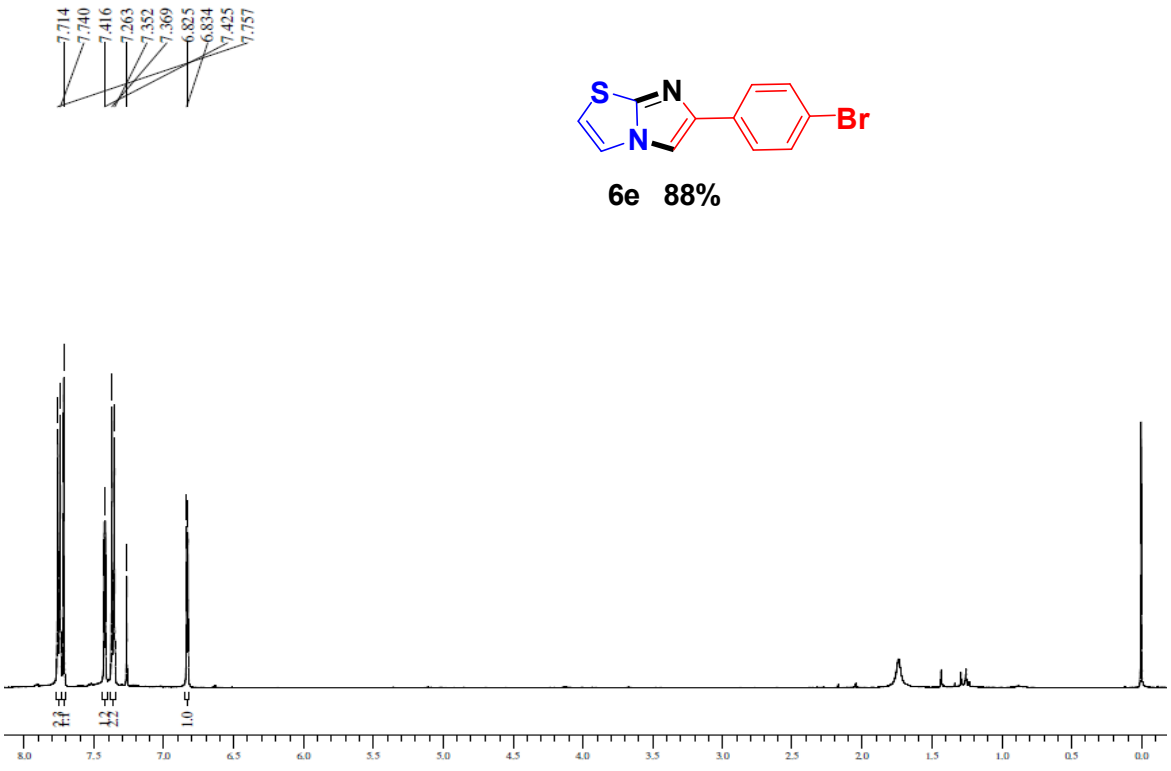


^{13}C NMR (75 MHz, $CDCl_3$)

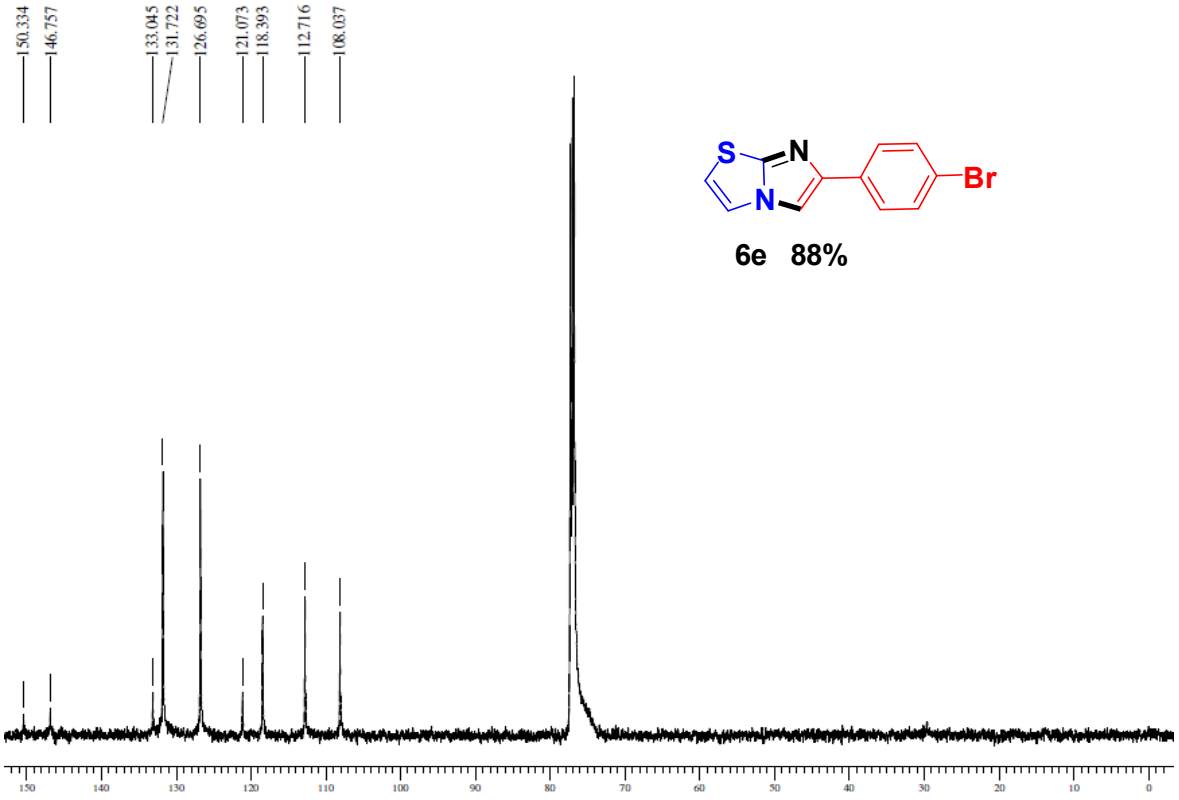


Compound 6e

^{1}H NMR (300 MHz, $CDCl_3$)

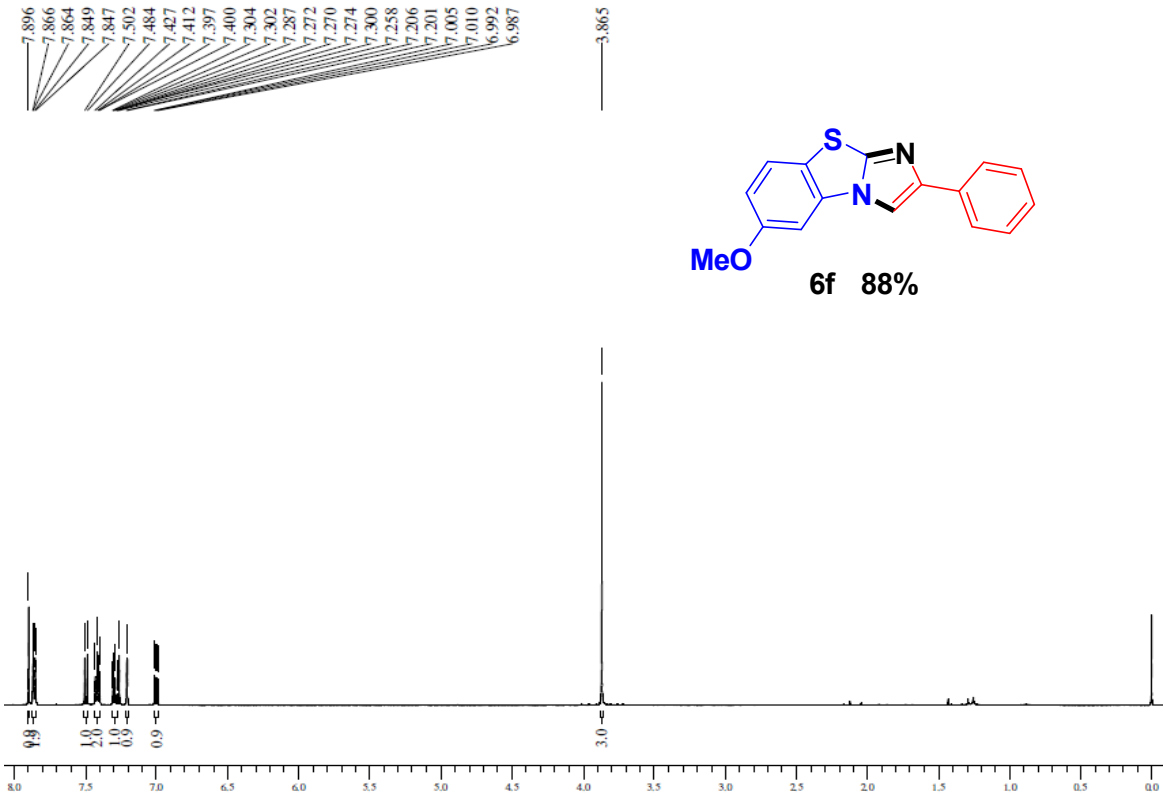


^{13}C NMR (75 MHz, $CDCl_3$)

