Supporting Information for

Iridium- and Rhodium-Catalyzed C−H Activation and Formyl Arylation of Benzaldehydes under Chelation-Assistance

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General Information

All chemicals were obtained from commercial sources and were used as received unless otherwise noted. *N*-Sulfonyl 2-aminobenzaldehyde (**4**), cyclometalated Rh(III) complexes (**11**),[1] and diaryliodonium triflates[2] were prepared according to following literature reports. All reactions were carried out using Schlenk techniques or in an argon-filled glovebox. NMR Spectra were recorded on a 400 MHz NMR spectrometer in the solvents indicated. The chemical shift is given in dimensionless δ values and is frequency referenced relative to TMS in ^{1}H and ^{13}C NMR spectroscopy. HRMS data were obtained using a TOF mode. Column chromatography was performed on silica gel (300-400 mesh) using ethyl acetate (EA)/petroleum ether (PE).

General Procedure for Synthesis of 3. Aldehydes (0.20 mmol), diaryliodonium triflate (0.22 mmol), CsOAc (0.24 mmol), $[Cp^*IrCl_2]_2$ (2.5 mol %), CH_3OH or CH_3CN (2.0 mL) were charged into the sealed tube. The reaction mixture was stirred at room temperature for 20 h. After the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using PE/EA (50:1) to afford compounds **3**.

(2-Hydroxyphenyl)(*o*-tolyl)methanone (3aa).[3] Pale yellow solid (31.8 mg, 75%, 0.15 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.25 (s, 1H), 7.53–7.46 (m, 1H), 7.43–7.37 (m, 1H), 7.33–7.26 (m, 4H), 7.06 (dd, J = 8.4, 0.8 Hz, 1H), 6.85–6.76 (m, 1H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 204.6, 163.4, 138.0, 136.9, 135.7, 133.8, 131.0, 130.3, 127.6, 125.5, 120.0, 119.0, 118.4, 19.7.

(2-Hydroxyphenyl)(*m*-tolyl)methanone (3ab).[4] Pale yellow liquid (42.2 mg, 99%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.06 (s, 1H), 7.60 (dd, J = 8.0, 1.3 Hz, 1H), 7.54–7.43 (m, 3H), 7.38-7.41 (m, 2H), 7.07 (d, J = 8.4 Hz, 1H), 6.87-6.91 (m, 1H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.9, 163.2, 138.3, 138.0, 136.3, 133.7, 132.7, 129.6, 128.2, 126.4, 119.2, 118.6, 118.4, 21.4.

(2-Hydroxyphenyl)(*p*-tolyl)methanone (3ac).[3] Pale yellow solid (38.1 mg, 90%, 0.18 mmol); ^{1}H NMR (400 MHz, $CDCl_3$); δ 12.04 (s, 1H), 7.58-7.63 (m, 3H), 7.52–7.44 (m, 1H), 7.30 (d, J = 7.9 Hz, 2H), 7.06 (d, J = 8.4 Hz, 1H), 6.86 (m, 1H), 2.44 (s, 3H). ^{13}C

NMR (100 MHz, $CDCl_3$) δ 201.5, 163.2, 142.9, 136.2, 135.3, 133.6, 129.6, 129.1, 119.4, 118.7, 118.5, 21.7.

(4-Chlorophenyl)(2-hydroxyphenyl)methanone (3ad).[3] Yellow solid (44.0 mg, 95%, 0.19 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.88 (s, 1H), 7.66–7.60 (m, 2H), 7.53 (m, 2H), 7.51–7.47 (m, 2H), 7.13–7.02 (m, 1H), 6.94–6.83 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.4, 163.3, 138.5, 136.7, 136.3, 133.3, 130.8, 128.8, 119.1, 118.9, 118.7.

(4-Bromophenyl)(2-hydroxyphenyl)methanone (3ae).[3] Yellow solid (50.9 mg, 92%, 0.18 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.87 (s, 1H), 7.65 (d, J = 8.4 Hz, 2H), 7.56–7.49 (m, 4H), 7.07 (d, J = 8.3 Hz, 1H), 6.91–6.83 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.4, 200.4, 163.3, 136.7, 133.3, 131.8, 130.9, 127.0, 119.0, 118.9, 118.7.

(2-Hydroxyphenyl)(4-(trifluoromethyl)phenyl)methanone (3af).[4] Yellow solid (51.6 mg, 97%, 0.19 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.88 (s, 1H), 7.78 (s, 4H), 7.58–7.52 (m, 1H), 7.50 (dd, J = 8.0, 1.6 Hz, 1H), 7.10 (dd, J = 8.4, 0.7 Hz, 1H), 6.95–6.85 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.6, 163.5, 141.2, 137.1, 133.6 (q, J = 26.4 Hz), 133.4, 129.4, 125.6 (q, J = 3.8 Hz), 123.74 (q, J = 272.6 Hz). 119.1, 118.9, 118.8. HRMS: $[M + H]^+$ calculated for $C_{14}H_{10}F_3O_2^+$: 267.0627, found: 267.0629.

(2-Hydroxy-3-methylphenyl)(*p*-tolyl)methanone (3ag).[5] Yellow solid (44.8 mg, 99%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.34 (s, 1H), 7.59 (d, J = 8.1 Hz, 2H), 7.45 (dd, J = 8.0, 1.0 Hz, 1H), 7.36 (d, J = 7.3 Hz, 1H), 7.29 (d, J = 7.9 Hz, 2H), 6.78 (t, J = 7.7 Hz, 1H), 2.44 (s, 3H), 2.31 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 201.8, 161.7, 142.7, 137.0, 135. 6, 131.3, 129.6, 129.1, 127.5, 118.7, 118.0, 21.7, 15.7.

(2-Hydroxy-4-methylphenyl)(*p*-tolyl)methanone (3ah).[6] Yellow solid (44.5 mg, 98%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.14 (s, 1H), 7.57 (d, J = 8.1 Hz, 2H), 7.48 (d, J = 8.2 Hz, 1H), 7.29 (d, J = 7.9 Hz, 2H), 6.87 (s, 1H), 6.67 (dd, J = 8.2, 1.1 Hz, 1H), 2.44 (s, 3H), 2.37 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 163.5, 147.9, 142.6, 135.5, 133.6, 129.5, 129.1, 120.0, 118.5, 117.2, 22.1, 21.7.

(2-Hydroxy-5-methoxyphenyl)(*p*-tolyl)methanone (3ai).[7] Yellow solid (40.8 mg, 84%, 0.17 mmol) ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.58 (s, 1H), 7.62 (d, J = 8.0 Hz, 2H), 7.31 (d, J = 7.9 Hz, 2H), 7.13 (dd, J = 9.0, 3.0 Hz, 1H), 7.09 (d, J = 3.0 Hz, 1H), 7.01 (d, J = 9.0 Hz,

1H), 3.71 (s, 3H), 2.45 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 157.5, 151.5, 142.9, 135.3, 129.5, 129.2, 123.9, 119.3, 119.0, 116.4, 56.1, 21.8.

(2-Hydroxy-3-methoxyphenyl)(*p*-tolyl)methanone (3aj). Yellow solid (45.6 mg, 94%, 0.19 mmol); mp 76-77 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.21 (s, 1H), 7.60 (d, J = 8.1 Hz, 2H), 7.29 (d, J = 8.1 Hz, 2H), 7.21 (dd, J = 8.1, 1.0 Hz, 1H), 7.09 (d, J = 7.8 Hz, 1H), 6.82 (t, J = 8.1 Hz, 1H), 3.94 (s, 3H), 2.44 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 201.6, 153.4, 149.1, 143.0, 135.4, 129.7, 129.1, 124.9, 119.7, 118.1, 117.0, 56.4, 21.8. HRMS: $[M + H]^+$ calculated for $C_{15}H_{15}O_3^+$: 243.1016 , found: 243.1016.

(5-Fluoro-2-hydroxyphenyl)(*p*-tolyl)methanone (3ak).[8] Yellow solid (41.7 mg, 91%, 0.18 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.74 (s, 1H), 7.60 (d, J = 8.1 Hz, 2H), 7.31 (dd, J = 12.3, 5.7 Hz, 3H), 7.27–7.19 (m, 1H), 7.03 (dd, J = 9.1, 4.5 Hz, 1H), 2.46 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 200.3, 159.2, 155.7, 153.3, 143.3, 134.6, 129.4 (d, J = 18.0 Hz), 123.7 (d, J = 23.6 Hz), 119.8 (d, J = 7.3 Hz), 119.0 (d, J = 6.3 Hz), 118.4 (d, J = 23.7 Hz), 21.8. ^{13}C NMR (101 MHz, $CDCl_3$) δ 200.43, 159.35(d, J = 1.4 Hz), 154.65 (d, J = 238.3 Hz), 143.38, 134.72, 129.52, 129.34, 123.70 (d, J = 23.6 Hz), 119.75 (d, J = 7.3 Hz), 118.97 (d, J = 6.3 Hz), 118.41 (d, J = 23.7 Hz), 21.78.

(5-Chloro-2-hydroxyphenyl)(*p*-tolyl)methanone (3al).[9] Yellow solid (49.0 mg, 99%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.90 (s, 1H), 7.58 (t, J = 5.8 Hz, 3H), 7.43 (dd, J = 8.9, 2.6 Hz, 1H), 7.33 (d, J = 7.9 Hz, 2H), 7.02 (d, J = 8.9 Hz, 1H), 2.46 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.4, 161.7, 143.5, 136.0, 134.6, 132.5, 129.6, 129.4, 123.4, 120.1, 120.0, 21.8.

(3-Bromo-2-hydroxyphenyl)(*p*-tolyl)methanone (3am). Yellow solid (54.7 mg, 94%, 0.19 mmol); mp: 116-117 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.70 (s, 1H), 7.74–7.76 (m, 1H), 7.61–7.58 (m, 3H), 7.31 (d, J = 7.9 Hz, 1H), 6.79 (t, J = 7.9 Hz, 1H), 2.45 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 159.6, 143.5, 139.3, 134.7, 132.9, 129.7, 129.3, 120.3, 119.4, 112.1, 21.8. HRMS: $[M + H]^+$ calculated for $C_{14}H_{12}BrO_2^+$: 291.0015, found: 291.0017.

(4-(Diethylamino)-2-hydroxyphenyl)(*p*-tolyl)methanone (3an).[10] Yellow solid (56.1 mg, 99%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 13.03 (s, 1H), 7.52 (d, J = 8.0 Hz, 2H), 7.40 (d, J = 9.0 Hz, 1H), 7.26 (d, J = 7.8 Hz, 2H), 6.19–6.09 (m, 2H), 3.40 (q, J = 7.1

Hz, 4H), 2.42 (s, 3H), 1.20 (t, J = 7.1 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.9, 166.3, 153.8, 141.2, 136.3, 135.6, 129.0, 128.9, 109.2, 103.5, 97.4**,** 44**.**8, 21.6, 12.8.

(2-Hydroxy-5-nitrophenyl)(*p*-tolyl)methanone (3ao). Yellow solid (38.0 mg, 74%, 0.15 mmol); mp: 107-108; ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.70 (s, 1H), 8.62 (d, J = 2.7 Hz, 1H), 8.38 (dd, J = 9.2, 2.7 Hz, 1H), 7.64 (d, J = 8.1 Hz, 2H), 7.39 (d, J = 8.0 Hz, 2H), 7.18 (d, J = 9.2 Hz, 1H), 2.50 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.3, 168.1, 144.4, 139.5, 133.8, 130.8, 129.7, 129.7 129.7, 119.6, 118.3, 21.9. HRMS: $[M + H]^+$ calculated for $C_{14}H_{12}NO_4^+$: 258.0761, found: 258.0762.

(3,5-Di-tert-butyl-2-hydroxyphenyl)(*p*-tolyl)methanone (3ap).[11] Yellow solid (62.8 mg, 97%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.70 (s, 1H), 7.59 (d, J = 8.0 Hz, 3H), 7.46 (d, J = 1.9 Hz, 1H), 7.29 (d, J = 7.9 Hz, 2H), 2.44 (s, 3H), 1.47 (s, 9H), 1.25 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 160.7, 142.5, 139.8, 137.9, 136.1, 131.1, 129.7, 129.0, 128.0, 118.5, 35.3, 34.4, 31.5, 29.6, 21.7.

(3,5-Dichloro-2-hydroxyphenyl)(*p*-tolyl)methanone (3aq). Yellow solid (55.8 mg, 99%, 0.20 mmol) . mp: 99-101 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.42 (s, 1H), 7.61 (s, 1H), 7.59 (d, J = 2.8 Hz, 2H), 7.53 (d, J = 2.5 Hz, 2H), 7.35 (d, J = 7.9 Hz, 1H), 2.47 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.1, 157.5, 144.0, 135.6, 134.2, 131.1, 129.7, 129.5, 124.1, 123.3, 120.6, 21.9. HRMS: $[M + H]^+$ calculated for $C_{14}H_{11}Cl_2O_2^+$: 281.0131, found: 281.0131.

(3,5-Dibromo-2-hydroxyphenyl)(*p*-tolyl)methanone (3ar). Yellow solid (67.0 mg, 90%, 0.18 mmol); mp: 134-135 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.57 (s, 1H), 7.88 (s, 1H), 7.71 (d, J = 1.7 Hz, 1H), 7.60 (d, J = 7.9 Hz, 2H), 7.35 (d, J = 7.9 Hz, 2H). 2.48 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.9, 158.8, 144.0, 141.2, 134.8, 134.1, 129.7, 129.5, 121.1, 113.3, 110.3, 21.9. HRMS: $[M + H]^+$ calculated for $C_{14}H_{11}Br_2O_2^+$: 368.9120, found: 368.9119.

(3-Bromo-5-chloro-2-hydroxyphenyl)(*p*-tolyl)methanone (3as). Yellow solid (64.4 mg, 99%, 0.20 mmol); mp: 114-115 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.54 (s, 1H), 7.74 (d, J = 1.7 Hz, 1H), 7.59 (d, J = 8.1 Hz, 2H), 7.57 (d, J = 2.5 Hz, 1H), 7.34 (d, J = 8.0 Hz, 2H), 2.47 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.9, 158.3, 144.0, 138.6, 134.1, 131.8,

129.7, 129.5, 123.7, 120.4, 112.9, 21.8. HRMS: $[M + H]^+$ calculated for $C_{14}H_{11}BrClO_2^+$: 324.9625, found: 324.9627.

(2-Hydroxynaphthalen-1-yl)(*p*-tolyl)methanone (3at). Yellow solid (52.0 mg, 99%, 0.20 mmol); mp: 129-130; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.97 (s, 1H), 7.90 (d, J = 9.0 Hz, 1H), 7.73 (d, J = 8.0 Hz, 1H), 7.54 (d, J = 8.0 Hz, 2H), 7.35 (d, J = 8.5 Hz, 1H), 7.29–7.10 (m, 5H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.1, 160.9, 143.8, 137.6, 136.0, 132.5, 129.8, 129.3, 128.6, 128.5, 126.7, 126.41, 123.8, 119.2, 114.9, 21.8. HRMS: $[M + H]^+$ calculated for $C_{18}H_{15}O_2^+$: 263.1067, found: 263.1070.

General Procedure for Synthesis of 5. *N*-sulfonyl 2-aminobenzaldehyde (0.20 mmol), diaryliodonium salts (0.40 mmol), CsOAc (0.40 mmol), $[RhCp^*Cl_2]_2$ (4 mol %) and DCM (2.0 mL) were charged into the sealed tube. The reaction mixture was stirred at 80 °C for 20 h. After cooled to room temperature, the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using PE/EA (30:1) to afford compounds **5**.

***N*-(2-benzoylphenyl)-4-methylbenzenesulfonamide (5aa).**[12] White solid (58.7 mg, 84%, 0.17 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.99 (s, 1H), 7.79 (d, J = 8.2 Hz, 1H), 7.60–7.48 (m, 4H), 7.43–7.34 (m, 5H), 7.1–7.07 (m, 1H), 7.02 (d, J = 8.1 Hz, 2H), 2.22 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.6, 143.8, 139.0, 137.6, 135.8, 133.8, 133.2, 132.8, 129.9, 129.6, 128.2, 127.3, 126.4, 123.6, 123.2, 21.5.