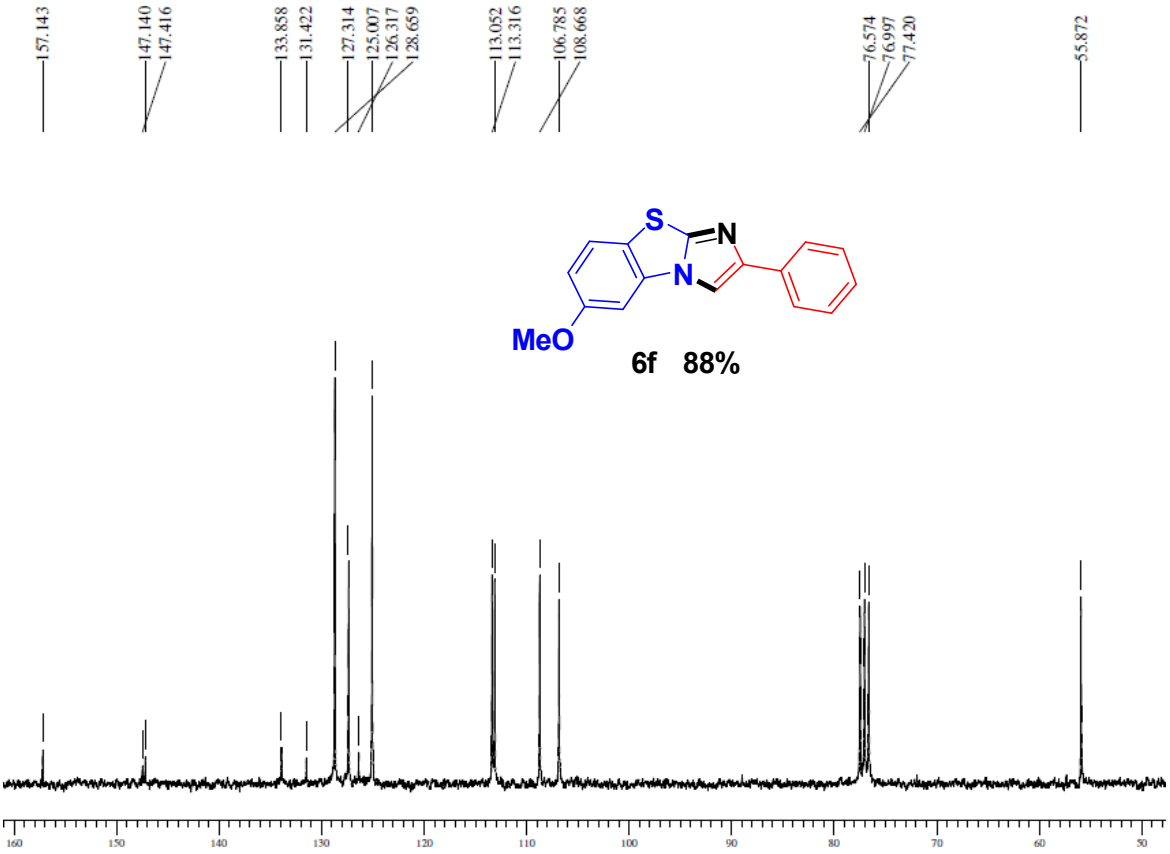


Compound 6f

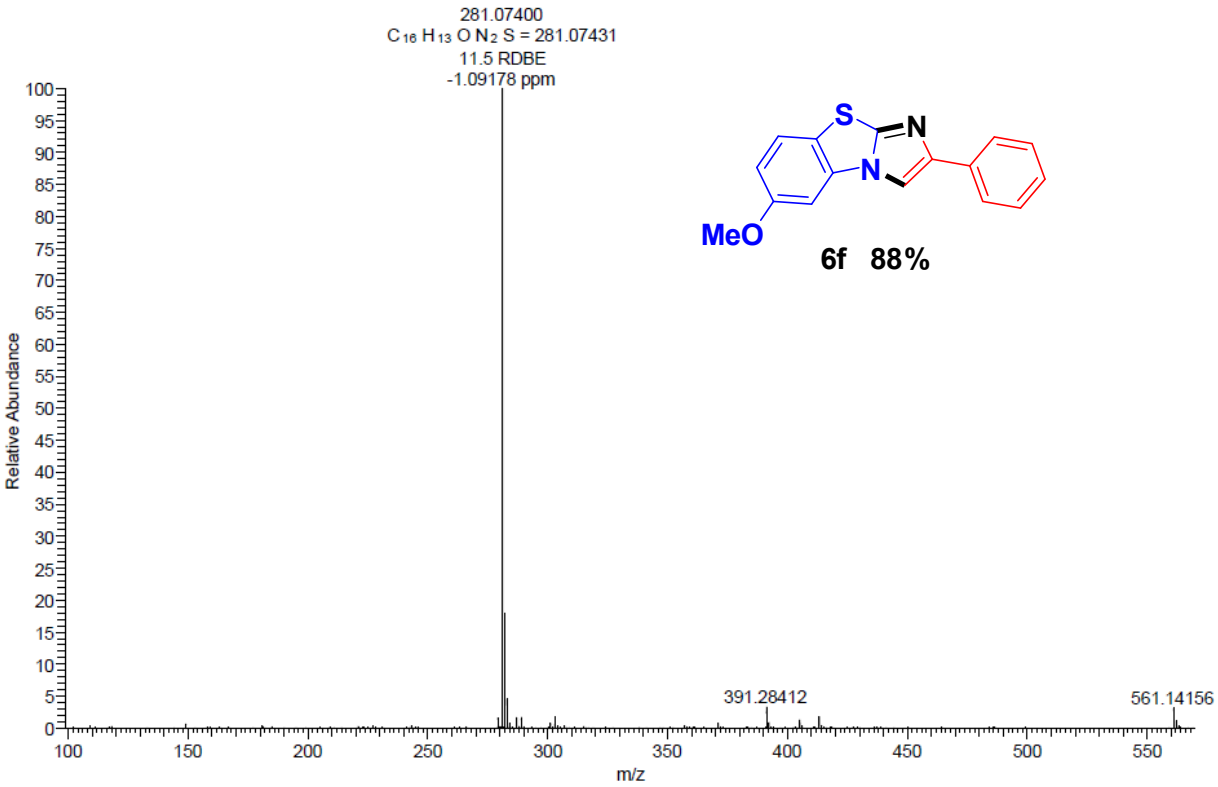
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