4-Methyl-*N*-(2-(2-methylbenzoyl)phenyl)benzenesulfonamide (5ab). White solid (72.4 mg, 99%, 0.20 mmol); mp: 92-93 ^{o}C; 1H NMR (400 MHz, $CDCl_3$) δ 11.03 (s, 1H), 7.80 (d, J = 8.3 Hz, 1H), 7.72 (d, J = 8.3 Hz, 2H), 7.54–7.43 (m, 1H), 7.37 (m, 1H), 7.25 (dd, J = 10.2, 4.3 Hz, 2H), 7.21–7.16 (m, 3H), 6.98 (m, 1H), 6.88 (d, J = 7.6 Hz, 1H), 2.35 (s, 3H), 2.12 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 202.2, 144.02, 140.4, 138.6, 136.6, 136.2, 134.9, 134.6, 131.0, 130.6, 129.8, 128.1, 127.4, 125.30, 124.4, 123.1, 120.8, 21.6, 19.6. $[M + H]^+$ calculated for $C_{21}H_{20}NO_3S^+$: 366.1158, found: 366.1158.

4-Methyl-*N*-(2-(3-methylbenzoyl)phenyl)benzenesulfonamide (5ac). White solid (72.3 mg, 99%, 0.20 mmol) mp: 90-91 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.01 (s, 1H), 7.78 (d, J = 8.2 Hz, 1H), 7.56 (d, J = 8.2 Hz, 2H), 7.53–7.47 (m, 1H), 7.37 (d, J = 7.7 Hz, 2H), 7.26 (t, J = 7.6 Hz, 1H), 7.22 (s, 1H), 7.10 (t, J = 7.5 Hz, 2H), 7.04 (d, J = 8.1 Hz, 2H), 2.38 (s,

3H), 2.23 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.9, 143.8, 139.0, 138.1, 137.72, 136.0, 133.8, 133.5, 133.2, 130.3, 129.6, 128.0, 127.3, 127.2, 126.5, 123.6, 123.2, 21.5, 21.4. [M + H]$^+$ calculated for $C_{21}H_{20}NO_3S^+$: 366.1158, found: 366.1158.

4-Methyl-*N*-(2-(4-methylbenzoyl)phenyl)benzenesulfonamide (5ad).[13] White solid (70.2 mg, 96%, 0.19 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.89 (s, 1H), 7.78 (d, J = 8.2 Hz, 1H), 7.53 (d, J = 8.3 Hz, 2H), 7.51–7.46 (m, 1H), 7.37 (d, J = 7.8 Hz, 1H), 7.29 (d, J = 8.1 Hz, 2H), 7.19 (d, J = 8.0 Hz, 2H), 7.10 (m, 1H), 7.01 (d, J = 8.1 Hz, 2H), 2.43 (s, 3H), 2.21 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 198.1, 143.8, 143.7, 138.8, 135.9, 134.9, 133.6, 132.9, 130.2, 129.62, 128.9, 127.3, 126.9, 123.6, 123.4, 21.8, 21.5.

***N*-(2-(4-chlorobenzoyl)phenyl)-4-methylbenzenesulfonamide (5ae).** White solid (70.9 mg, 96%, 0.19 mmol); mp: 118-119 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 7.78 (d, J = 8.3 Hz, 1H), 7.53 (dd, J = 11.8, 4.7 Hz, 3H), 7.41–7.30 (m, 5H), 7.12 (t, J = 7.5 Hz, 1H), 7.03 (d, J = 8.2 Hz, 2H), 2.24 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.1, 143.9, 139.3, 138.9, 135.9, 135.8, 134.0, 132.7, 131.4, 129.7, 128.5, 127.3, 126.3, 123.8, 123.5, 21.5. HRMS: [M + H]$^+$ calculated for $C_{20}H_{17}ClNO_3S^+$: 380.0612, found: 380.0611.

(2-Hydroxyphenyl)(4-(trifluoromethyl)phenyl)methanone (5af). Pale yellow solid (45.4 mg, 54%, 0.11 mmol); mp: 138-139 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.81 (s, 1H), 7.78 (d, J = 8.2 Hz, 1H), 7.56 (d, J = 8.5 Hz, 2H), 7.54–7.49 (m, 1H), 7.39 (dd, J = 7.8, 1.3 Hz, 1H), 7.28 (d, J = 8.2 Hz, 2H), 7.21 (d, J = 8.1 Hz, 2H), 7.16 (dd, J = 10.3, 4.7 Hz, 3H), 2.44 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.5, 144.0, 140.8, 139.4, 135.9, 134.6, 133.9 (q, J = 32.7 Hz), 133.2, 130.0, 129.7, 127.7, 125.2 (q, J = 7.2, 3.5 Hz), 123.7, 123.6 (q, J = 272.7 Hz), 123.0, 21.4. One carbon is not visible due to overlapping peaks HRMS: [M + H]$^+$ calculated for $C_{21}H_{17}F_3NO_3S^+$: 420.0876, found: 420.0876.

4-Methyl-*N*-(4-methyl-2-(4-methylbenzoyl)phenyl)benzenesulfonamide (5ag). White solid (75.8 mg, 99%, 0.20 mmol); mp: 118-119 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.57 (s, 1H), 7.67 (d, J = 8.3 Hz, 1H), 7.48 (d, J = 8.0 Hz, 2H), 7.31 (d, J = 8.2 Hz, 1H), 7.25 (d, J = 8.1 Hz, 2H), 7.18 (d, J = 7.8 Hz, 2H), 7.12 (s, 1H), 6.97 (d, J = 7.9 Hz, 2H), 2.43 (s, 3H), 2.26 (s, 3H), 2.18 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.0, 143.7, 143.6, 135.9, 135.8, 134.9, 134.2, 133.8, 132.9, 130.3, 129.6, 128.8, 127.7, 127.3, 124.3, 21.8, 21.5, 20.9. HRMS: [M + H]$^+$ calculated for $C_{22}H_{22}NO_3S^+$: 380.1315, found: 380.1315.

***N*-(4-fluoro-2-(4-methylbenzoyl)phenyl)-4-methylbenzenesulfonamide (5ah).** White solid (67.8 mg, 88%, 0.18 mmol); mp: 136-137 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) H NMR (400 MHz, $CDCl_3$) δ 9.33 (s, 1H), 7.78 (dd, J = 9.0, 4.9 Hz, 1H), 7.44 (d, J = 8.2 Hz, 2H), 7.27–7.21 (m, 3H), 7.18 (d, J = 8.1 Hz, 2H), 7.02 (dd, J = 8.5, 2.9 Hz, 1H), 6.95 (d, J = 8.1 Hz, 2H), 2.44 (s, 3H), 2.17 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.30, 158.61 (d, J = 247.0 Hz), 144.4, 143.8, 135.4, 134.3, 134.2, 133.9, 130.2, 129.6, 123.0, 127.3, 127.2 (d, J = 7.7 Hz) 120.3 (d, J = 22.4 Hz), 118.7 (d, J = 23.9 Hz). 21.8, 21.4. HRMS: $[M + H]^+$ calculated for $C_{21}H_{19}FNO_3S^+$: 384.1064, found: 384.1064.

***N*-(4-bromo-2-(4-methylbenzoyl)phenyl)-4-methylbenzenesulfonamide (5ai).** White solid (80.2 mg, 90%, 0.18 mmol); mp: 112-113 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.63 (s, 1H), 7.68 (d, J = 8.8 Hz, 1H), 7.60 (dd, J = 8.8, 2.1 Hz, 1H), 7.51 (d, J = 8.1 Hz, 2H), 7.47 (d, J = 2.2 Hz, 1H), 7.28 (d, J = 8.1 Hz, 2H), 7.21 (d, J = 8.0 Hz, 2H), 7.02 (d, J = 8.0 Hz, 2H), 2.44 (s, 3H), 2.21 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.6, 144.4, 144.0, 137.7, 136.3, 135.6, 135.0, 134.2, 130.2, 129.8, 129.1, 128.7, 127.3, 125.4, 116.8, 21.8, 21.5. HRMS: $[M + H]^+$ calculated for $C_{21}H_{19}BrNO_3S^+$: 444.0264, found: 444.0264.

4-Methyl-*N*-(2-(4-methylbenzoyl)-5-nitrophenyl)benzenesulfonamide (5aj). Yellow solid (22.3 mg, 27%, 0.05 mmol); mp: 158-159 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.77 (s, 1H), 8.59 (d, J = 2.1 Hz, 1H), 7.90 (dd, J = 8.5, 2.1 Hz, 1H), 7.65 (d, J = 8.3 Hz, 2H), 7.58 (d, J = 8.5 Hz, 1H), 7.37 (d, J = 8.1 Hz, 2H), 7.25 (d, J = 9.3 Hz, 3H), 7.11 (d, J = 8.1 Hz, 2H), 2.46 (s, 2H), 2.26 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.6, 149.3, 145.1, 144.6, 140.1, 135.6, 134.1, 133.4, 130.5, 130.44, 130.0, 129.4, 127.5, 117.6, 117.2, 21.9, 21.6. HRMS: $[M + H]^+$ calculated for $C_{21}H_{19}N_2O_5S^+$: 411.1009, found: 411.1008.

***N*-(2-(4-methylbenzoyl)phenyl)-[1,1'-biphenyl]-4-sulfonamide (5ak).** White solid (84.5 mg, 99%, 0.20 mol); mp: 130-131 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 7.83 (d, J = 8.1 Hz, 1H), 7.67 (d, J = 8.4 Hz, 2H), 7.57–7.49 (m, 1H), 7.44–7.32 (m, 8H), 7.25 (d, J = 8.1 Hz, 2H), 7.13 (m, 1H), 7.05 (d, J = 8.0 Hz, 2H), 2.27 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.0, 145.6, 143.9, 138.9, 138.4, 137.3, 134.7, 133.5, 132.7, 130.1, 129.0, 129.0, 128.6, 127.8, 127.7, 127.4, 127.3, 124.3, 124.0, 21.6. HRMS: $[M + H]^+$ calculated for $C_{26}H_{22}NO_3S^+$: 428.1315, found: 428.1317.

***N*-(2-(4-methylbenzoyl)phenyl)naphthalene-1-sulfonamide (5al).** White solid (79.4 mg, 99%, 0.20 mmol) White solid; mp: 130-131 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.40 (s, 1H), 8.55 (d, J = 8.6 Hz, 1H), 8.21 (d, J = 7.3 Hz, 1H), 7.87 (d, J = 8.2 Hz, 1H), 7.73 (d, J = 8.2 Hz, 1H), 7.67 (d, J = 8.1 Hz, 1H), 7.46–7.36 (m, 3H), 7.31 (t, J = 7.5 Hz, 1H), 7.22 (d, J = 7.6 Hz, 1H), 7.07 (d, J = 8.0 Hz, 2H), 7.02 (d, J = 8.1 Hz, 2H), 6.95 (t, J = 7.6 Hz, 1H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.1, 143.5, 138.8, 134.7, 134.1, 133.8, 133.4, 132.9, 130.4, 129.9, 128.8, 128.5, 127.8, 126.9, 126.1, 124.3, 123.9, 123.0, 121.6, 21.7. HRMS: $[M + H]^+$ calculated for $C_{24}H_{20}NO_3S^+$: 402.1158, found: 402.1158.

***N*-(2-(4-methylbenzoyl)phenyl)-3-(trifluoromethyl)benzenesulfonamide (5am).** White solid (76.4 mg, 91%, 0.18 mmol); mp: 121-122 ^{o}C; Yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.03 (s, 1H), 7.88 (d, J = 8.8 Hz, 2H), 7.80 (d, J = 8.2 Hz, 1H), 7.53-7.58 (m, 2H), 7.35-7.42 (m, 2H), 7.27 (d, J = 7.9 Hz, 2H), 7.14-7.19 (m, 3H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.0, 144.2, 140.1, 138.0, 134.5, 133.8, 133.0, 131.5 (q, J = 33.3 Hz), 130.5, 130.1, 129.9, 129.5 (q, J = 3.2 Hz), 129.0, 127.0, 124.3 (q, J = 36.2 Hz), 124.3, 123.7, 120.3 (q, J = 273.7 Hz), 21.7. HRMS: $[M + H]^+$ calculated for $C_{21}H_{17}F_3NO_3S^+$: 420.0876, found: 420.0883.

***N*-(2-(4-methylbenzoyl)phenyl)benzenesulfonamide (5an).** Colorless liquid (65.9 mg, 94%, 0.19 mmol); mp: 95-96 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.16 (s, 1H), 7.86 (d, J = 8.2 Hz, 1H), 7.81–7.71 (m, 2H), 7.62–7.53 (m, 1H), 7.50–7.39 (m, 2H), 7.40–7.30 (m, 4H), 7.26 (d, J = 8.1 Hz, 2H), 7.20–7.11 (m, 1H), 2.49 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.4, 143.8, 139.1, 138.9, 135.1, 133.7, 133.2, 132.9 130.2, 129.0, 129.0, 127.3, 126.4, 123.5, 122.8, 21.8.

4-Chloro-*N*-(2-(4-methylbenzoyl)phenyl)benzenesulfonamide (5ao). White solid (70.0 mg, 91%, 0.18 mmol); mp: 118-119 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.81 (s, 1H), 7.78 (d, J = 8.2 Hz, 1H), 7.56 (d, J = 8.5 Hz, 2H), 7.54–7.47 (m, 1H), 7.39 (dd, J = 7.8, 1.3 Hz, 1H), 7.28 (d, J = 8.2 Hz, 2H), 7.21 (d, J = 8.1 Hz, 2H), 7.16 (m, 3H), 2.44 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.0, 144.3, 139.5, 138.1, 137.3, 134.6, 133.6, 132.8, 130.2, 129.3, 129.1, 128.8, 127.6, 124.2, 124.1, 21.8. HRMS: $[M + H]^+$ calculated for $C_{20}H_{17}ClNO_3S^+$: 386.0612, found: 386.0612.

4-(Tert-butyl)-*N*-(2-(4-methylbenzoyl)phenyl)benzenesulfonamide (5ap). White solid (53.7 mg, 66%, 0.13 mmol); mp: 138-139 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.08 (s, 1H), 7.81 (d, J = 8.2 Hz, 1H), 7.61 (d, J = 8.4 Hz, 2H), 7.51 (t, J = 7.6 Hz, 1H), 7.39 (d, J = 7.7 Hz, 1H), 7.32 (d, J = 8.0 Hz, 2H), 7.28 (d, J = 8.5 Hz, 2H), 7.19 (d, J = 7.9 Hz, 2H), 7.09 (t, J = 7.6 Hz, 1H), 2.41 (s, 3H), 1.19 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.4, 156.7, 143.7, 139.1, 136.2, 135.2, 133.7, 133.2, 130.1, 129.0, 127.1, 126.4, 126.0, 123.4, 123.1, 35.1, 31.0, 21.7. HRMS: $[M + H]^+$ calculated for $C_{24}H_{26}NO_3S^+$: 408.1628, found: 408.1629.

***N*-(2-(4-methylbenzoyl)phenyl)-4-nitrobenzenesulfonamide (5aq).** Yellow solid (26.5 mg, 33%, 0.07 mmol); mp: 168-170^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.68 (s, 1H), 7.95 (d, J = 8.8 Hz, 2H), 7.80 (d, J = 8.6 Hz, 1H), 7.77 (d, J = 8.8 Hz, 2H), 7.58 (m, 1H), 7.40 (d, J = 7.7 Hz, 1H), 7.25 (m, 2H), 7.21 (d, J = 7.5 Hz, 1H), 7.14 (d, J = 8.0 Hz, 2H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.3, 150.0, 145.0, 144.4, 137.0, 134.0, 133.6, 132.3, 130.3, 129.1, 128.7, 128.3, 125.3, 125.0, 124.2, 21.7. HRMS: $[M + H]^+$ calculated for $C_{20}H_{16}N_2O_5S^+$: 397.0853, found: 397.0853.

***N*-(2-(4-methylbenzoyl)phenyl)methanesulfonamide (5ar).**[13] White solid (53.0 mg, 92%, 0.18 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.13 (s, 1H), 7.80 (d, J = 7.9 Hz, 1H), 7.60 (m, 4H), 7.30 (d, J = 7.1 Hz, 2H), 7.15 (t, J = 6.9 Hz, 1H), 3.05 (s, 3H), 2.45 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.8, 143.9, 139.9, 135.4, 134.3, 134.1, 130.2, 129.2, 124.1, 122.7, 119.8, 40.2, 21.8.

***N*-(2-(4-methylbenzoyl)phenyl)acetamide (5as).**[14] White solid (21.0 mg, 39%, 0.08 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.73 (s, 1H), 8.60 (d, J = 8.3 Hz, 1H), 7.62 (d, J = 8.0 Hz, 2H), 7.56 (t, J = 7.6 Hz, 2H), 7.33–7.24 (m, 2H), 7.08 (t, J = 7.6 Hz, 1H), 2.45 (s, 3H), 2.22 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.5, 169.3, 143.7, 140.4, 136.0, 134.1, 133.4, 130.4, 129.2, 123.8, 122.2, 121.7, 25.4, 21.8.