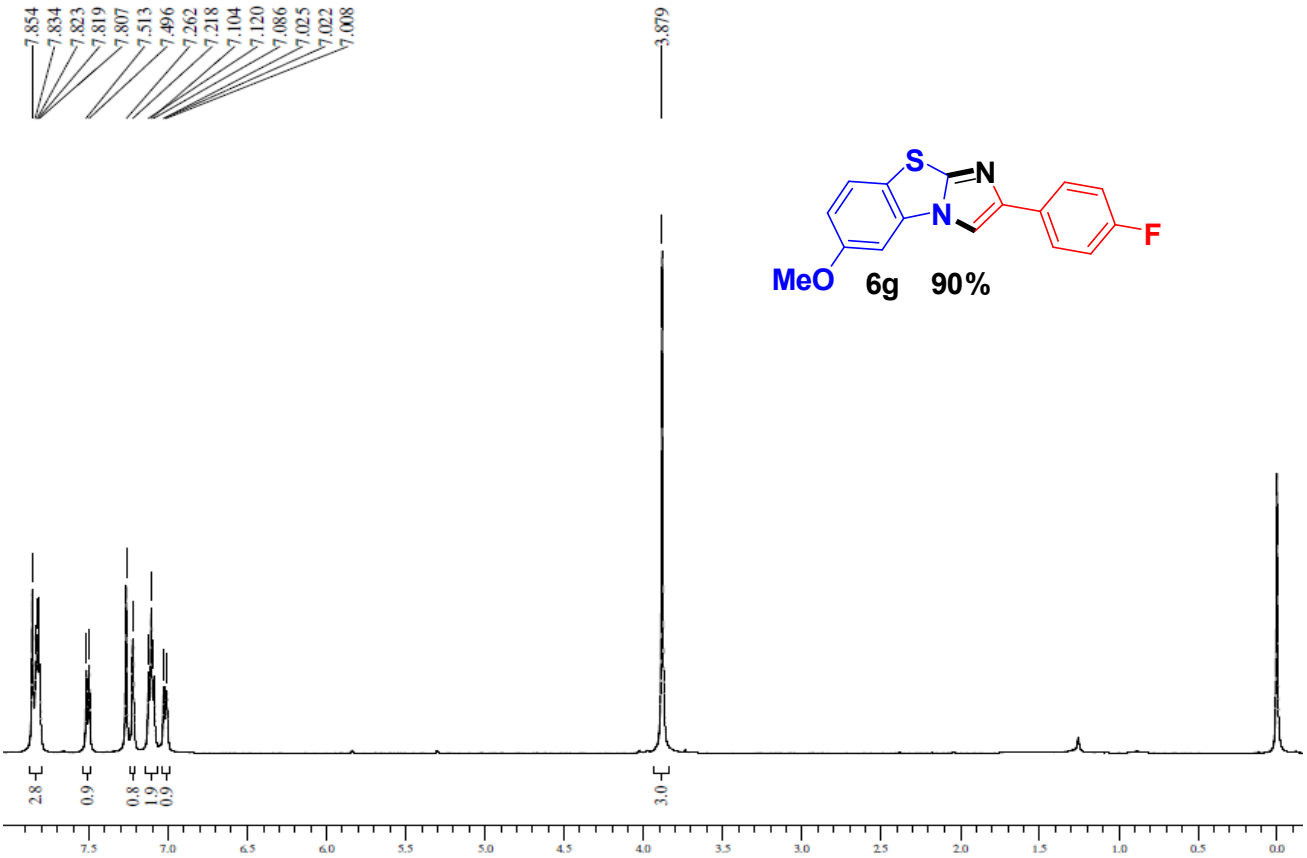


HRMS (ESI)

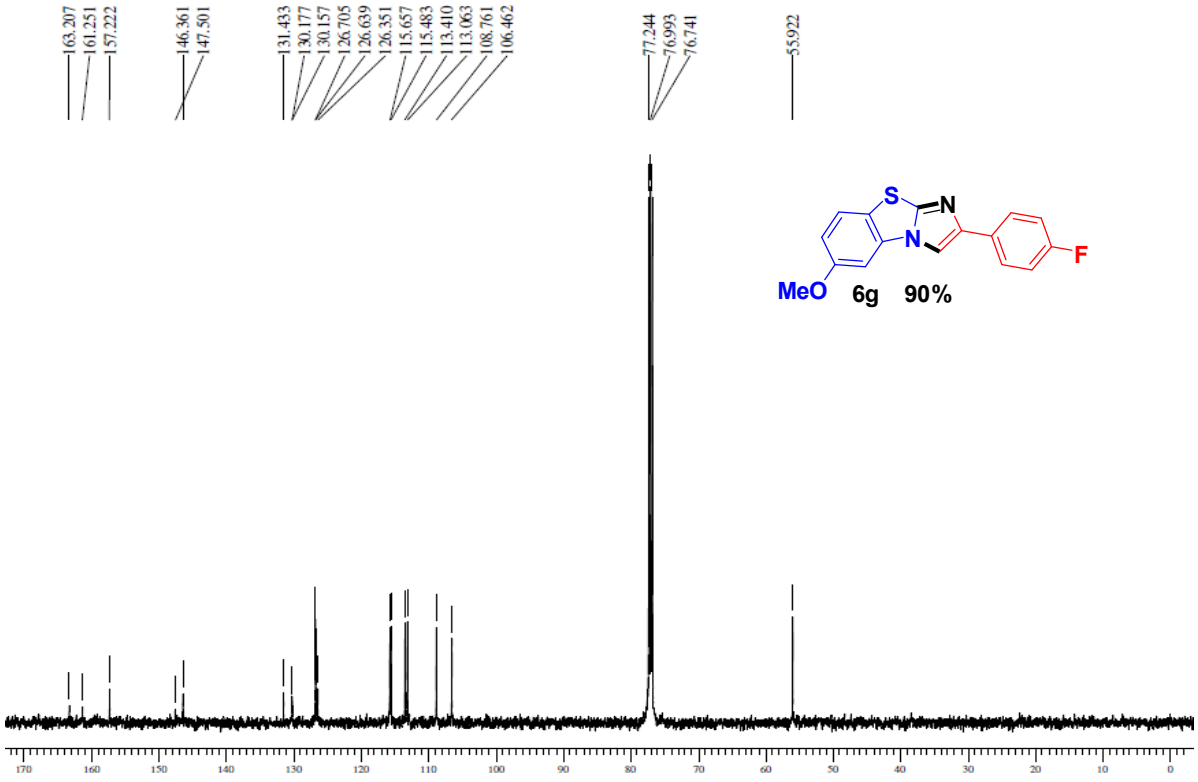


Compound 6g

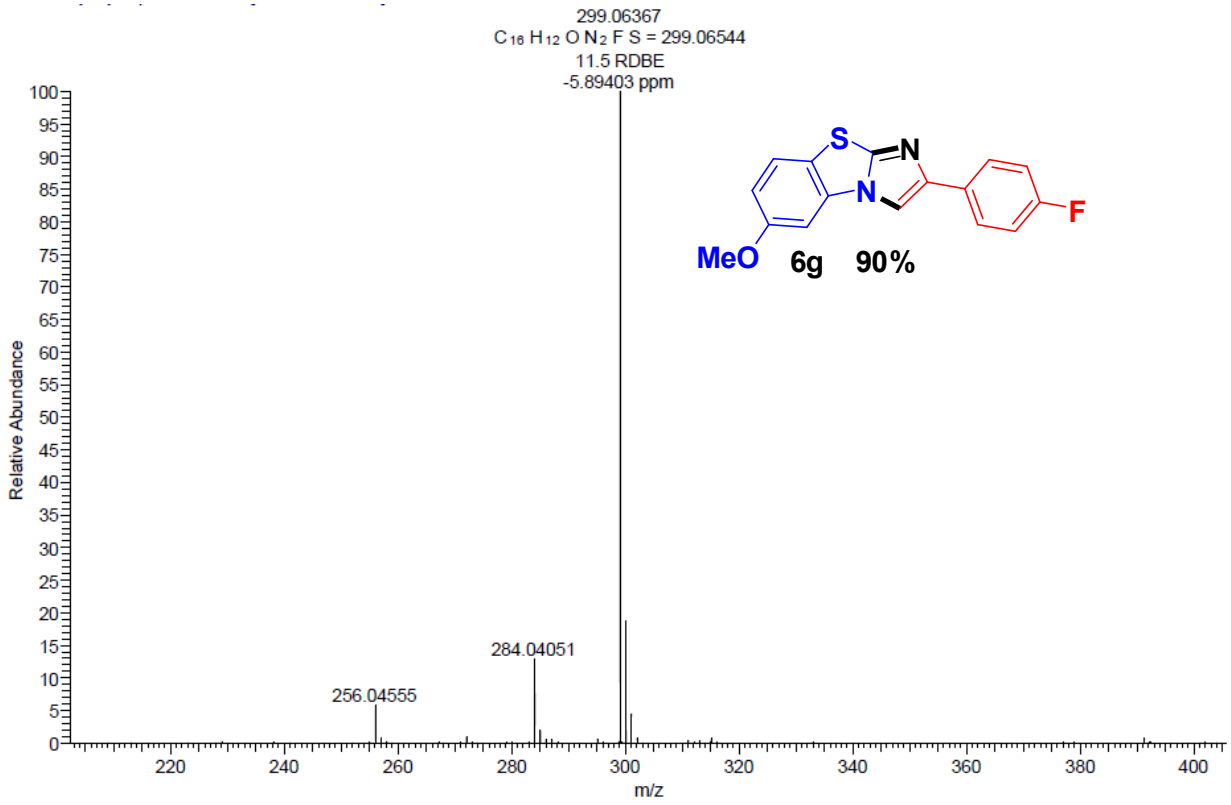
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