General Procedure for Synthesis of 6. Quinoline-8-carbaldehyde (0.20 mmol), diaryliodonium salts (0.24 mmol), $[RhCp^*Cl_2]_2$ (2 mol %), $AgNTf_2$ (16 mol %), 200 mg 4Å MS and, cyclohexane (2.0 mL) were charged into the sealed tube. The reaction mixture was stirred at 100 °C for 20 h. After cooled to room temperature, the solvent was removed

under reduced pressure and the residue was purified by silica gel chromatography using PE/EA (25:1-8:1) to afford compounds **6**.

Phenyl(quinolin-8-yl)methanone (6aa).[15] White solid (46.4 mg, 99%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 (dd, J = 4.2, 1.7 Hz, 1H), 8.21 (dd, J = 8.3, 1.6 Hz, 1H), 7.96 (dd, J = 8.2, 1.2 Hz, 1H), 7.89–7.76 (m, 2H), 7.74 (dd, J = 7.0, 1.3 Hz, 1H), 7.66–7.59 (m, 1H), 7.55 (t, J = 7.4 Hz, 1H), 7.45–7.33 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.0, 151.0, 146.3, 139.5, 137.9, 136.1, 133.4, 130.4, 129.8, 128.5, 128.4, 126.0, 121.8.

Quinolin-8-yl(*o*-tolyl)methanone (6ab).[15] White solid (41.8 mg, 85%, 0.17 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 (dd, J = 4.1, 1.6 Hz, 1H), 8.17 (dd, J = 8.3, 1.3 Hz, 1H), 7.93 (d, J = 8.1 Hz, 1H), 7.72 (dd, J = 7.0, 1.1 Hz, 1H), 7.64–7.53 (m, 1H), 7.42–7.27 (m, 4H), 7.08 (m, 1H), 2.68 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.0, 151.1, 146.2, 140.7, 139.8, 138.1, 136.0, 132.4, 131.9, 131.8, 130.1, 128.8, 128.4, 125.9, 125.4, 121.6, 21.8.

Quinolin-8-yl(*m*-tolyl)methanone (6ac).[15] White solid (45.7 mg, 92%, 0.18 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.83 (d, J = 2.4 Hz, 1H), 8.19 (d, J = 8.3 Hz, 1H), 7.94 (d, J = 8.1 Hz, 1H), 7.75–7.69 (m, 2H), 7.61 (t, J = 7.6 Hz, 1H), 7.55 (d, J = 7.7 Hz, 1H), 7.43–7.32 (m, 2H), 7.26 (t, J = 7.6 Hz, 1H), 2.34 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.2, 150.9, 146.2, 139.6, 138.24, 137.9, 136.1, 134.2, 130.4, 129.7, 128.3, 128.2, 127.9, 125.9, 121.7, 21.4.

Quinolin-8-yl(*p*-tolyl)methanone (6ad).[15] White solid (48.4 mg, 98%, 0.20 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.85 (dd, J = 4.2, 1.7 Hz, 1H), 8.21 (dd, J = 8.3, 1.7 Hz, 1H), 7.95 (dd, J = 8.1, 1.3 Hz, 1H), 7.73 (dd, J = 10.2, 4.8 Hz, 3H), 7.65–7.54 (m, 1H), 7.41 (dd, J = 8.3, 4.2 Hz, 1H), 7.21 (d, J = 8.0 Hz, 2H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.7 151.0, 146.3, 144.3, 136.1, 135.5, 130.5, 129.7, 129.2, 128.4, 128.2, 126.0, 121.7, 21.9.

(5-Bromoquinolin-8-yl)(phenyl)methanone (6ae).[15] White solid (53.6 mg, 86%, 0.17 mmol); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.86–8.77 (m, 1H), 8.58 (dd, J = 8.5, 1.5 Hz, 1H), 7.92 (dd, J = 7.6, 2.8 Hz, 1H), 7.83–7.79 (m, 2H), 7.60 (dd, J = 7.6, 1.7 Hz, 1H), 7.57–7.47 (m, 2H), 7.40 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.1, 151.5, 146.8, 139.3, 137.63, 135.6, 133.5, 130.2, 129.8, 128.5, 128.4, 127.7, 123.8, 122.9.

(5-Bromoquinolin-8-yl)(*o*-tolyl)methanone (6af). White solid (59.7 mg, 92%, 0.18 mmol); mp: 130-131 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.83 (dd, J = 4.1, 1.5 Hz, 1H), 8.56 (dd, J = 8.6, 1.4 Hz, 1H), 7.88 (d, J = 7.7 Hz, 1H), 7.59 (d, J = 7.7 Hz, 1H), 7.49 (dd, J = 8.6, 4.2 Hz, 1H), 7.40–7.34 (m, 1H), 7.32–7.23 (m, 2H), 7.08 (m, 1H), 2.69 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 199.1, 151.6, 146.8, 140.6, 40.0, 137.7, 135.5, 132.4, 132.0, 132.0, 129.8, 128.8, 127.8, 125.4, 124.1, 122.8, 21.9. HRMS: $[M + H]^+$ calculated for $C_{17}H_{13}BrNO^+$: 326.0175, found: 326.0176.

(5-Bromoquinolin-8-yl)(*m*-tolyl)methanone (6ag). White solid (60.4 mg, 93%, 0.19 mmol); mp: 107-108 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 (dd, J = 4.2, 1.6 Hz, 1H), 8.84 (dd, J = 4.2, 1.6 Hz, 1H), 8.59 (dd, J = 8.6, 1.6 Hz, 1H), 8.59 (dd, J = 8.6, 1.6 Hz, 1H), 7.91 (d, J = 7.6 Hz, 1H), 7.70 (s, 1H), 7.58 (d, J = 7.6 Hz, 1H), 7.55–7.48 (m, 2H), 7.37 (d, J = 7.5 Hz, 1H), 7.28 (d, J = 7.6 Hz, 1H), 2.35 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.3, 151.5, 146.9, 139.5, 138.4, 137.6, 135.6, 134.4, 130.4, 129.8, 128.4, 128.3, 127.8, 127.7, 123.7, 122.9 21.4. HRMS: $[M + H]^+$ calculated for $C_{17}H_{13}BrNO^+$: 326.0175, found: 326.0177.

(5-Bromoquinolin-8-yl)(*p*-tolyl)methanone (6ah). White solid (61.3 mg, 94%, 0.19 mmol); mp: 173-174^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 (dd, J = 4.2, 1.7 Hz, 1H), 8.58 (dd, J = 8.6, 1.7 Hz, 1H), 7.91 (d, J = 7.6 Hz, 1H), 7.71 (d, J = 8.2 Hz, 2H), 7.57 (d, J = 7.6 Hz, 1H), 7.51 (dd, J = 8.6, 4.2 Hz, 1H), 7.20 (d, J = 8.0 Hz, 2H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.7, 151.5, 146.8, 144.5, 139.6, 135.5 135.2, 130.4, 129.8, 129.3, 128.3, 127.7, 123.6, 122.8, 21.9. ^{1}H NMR HRMS: $[M + H]^+$ calculated for $C_{17}H_{13}BrNO^+$: 326.0175, found: 326.0176**.**

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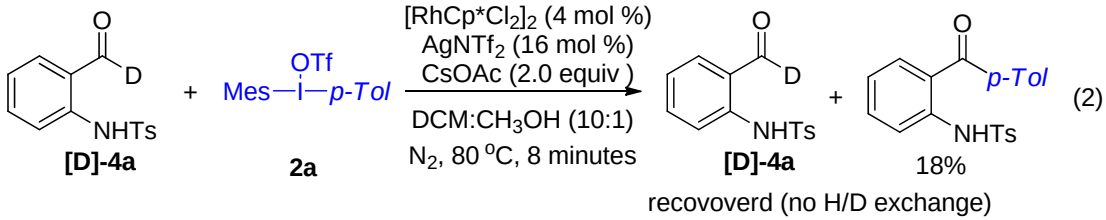
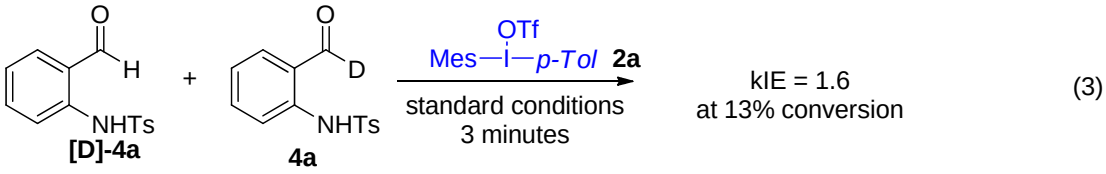
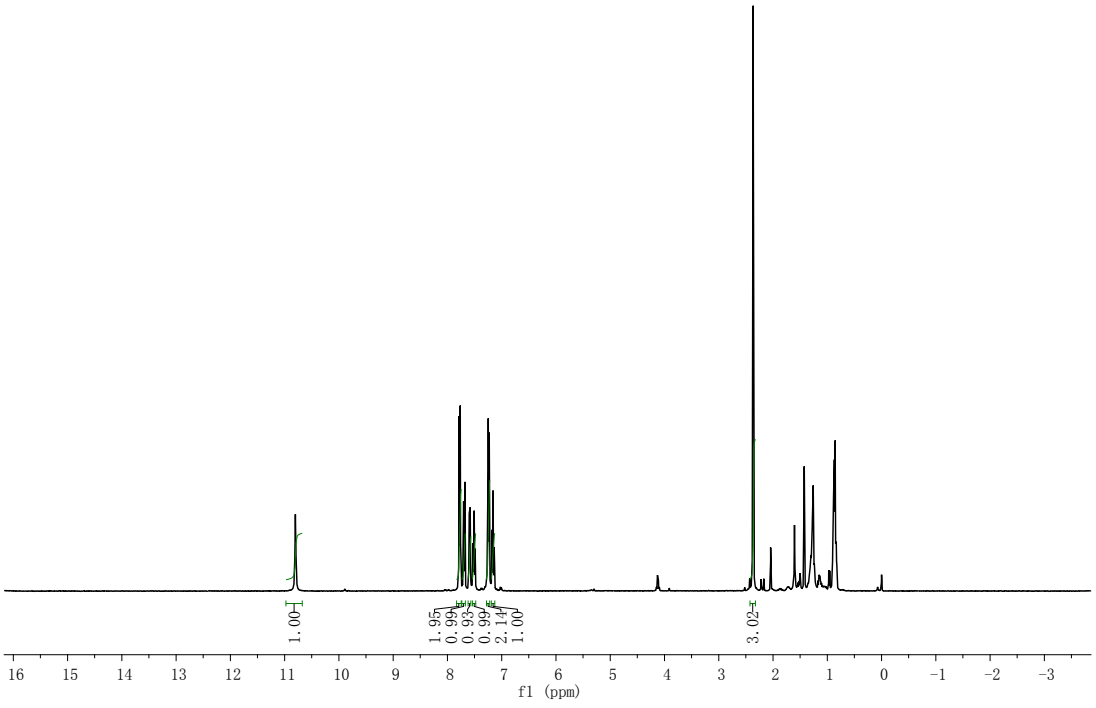
H/D exchange





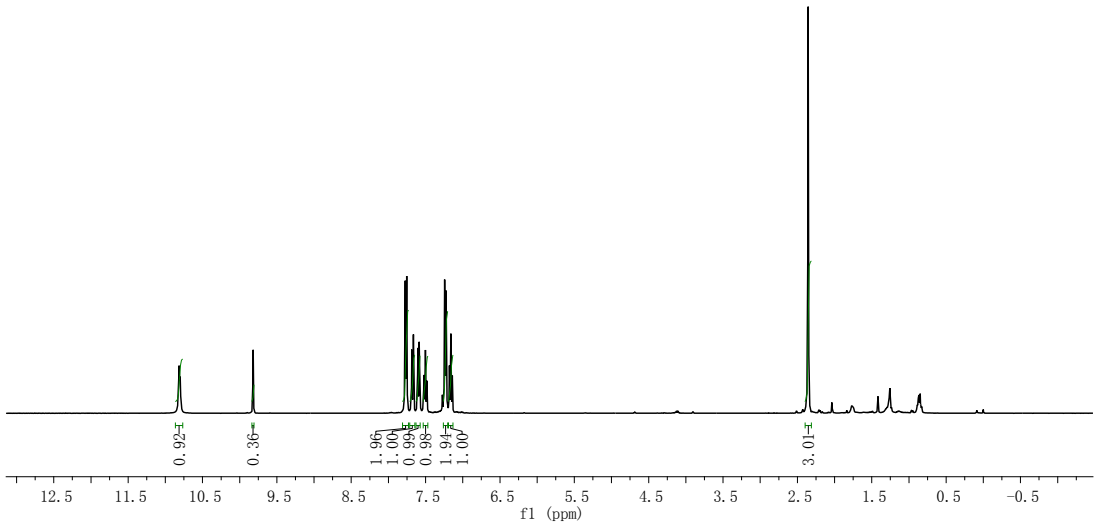
4a (0.2 mmol), **2a** (0.4 mmol) $[RhCp^*Cl_2]_2$ (4 mol %), $AgNTf_2$ (16 mol %), CsOAc (0.4 mmol), and DCM：CH_3OH（10：1，2mL）were charged into an NMR tube, and the mixture was heated at 80 ^oC for 8 minutes. No H/D exchange was observed on the basis of ^1H NMR analysis.



Deuterium-Labeling Experiment

An equimolar mixture of **4a** and [D]-**4a** (0.4 mmol in total), **2a** (0.40 mmol), $[Cp^*RhCl_2]_2$ (0.08 mmol), $AgNTf_2$ (0.16 mmol), CsOAc (0.4 mmol) were charged into a pressure tube, to which was added DCM (2.0 mL) The reaction mixture was stirred under N_2 at 80 ^oC for 3 minutes. After quenched at 0 ^oC, the conversion was isolated 13% after chromatography using EA/PE (25:1). ^1H NMR analysis of the level of deuteration of the recovered aldehydes (64% C-D and 36% C-H)