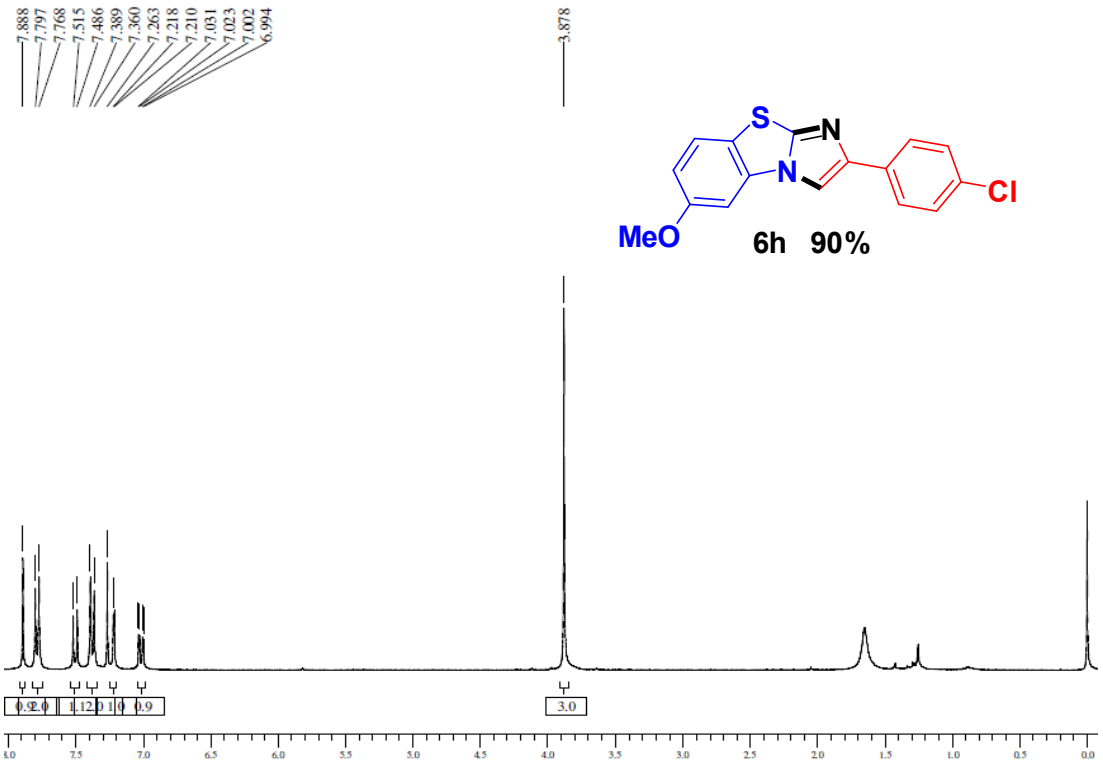


HRMS (ESI)