gave $k_H/k_D = 1.6$

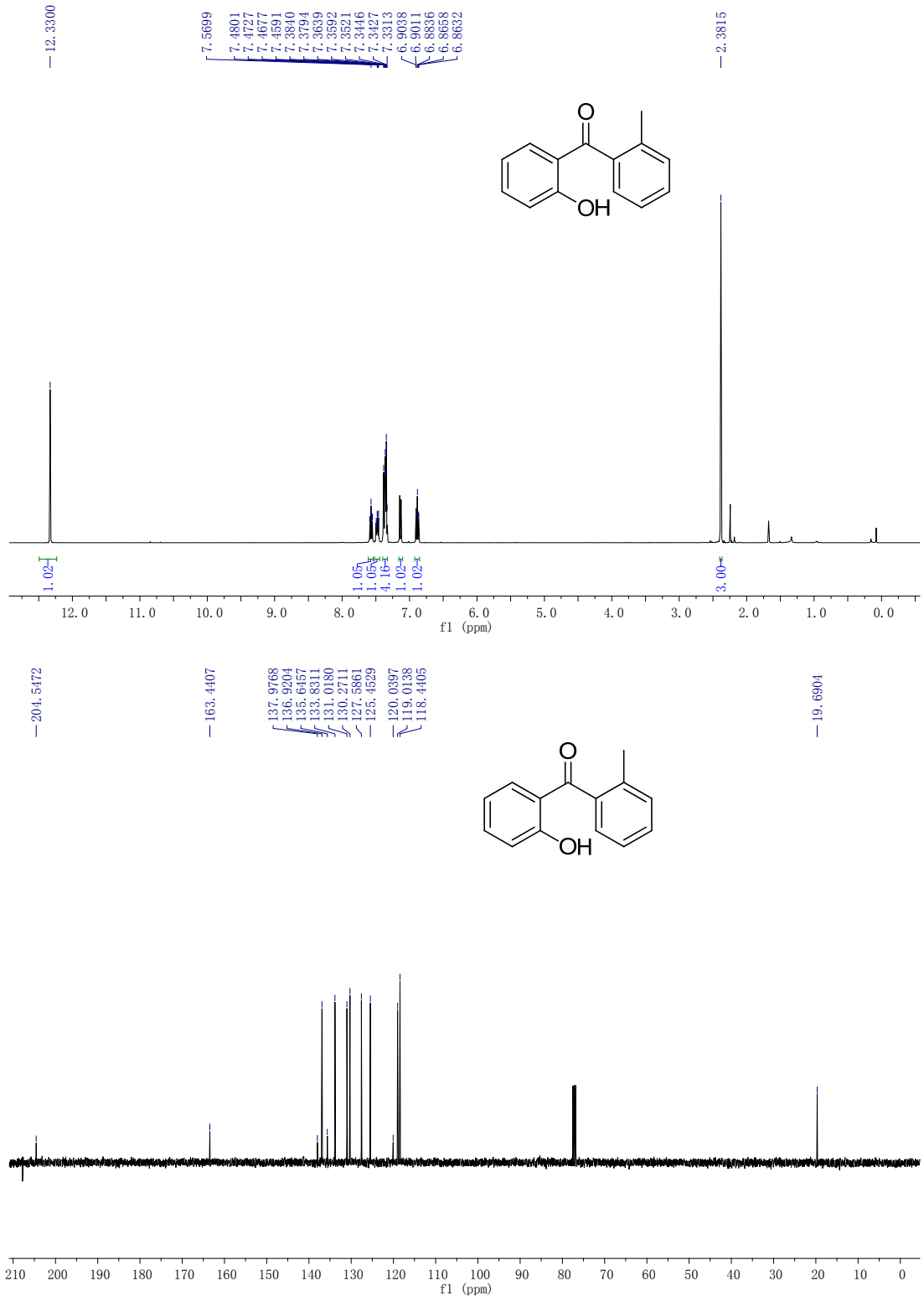


	C-H	C-D
$t = 0$	1	1
conversion	-kx	-x
$t = 3$ minutes	1-kx	1-x

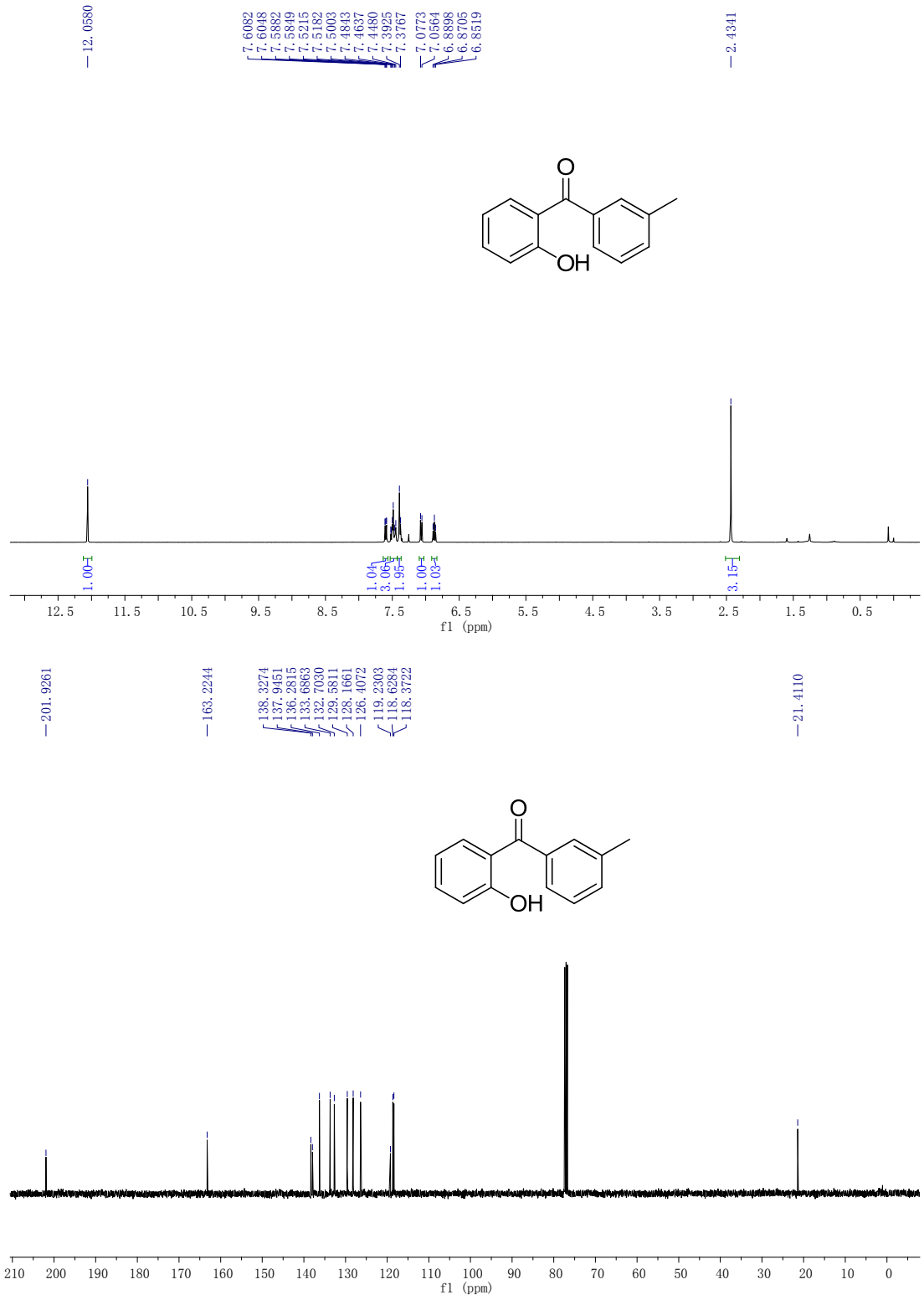
(1-x)/(1-kx) = 0.64/0.36
(kx+x)/2 = 0.13
k = KIE = 1.6

NMR spectra

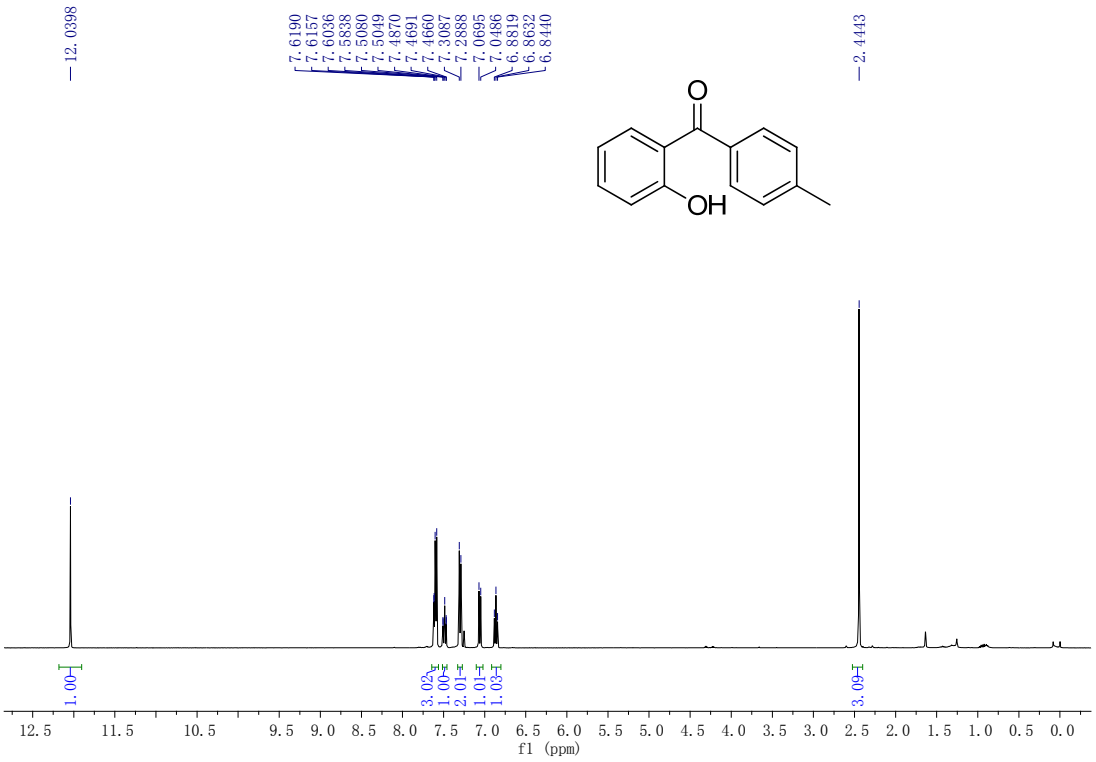
^{1}H and ^{13}C NMR Spectra of Compound **3aa**