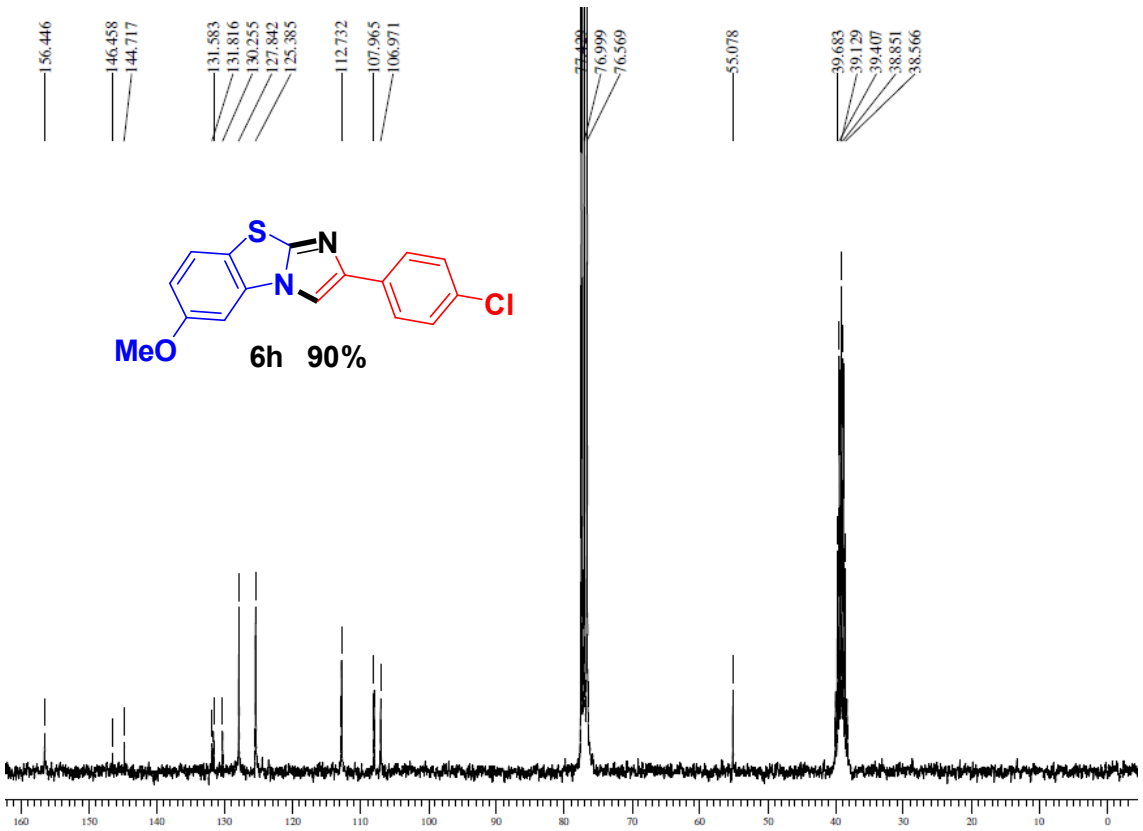


Compound 6h

^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



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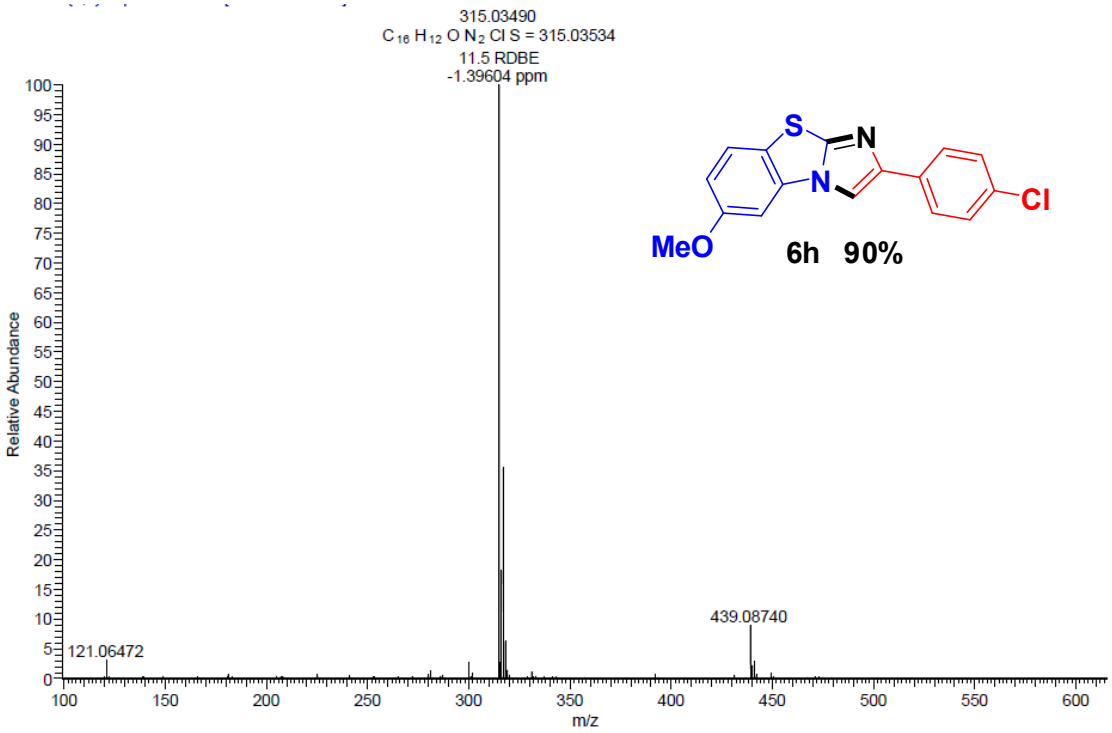
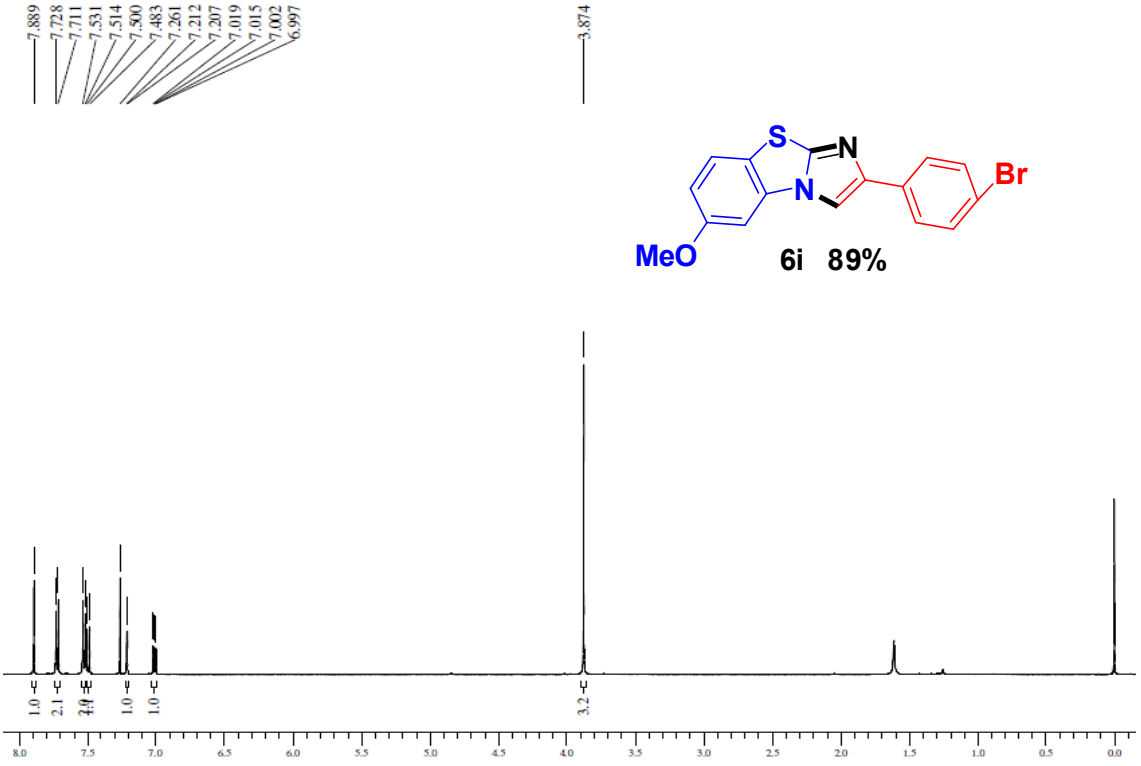
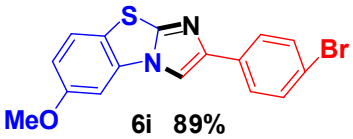


Compound 6i

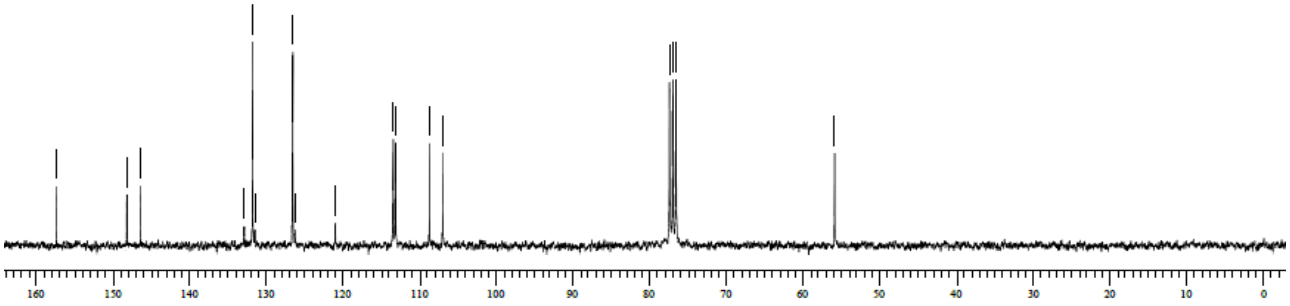
^{1}H NMR (300 MHz, $CDCl_3$)



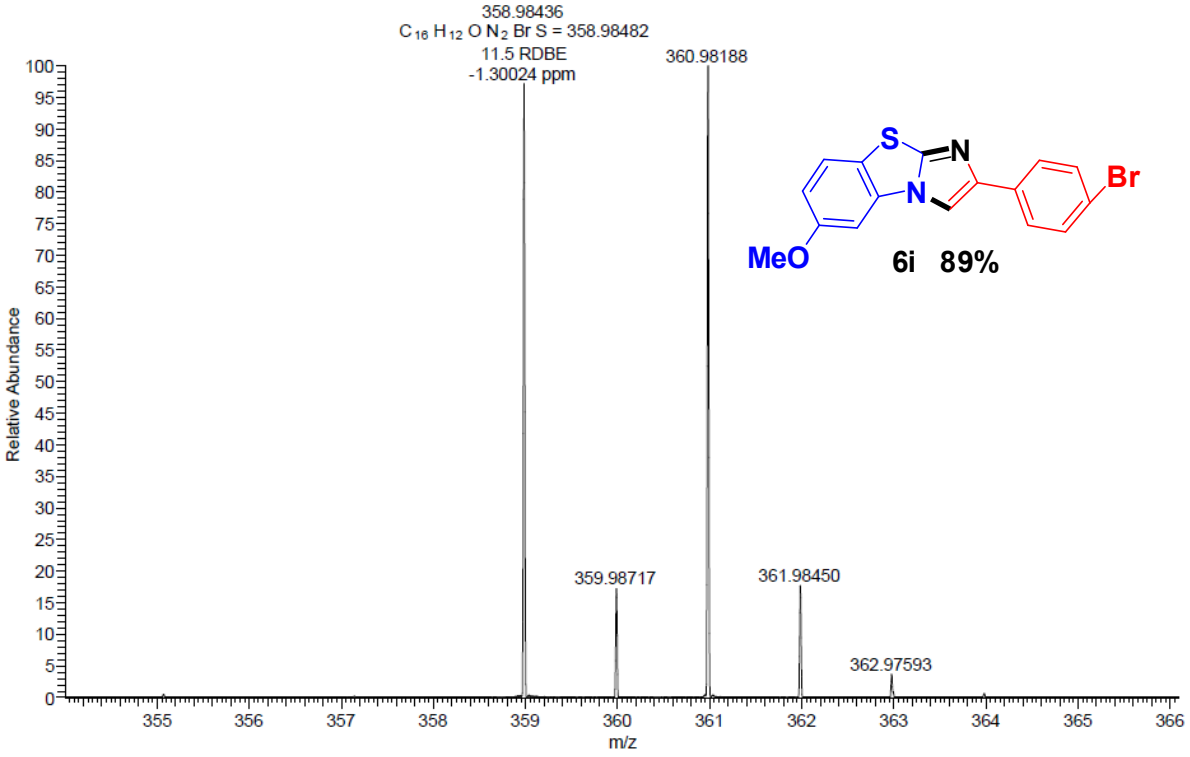
^{13}C NMR (75 MHz, $CDCl_3$)