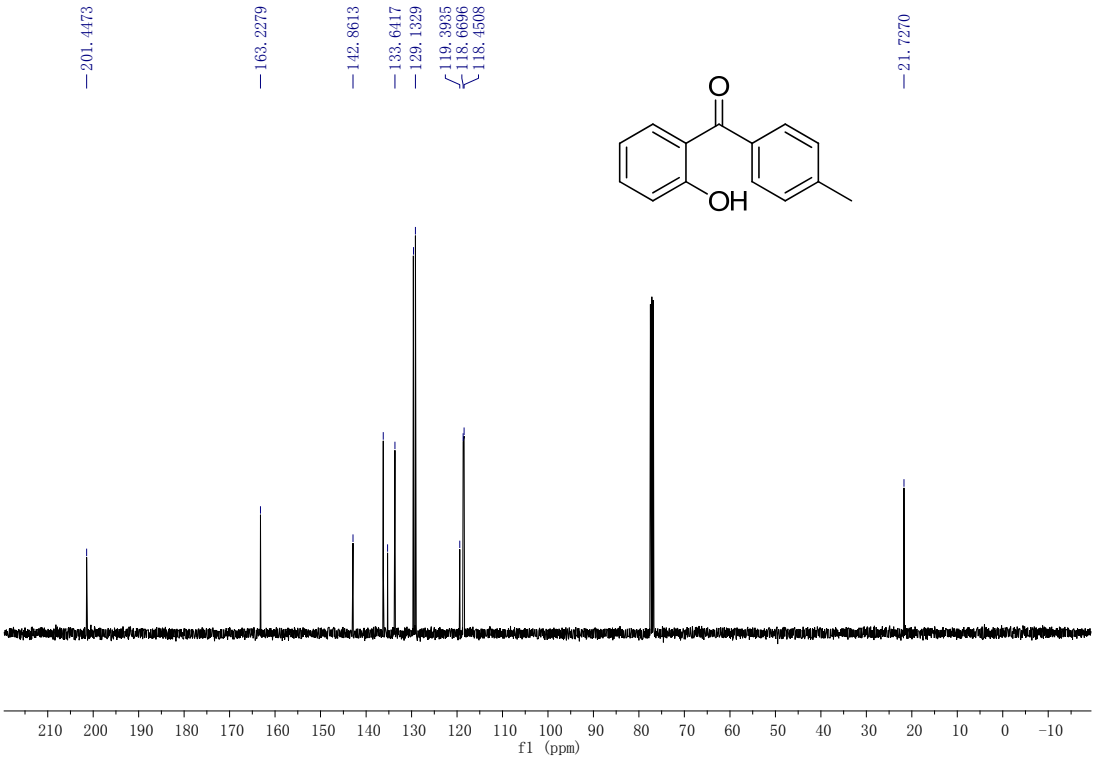


^{1}H and ^{13}C NMR Spectra of Compound **3ab**

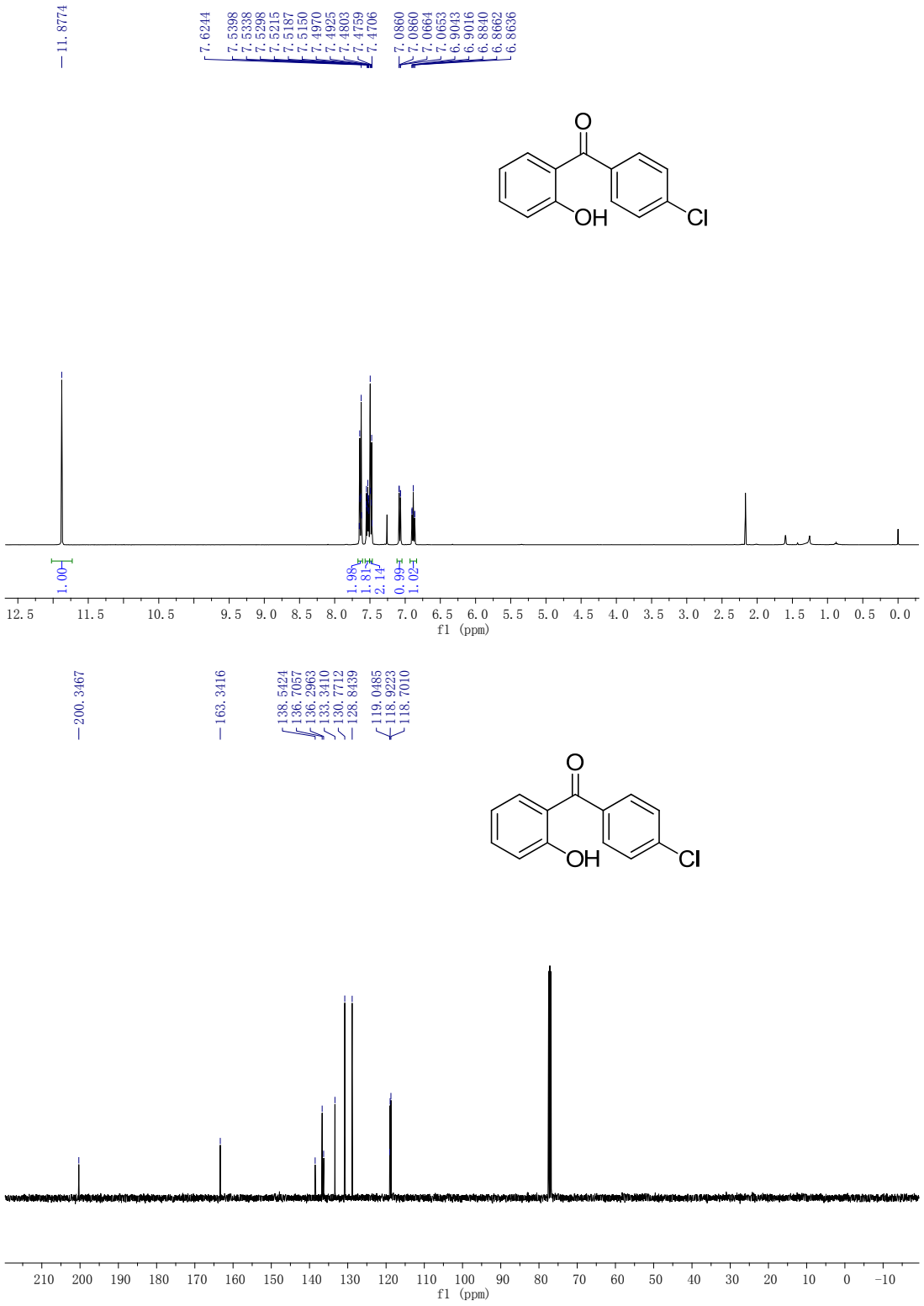


^{1}H and ^{13}C NMR Spectra of Compound **3ac**

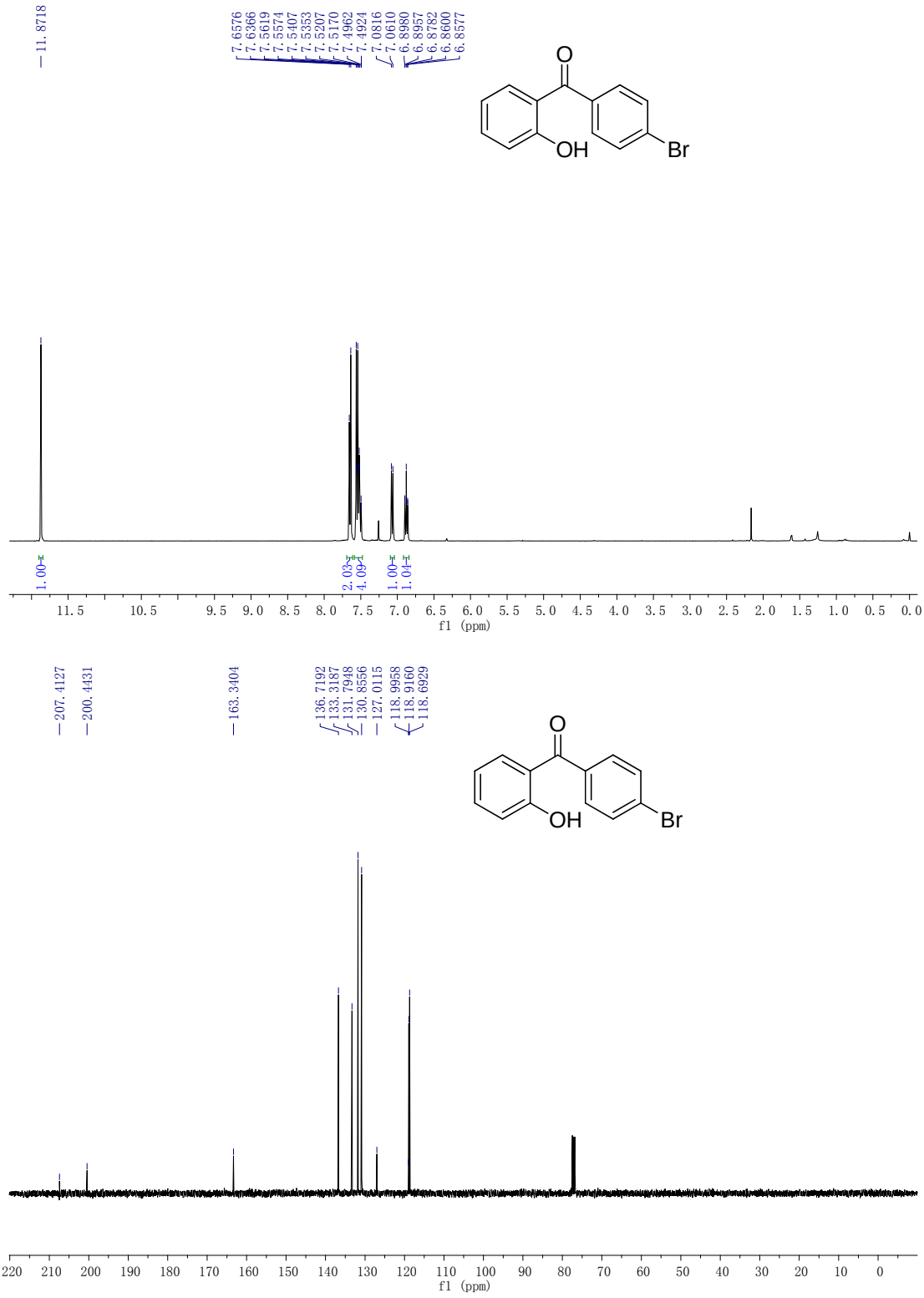




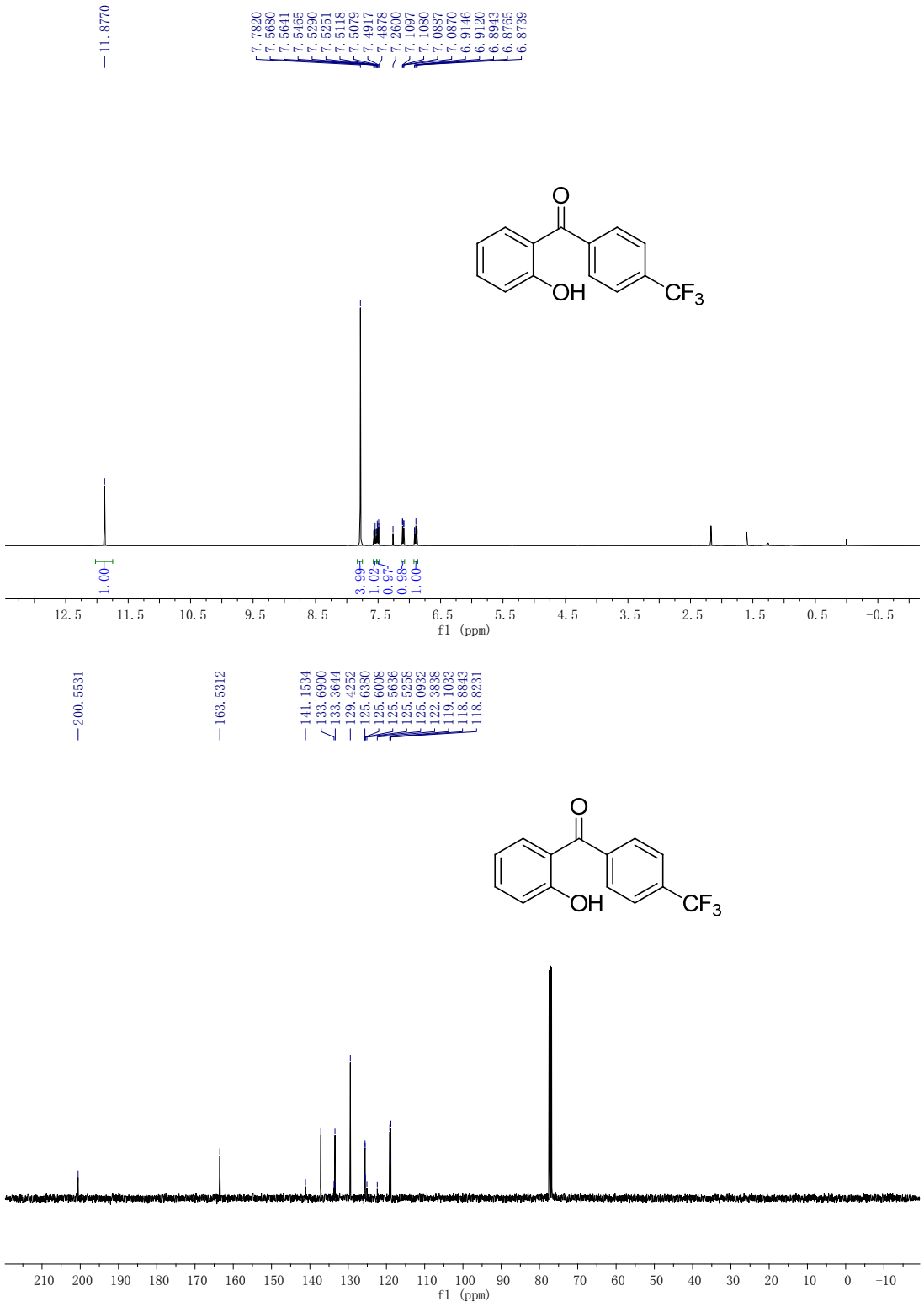
^{1}H and ^{13}C NMR Spectra of Compound **3ad**



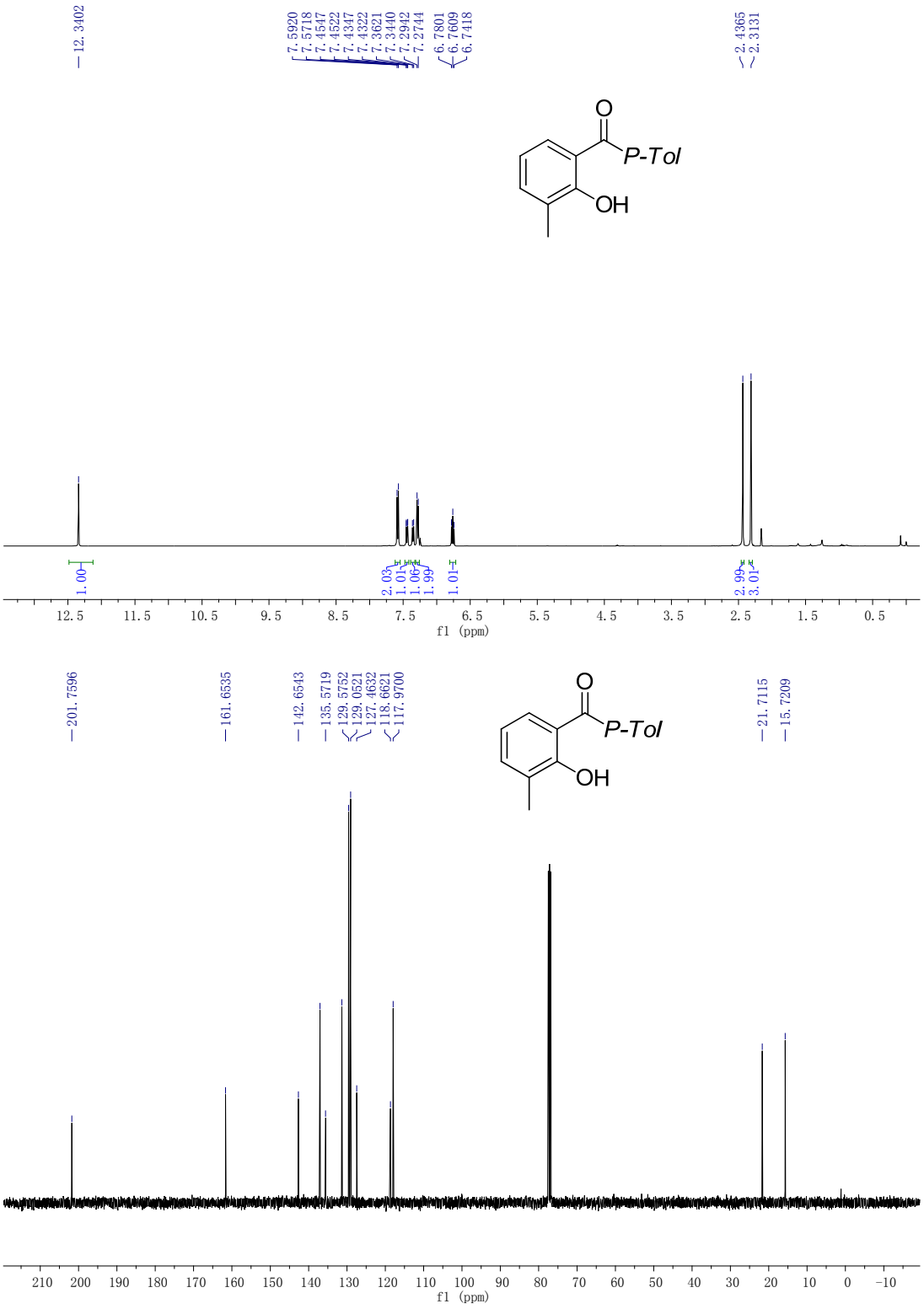
^{1}H and ^{13}C NMR Spectra of Compound **3ae**



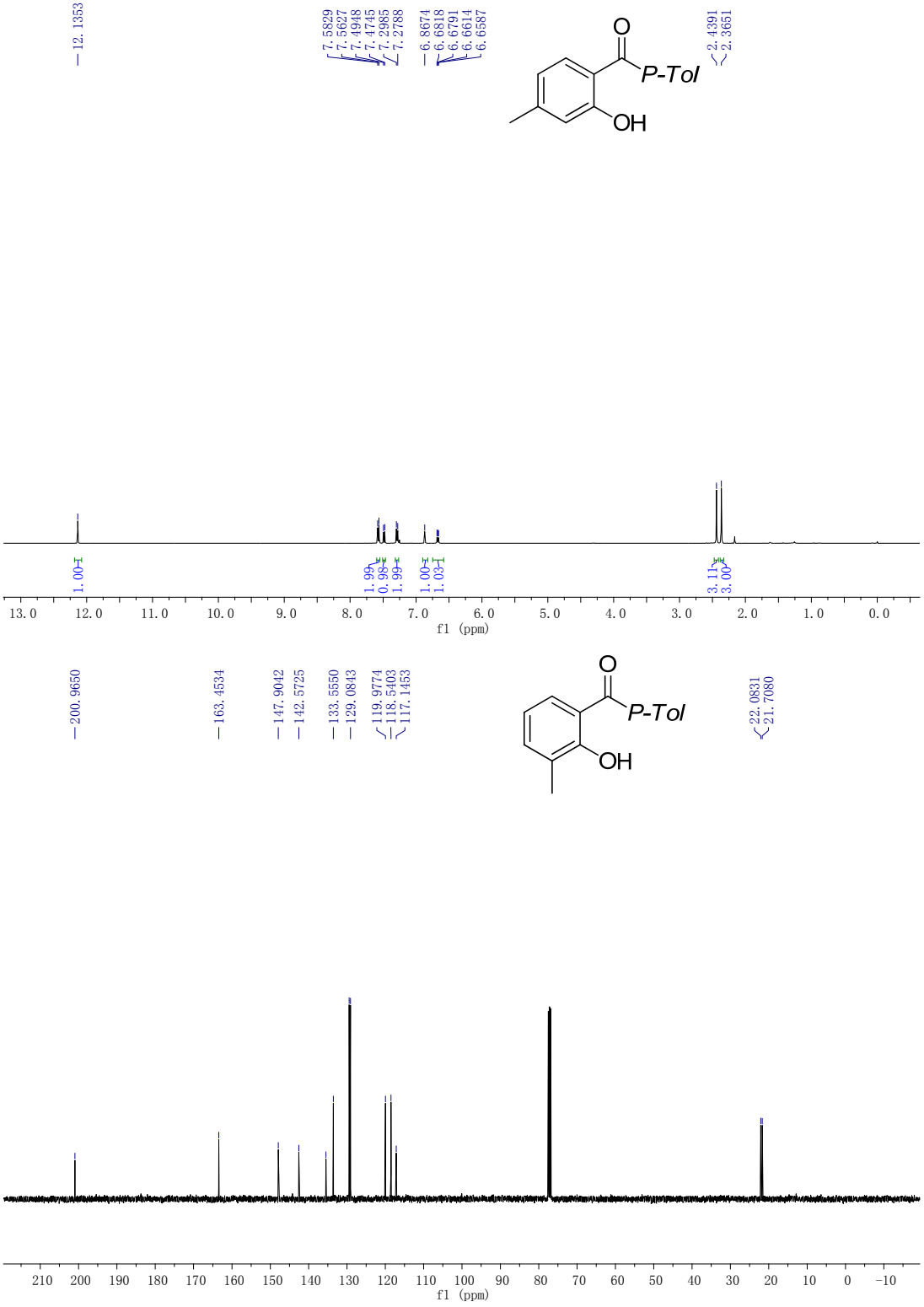
^{1}H and ^{13}C NMR Spectra of Compound **3af**



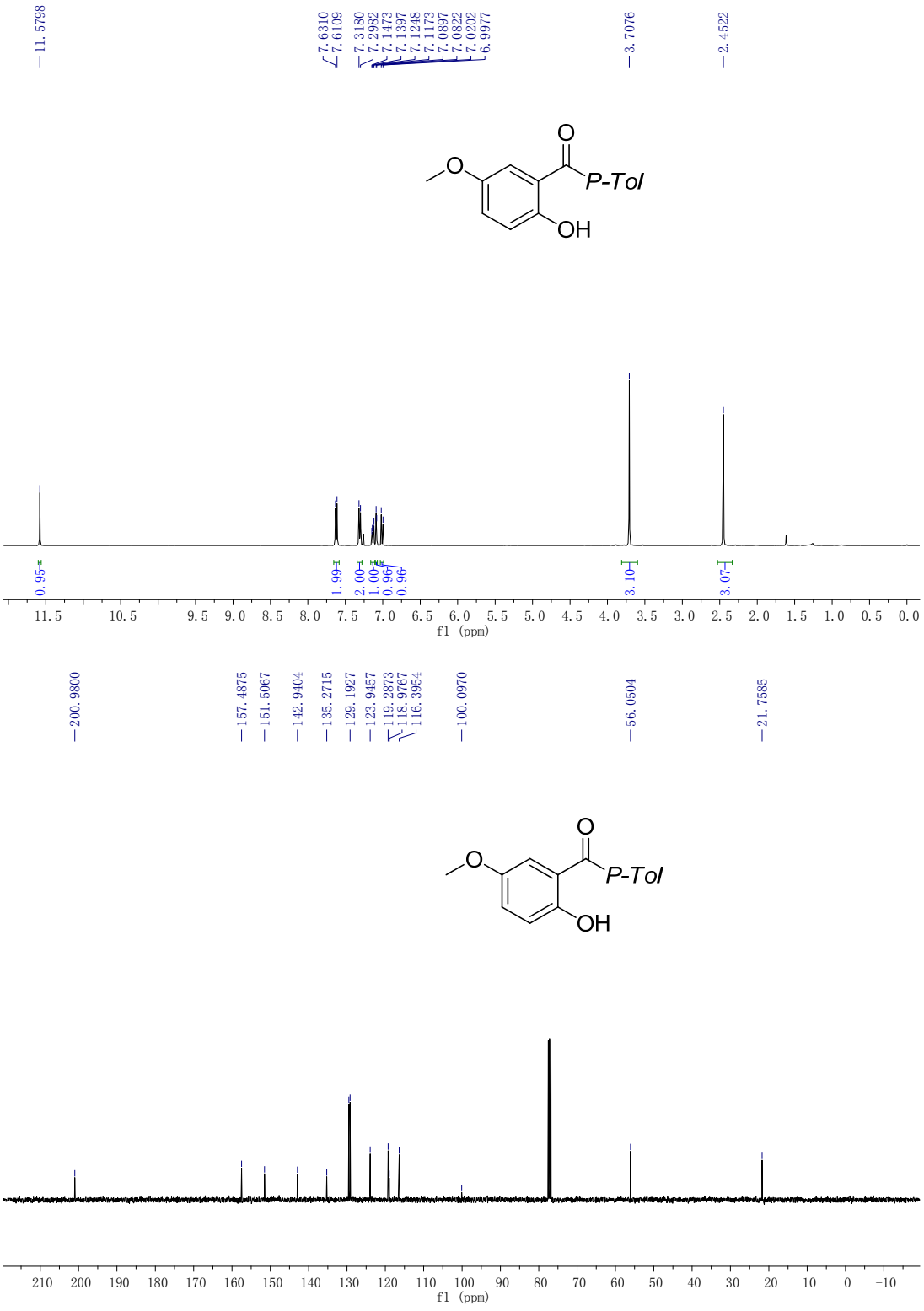
^{1}H and ^{13}C NMR Spectra of Compound **3ag**



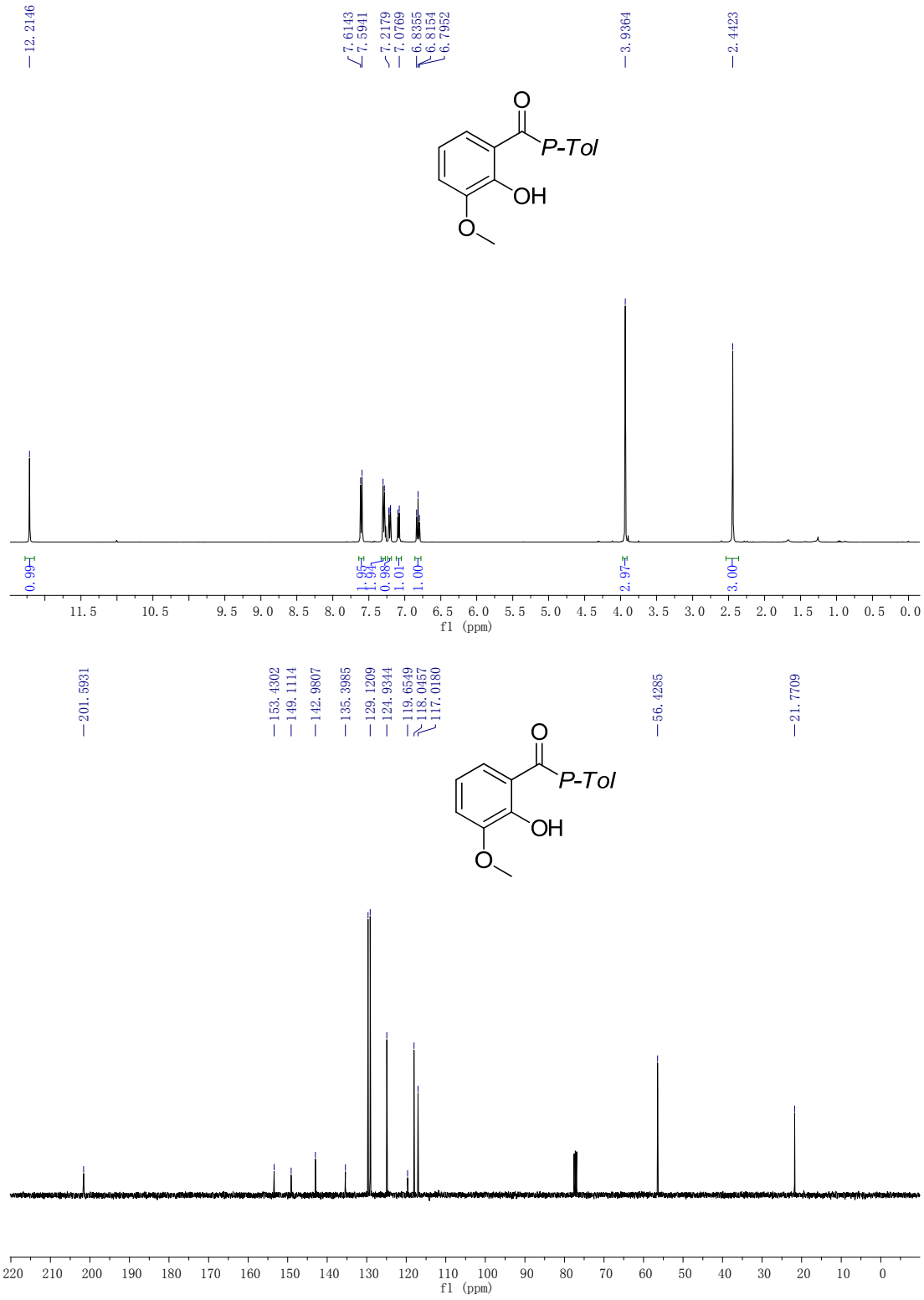
^{1}H and ^{13}C NMR Spectra of Compound **3ah**



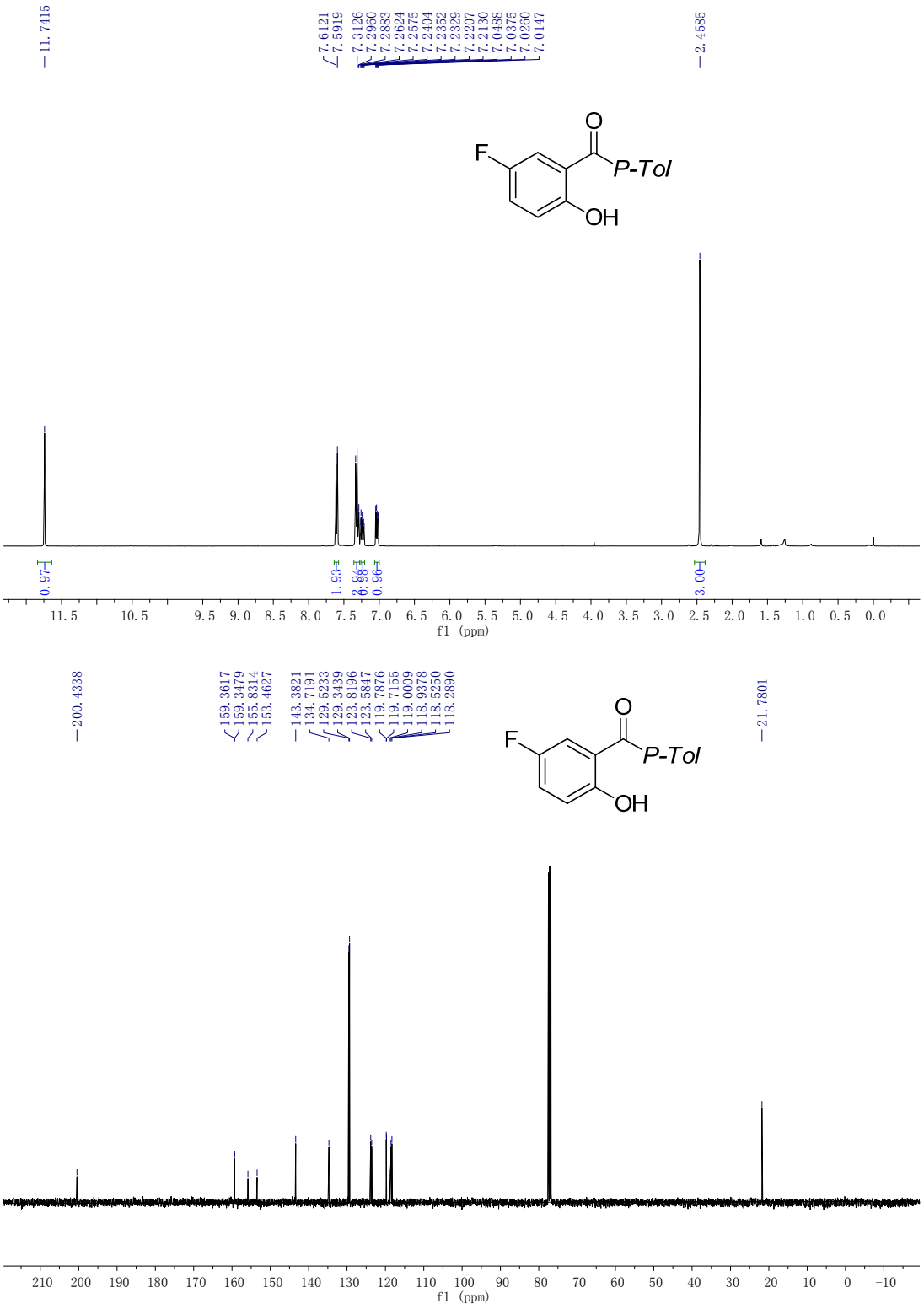
^{1}H and ^{13}C NMR Spectra of Compound **3ai**



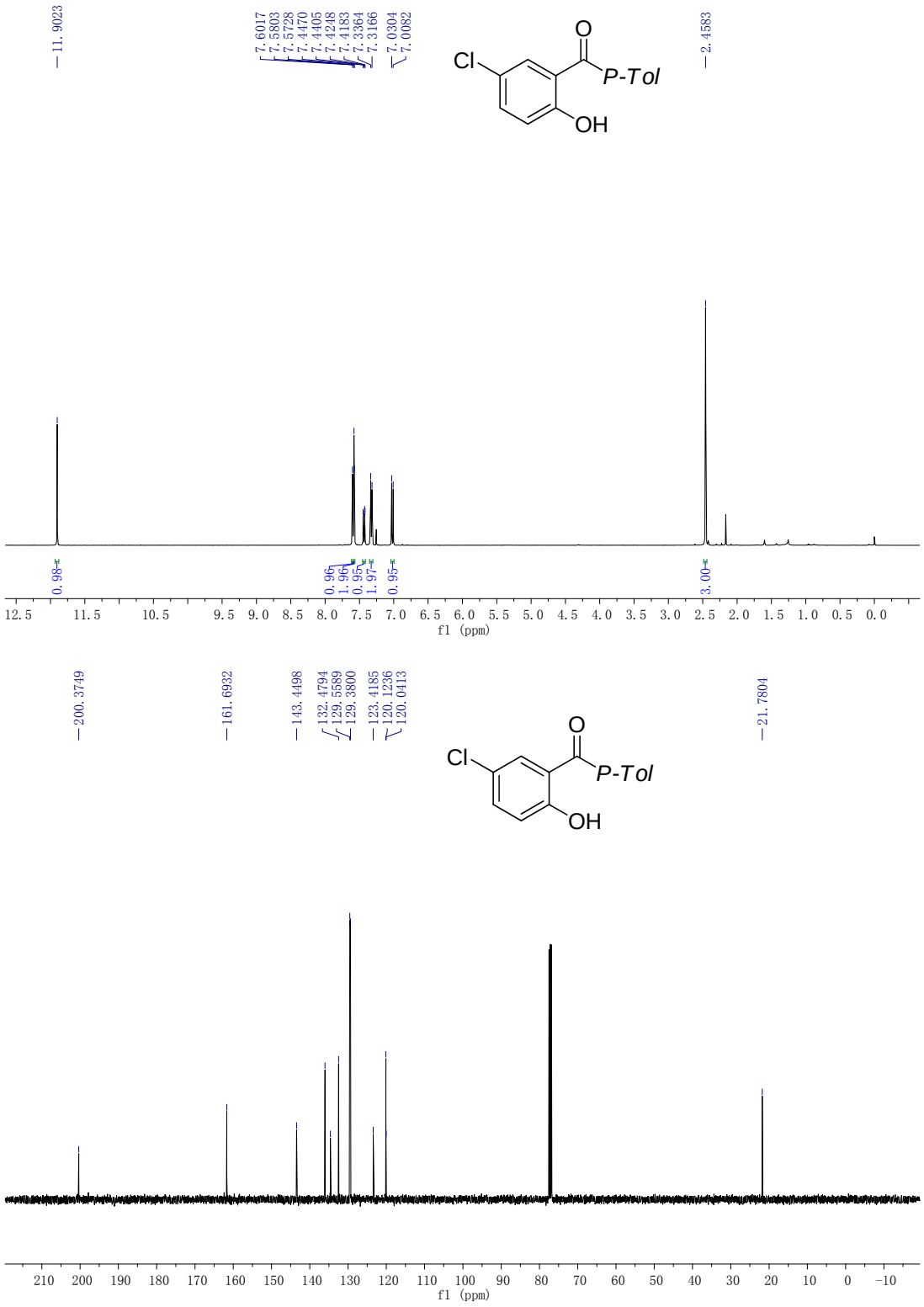
^{1}H and ^{13}C NMR Spectra of Compound **3aj**



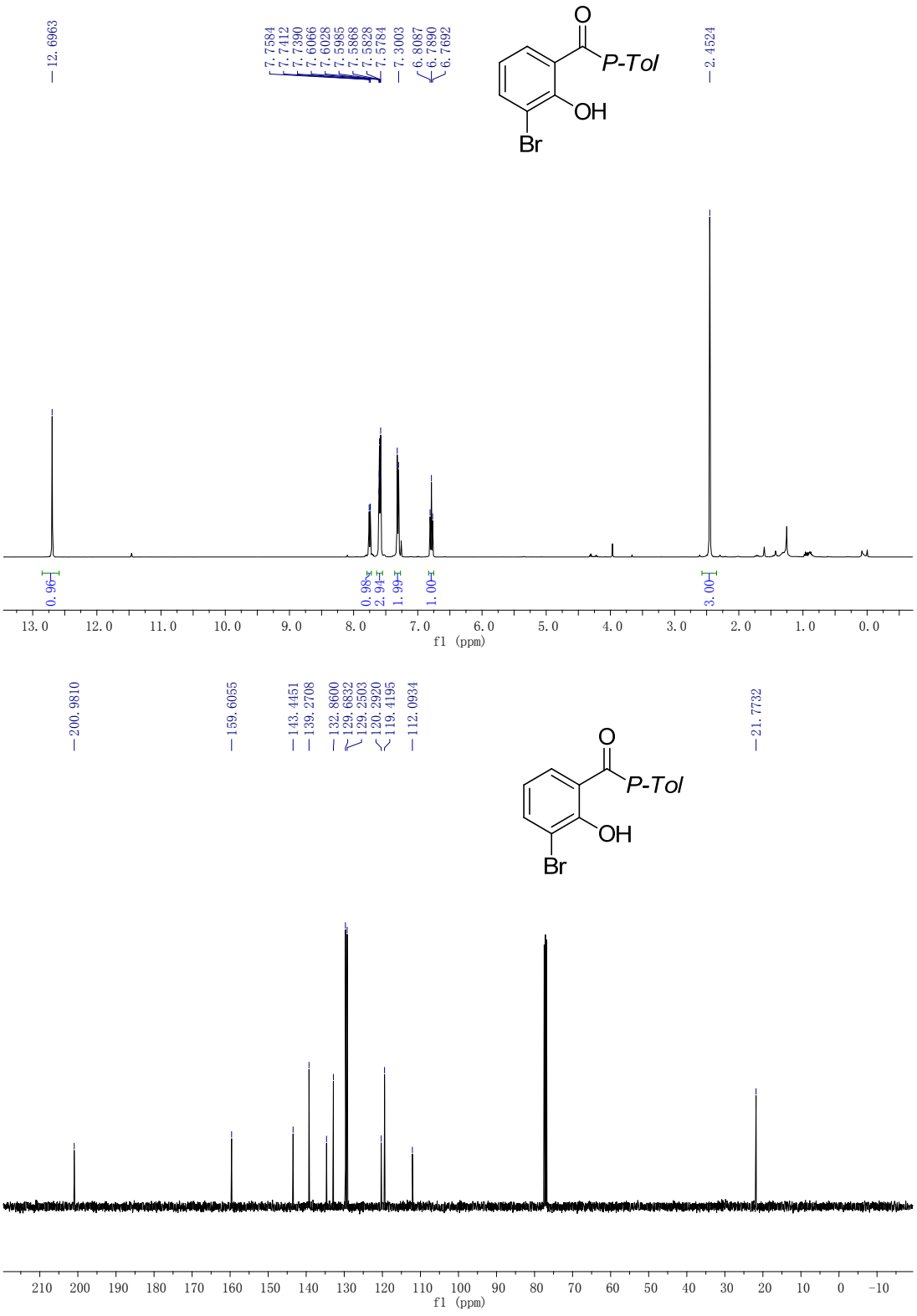
^{1}H and ^{13}C NMR Spectra of Compound **3ak**