6i 89%



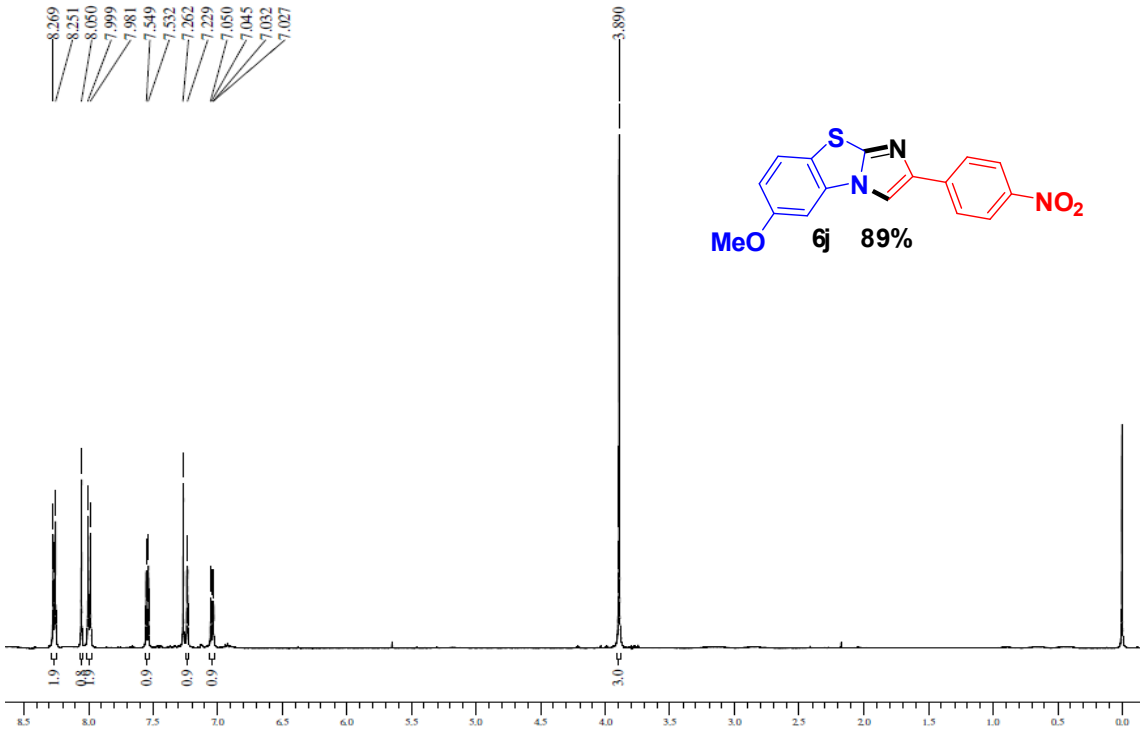
HRMS (ESI)