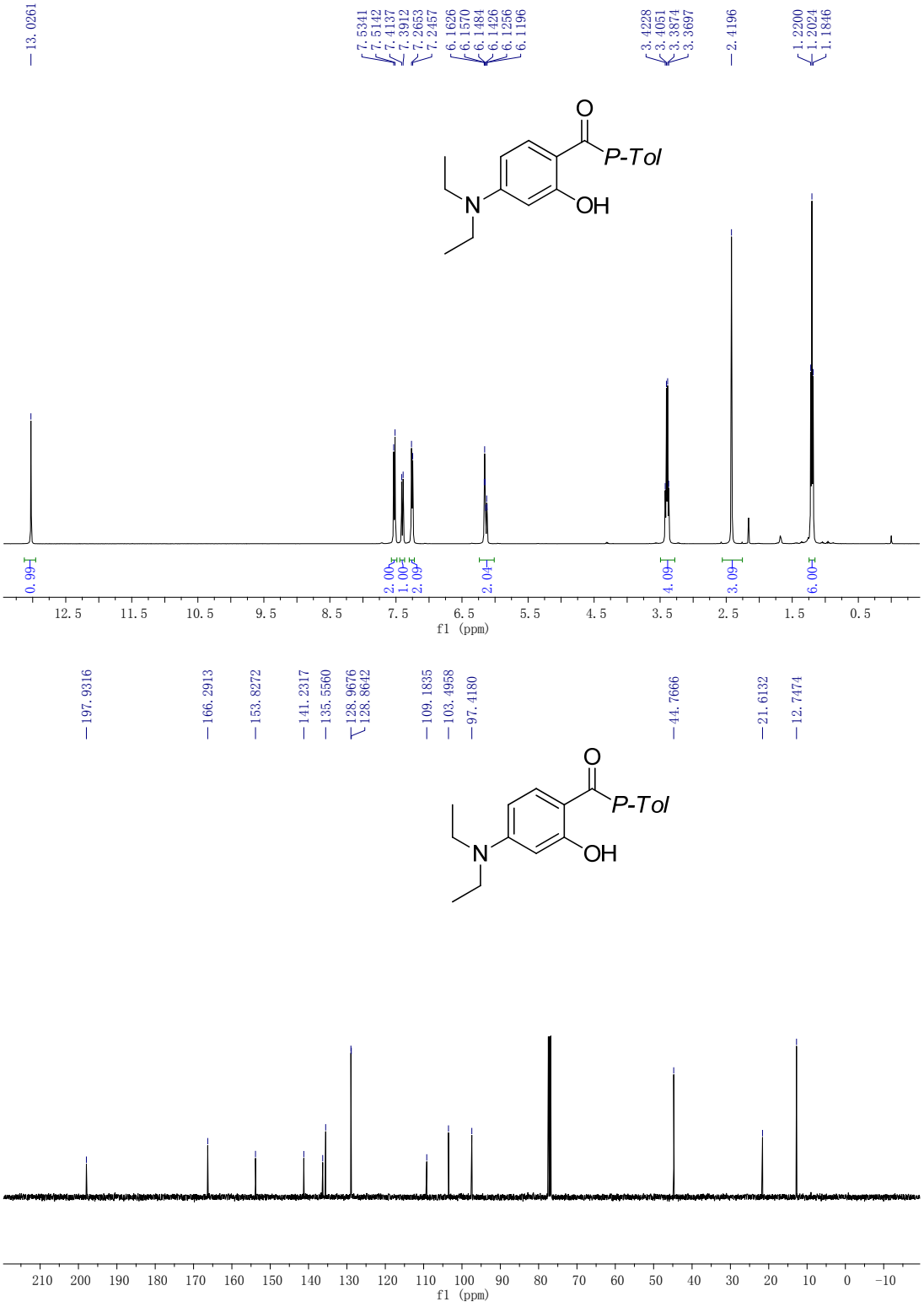
^{1}H and ^{13}C NMR Spectra of Compound **3al**



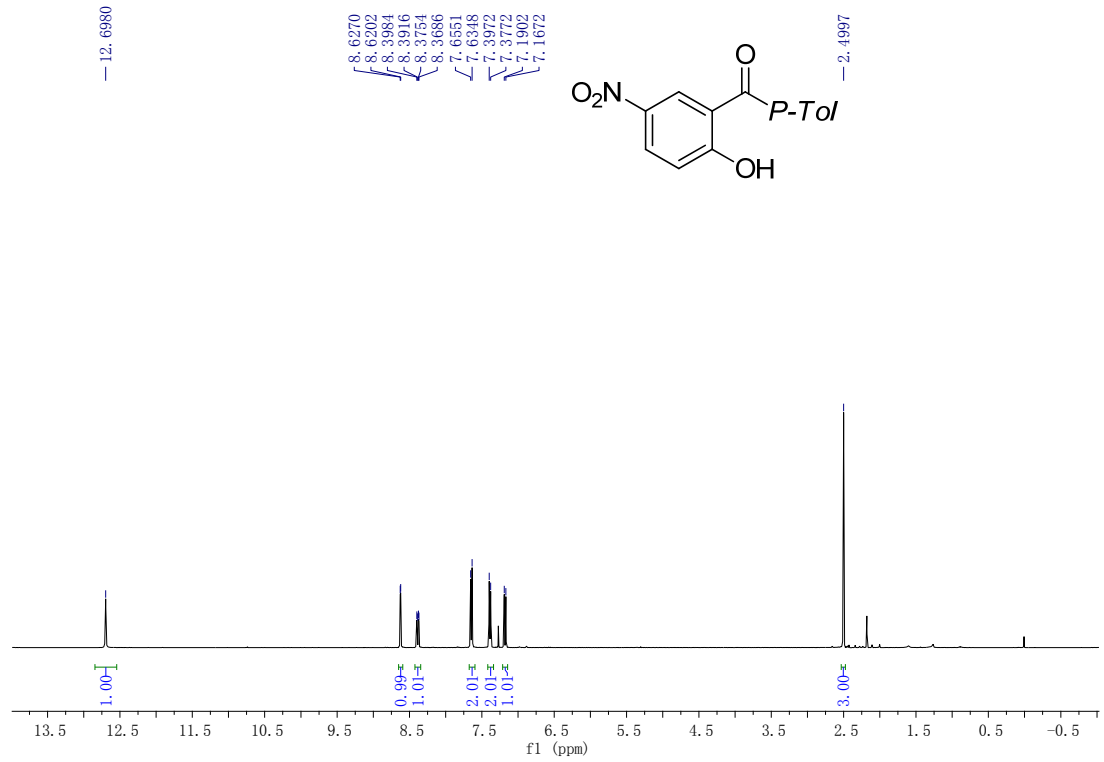
^{1}H and ^{13}C NMR Spectra of Compound **3am**

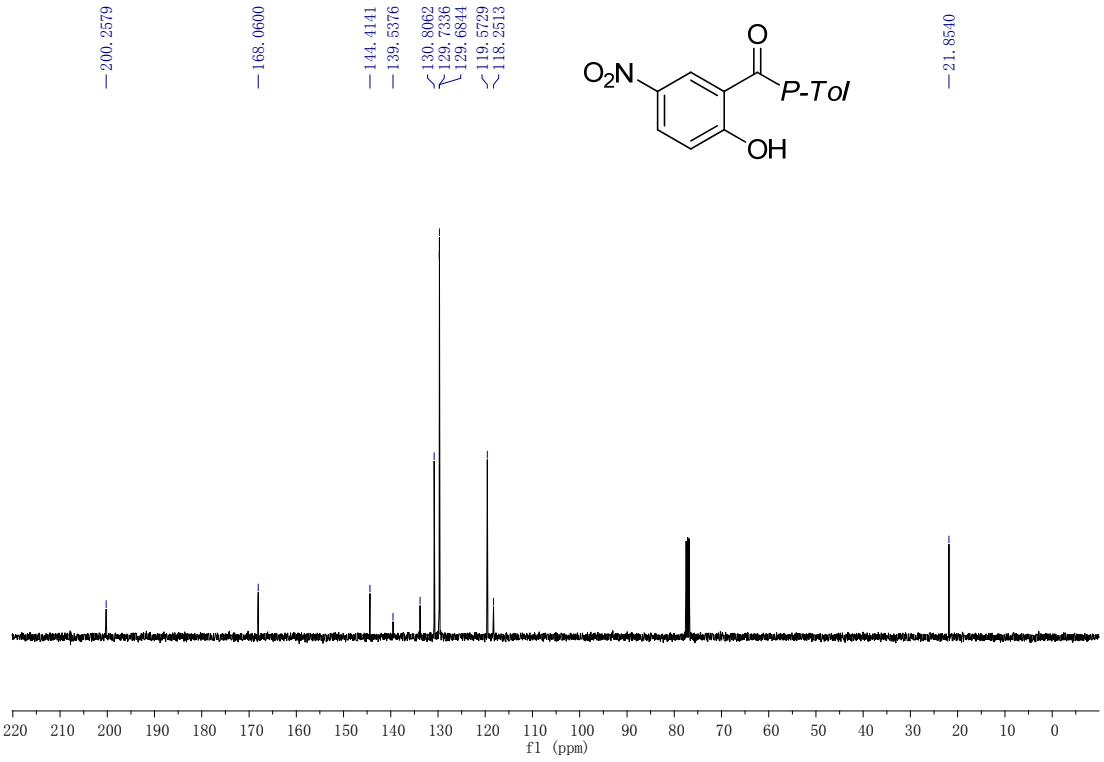


^{1}H and ^{13}C NMR Spectra of Compound **3an**

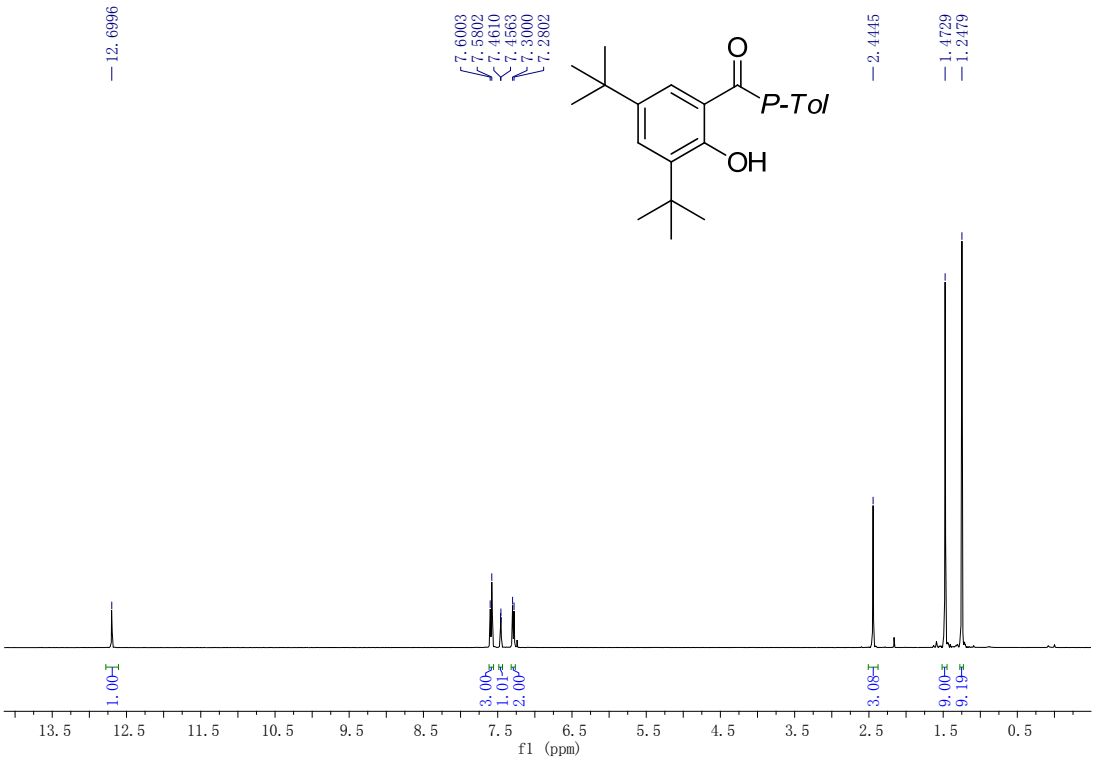


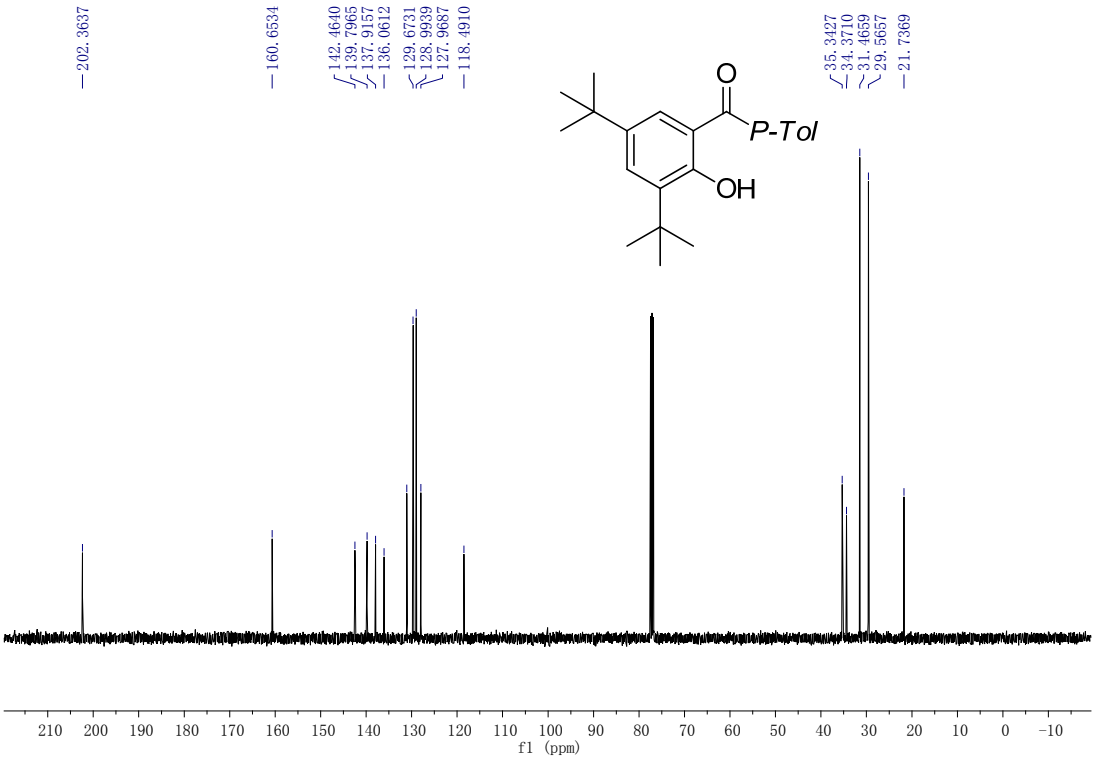
^{1}H and ^{13}C NMR Spectra of Compound **3ao**