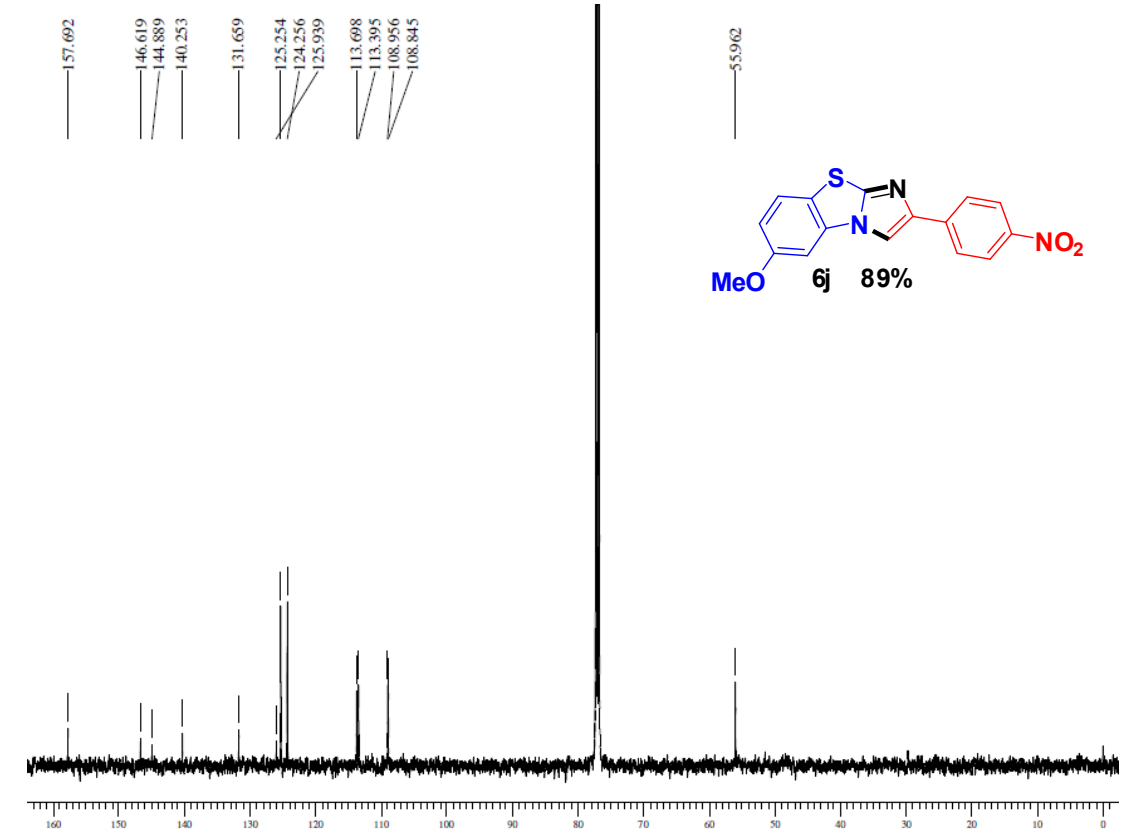
6i 89%

Compound 6j

^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



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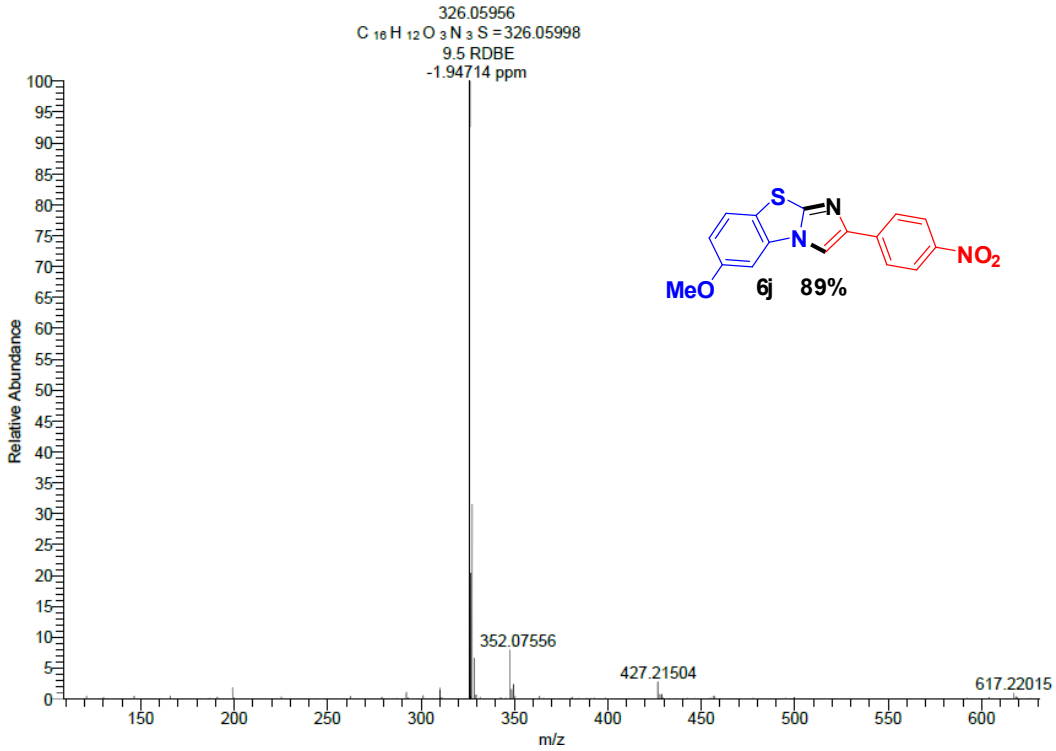
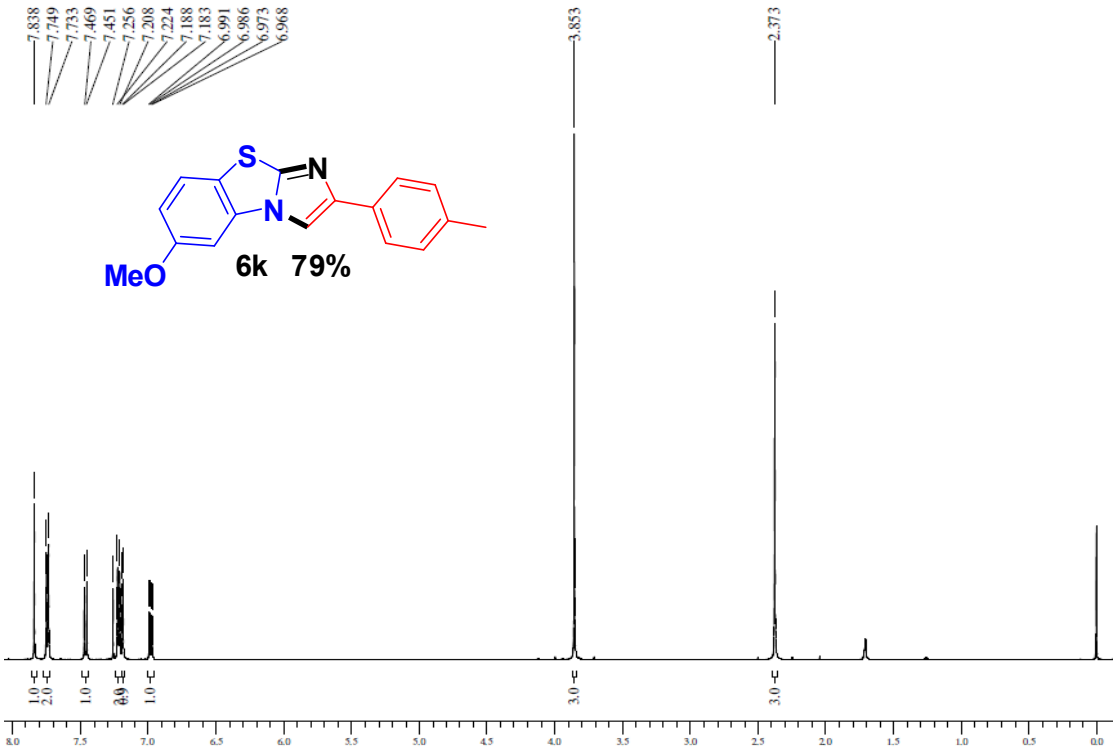
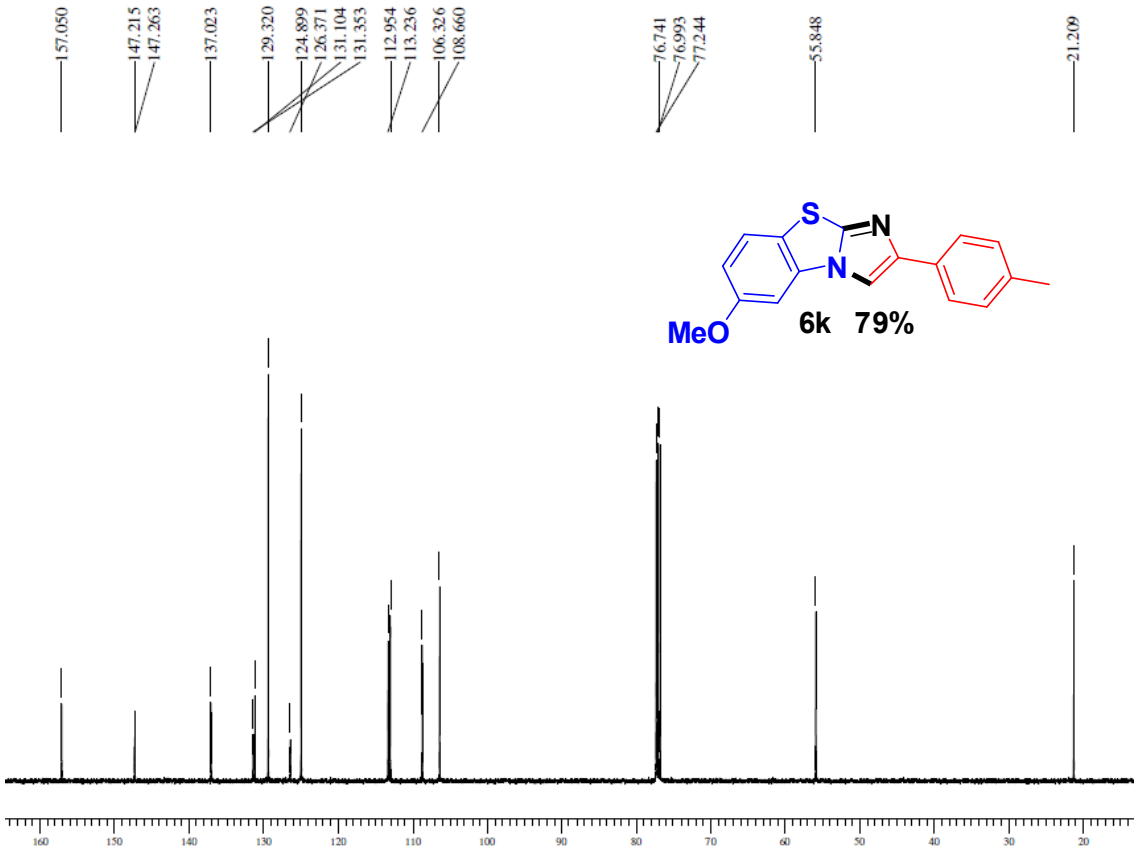


Compound 6k

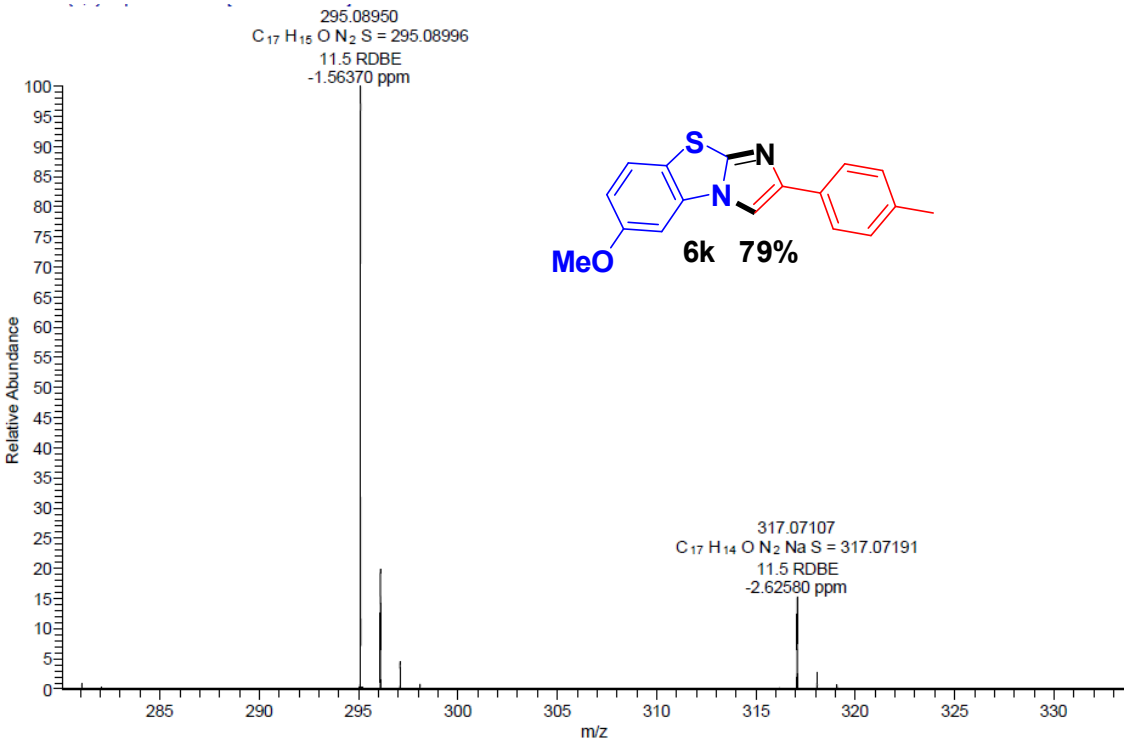
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)

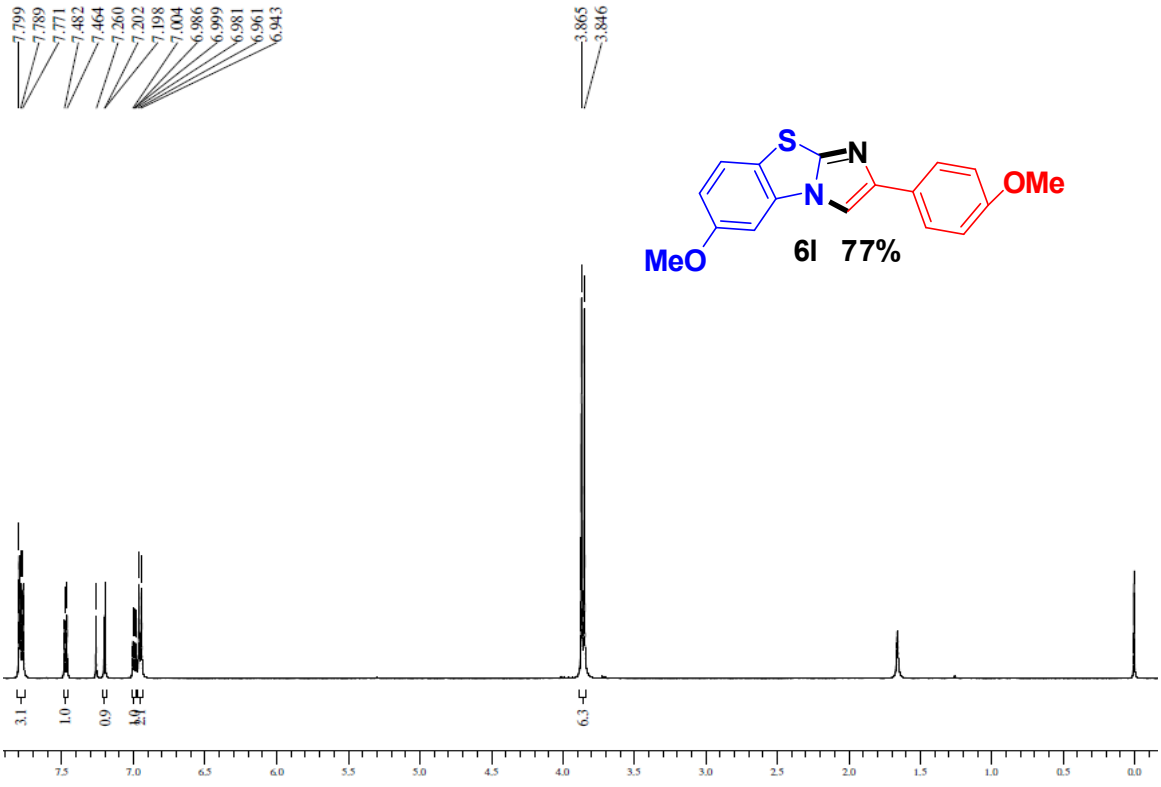


HRMS (ESI)

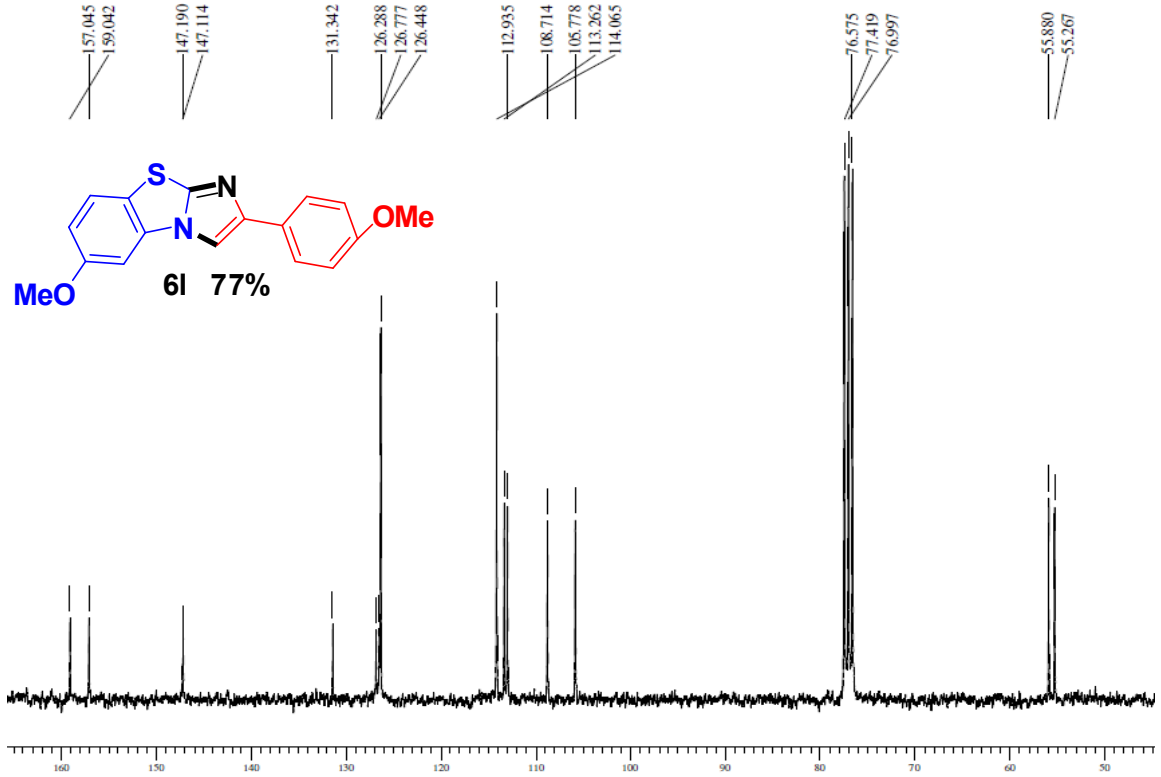


Compound 6l

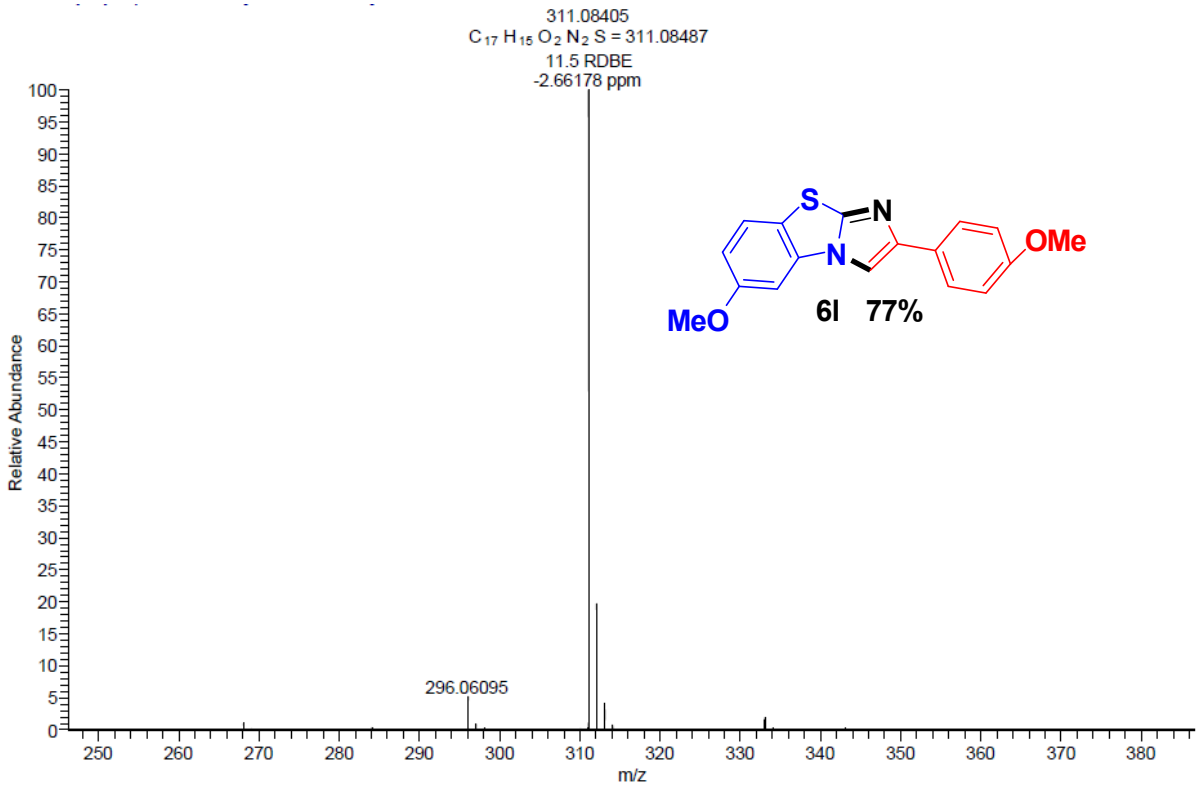
^{1}H NMR (300 MHz, $CDCl_3$)



^{13}C NMR (75 MHz, $CDCl_3$)



HRMS (ESI)


311.08405
C17 H15 O2 N2 S = 311.08487
11.5 RDBE
-2.66178 ppm
Relative Abundance
m/z
296.06095
S
N
N
OMe
MeO
6l 77%