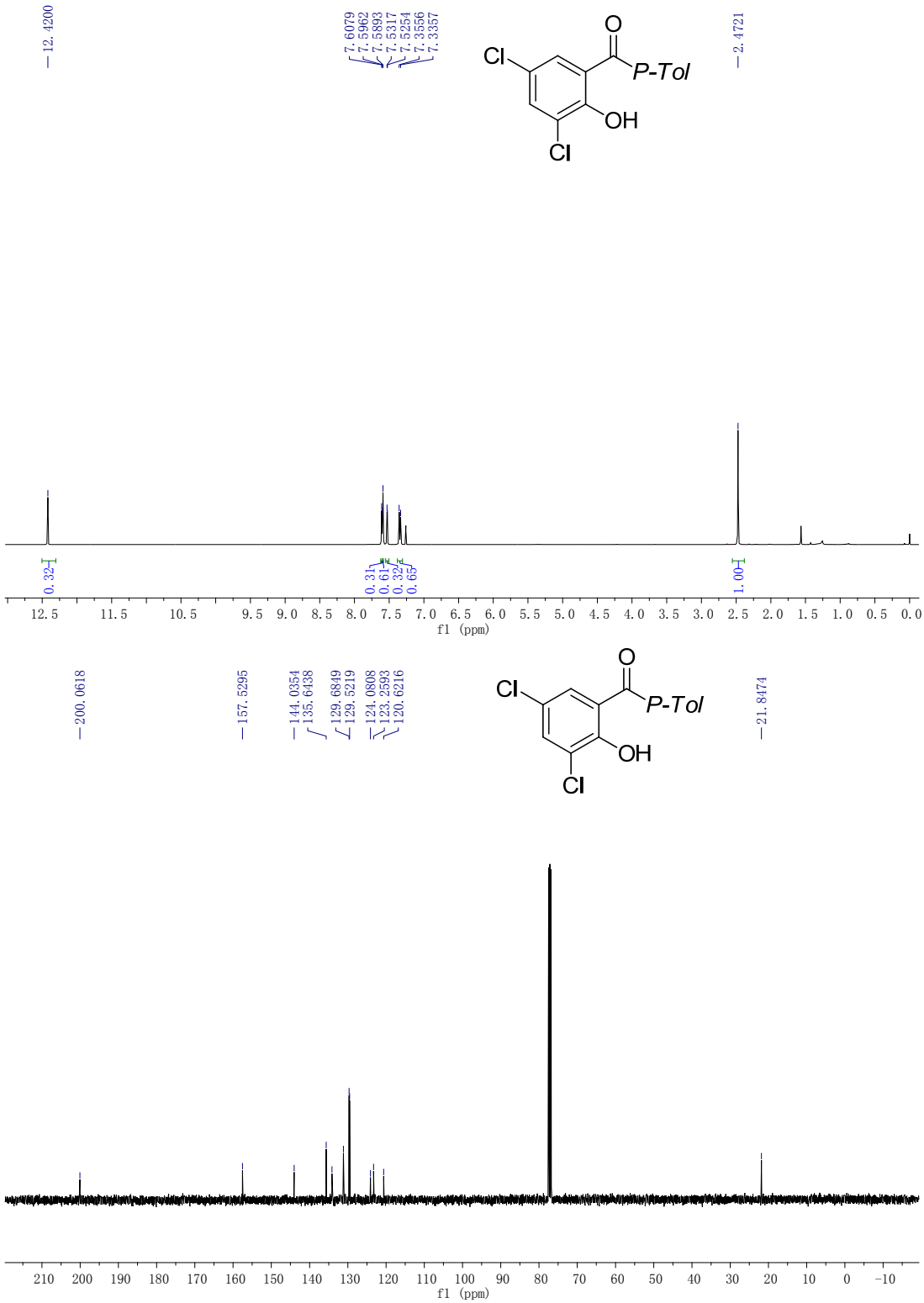


^{1}H and ^{13}C NMR Spectra of Compound **3ap**

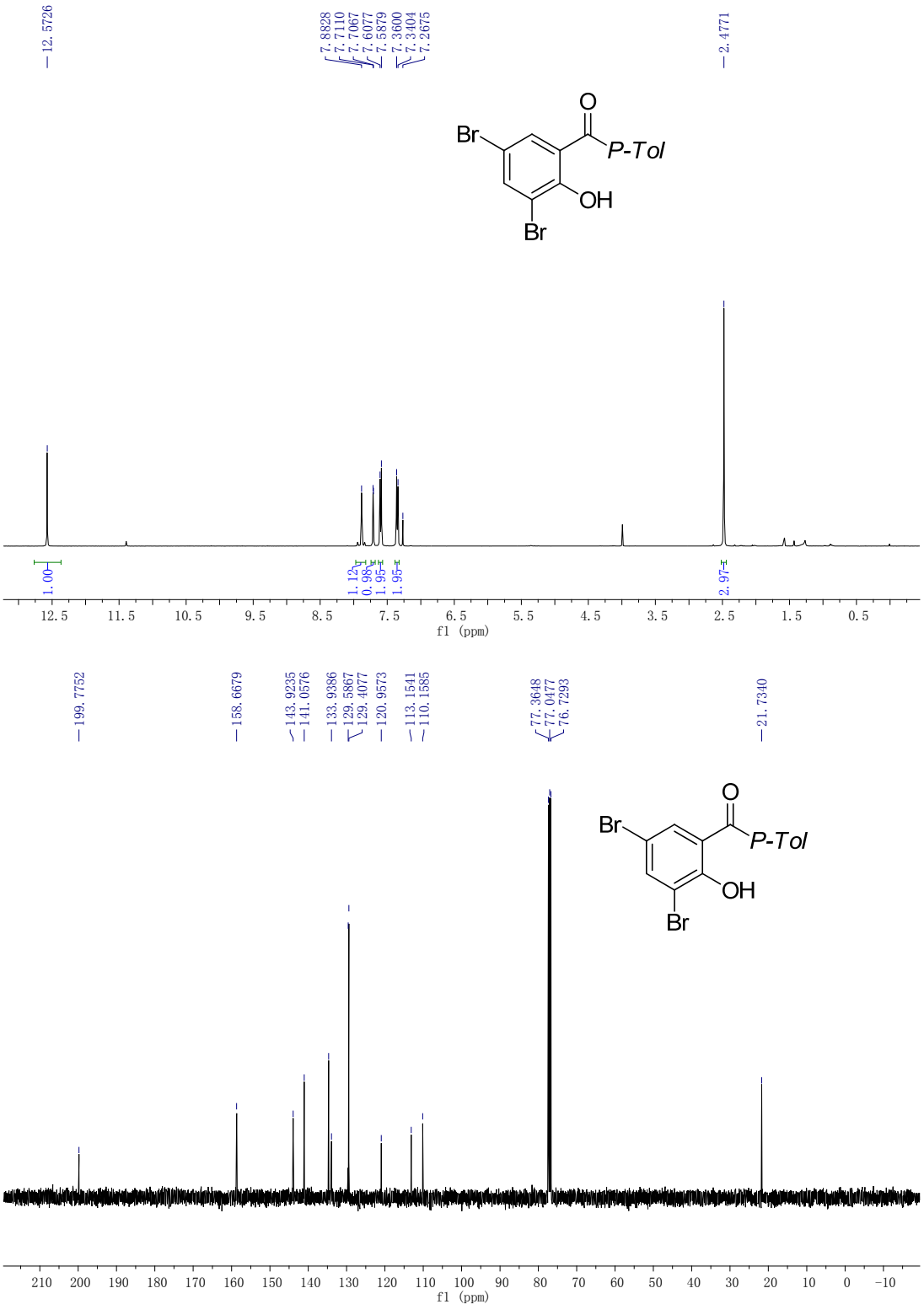




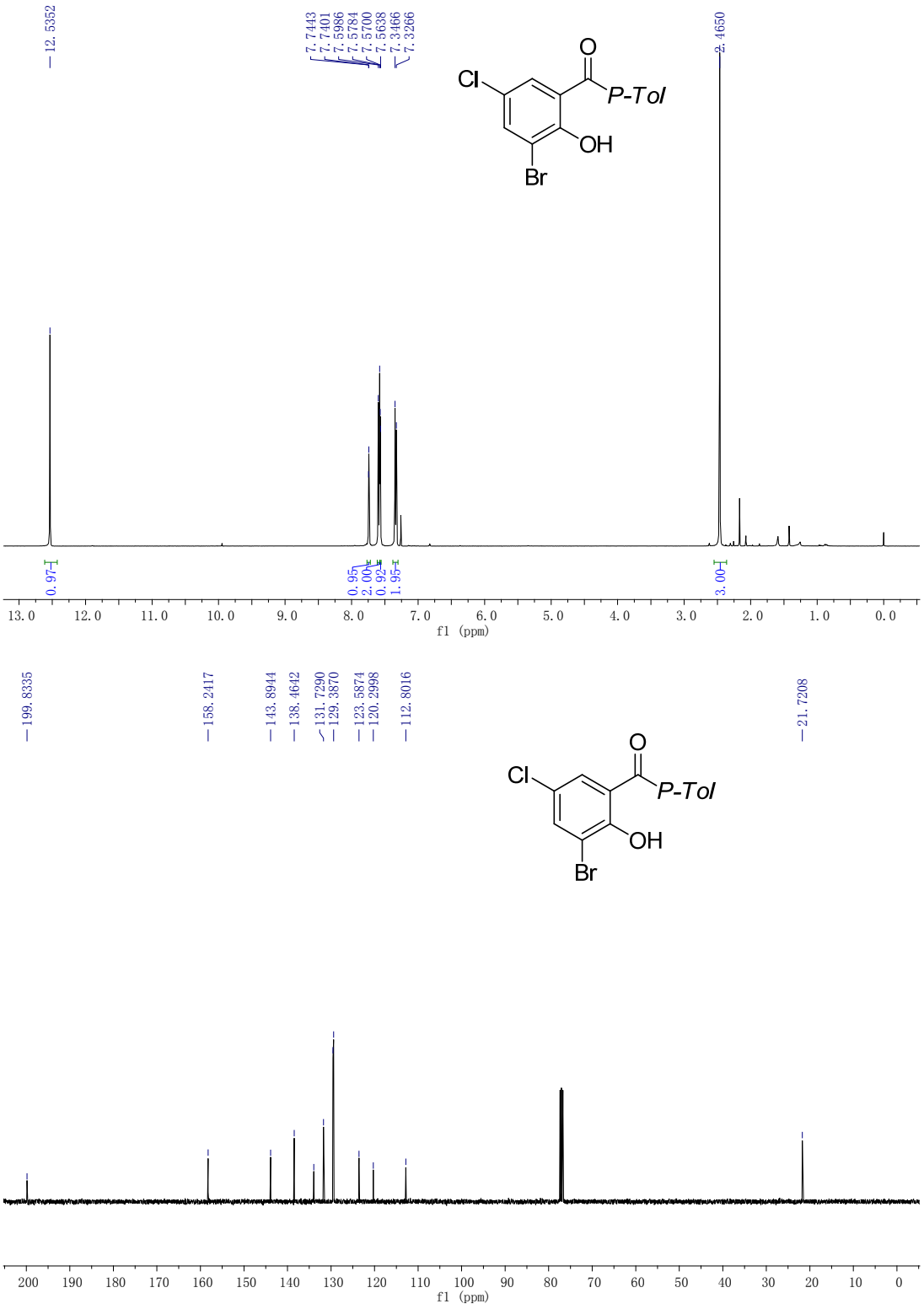
^{1}H and ^{13}C NMR Spectra of Compound **3aq**



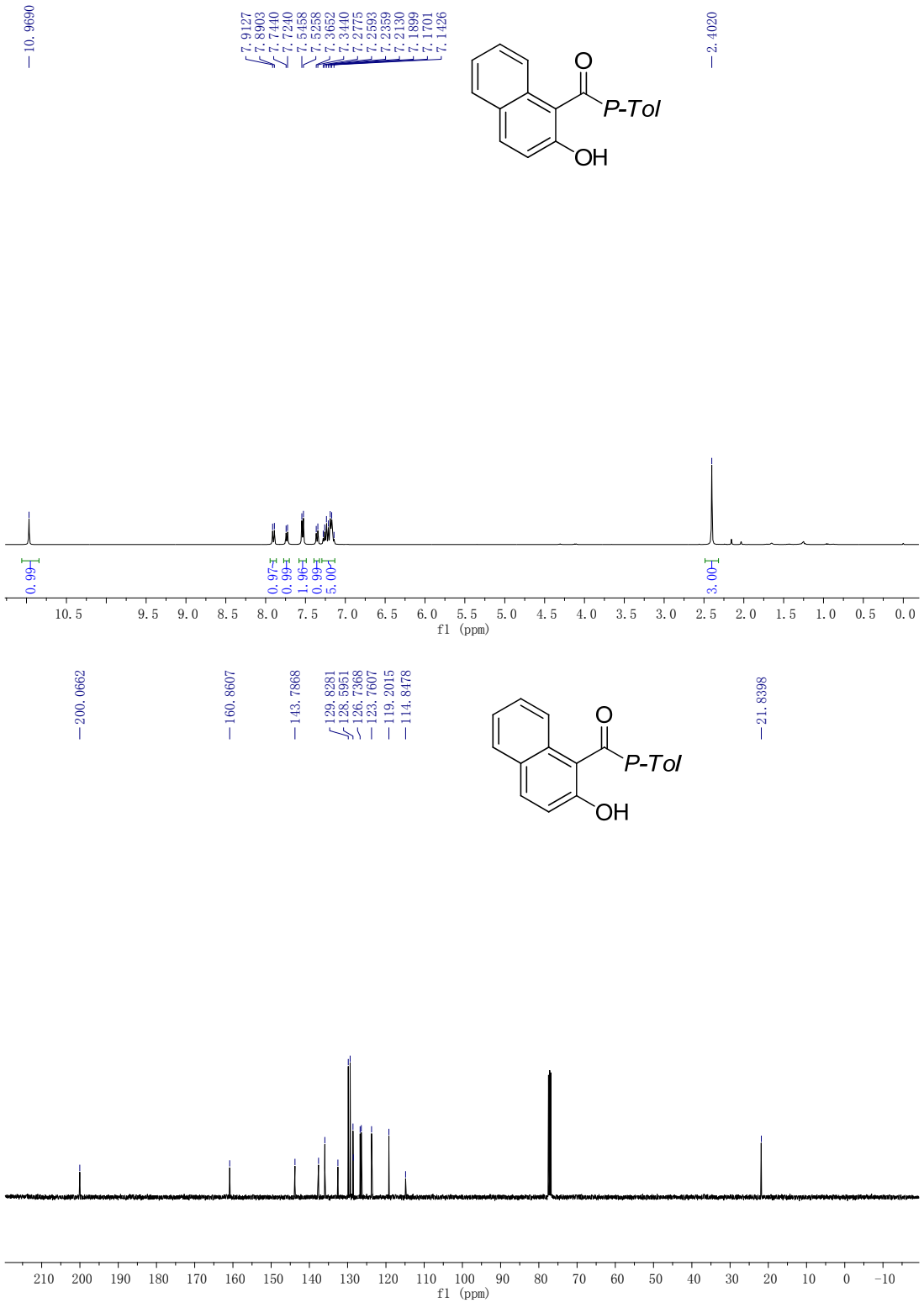
^{1}H and ^{13}C NMR Spectra of Compound **3ar**



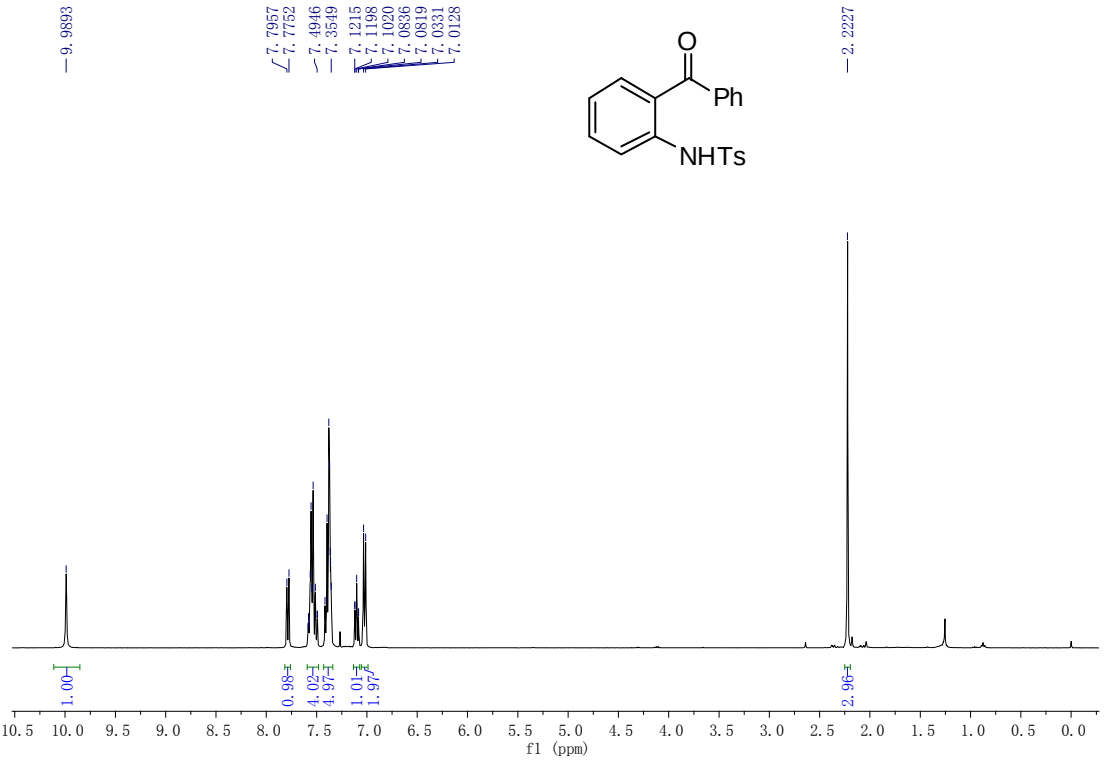
^{1}H and ^{13}C NMR Spectra of Compound **3as**

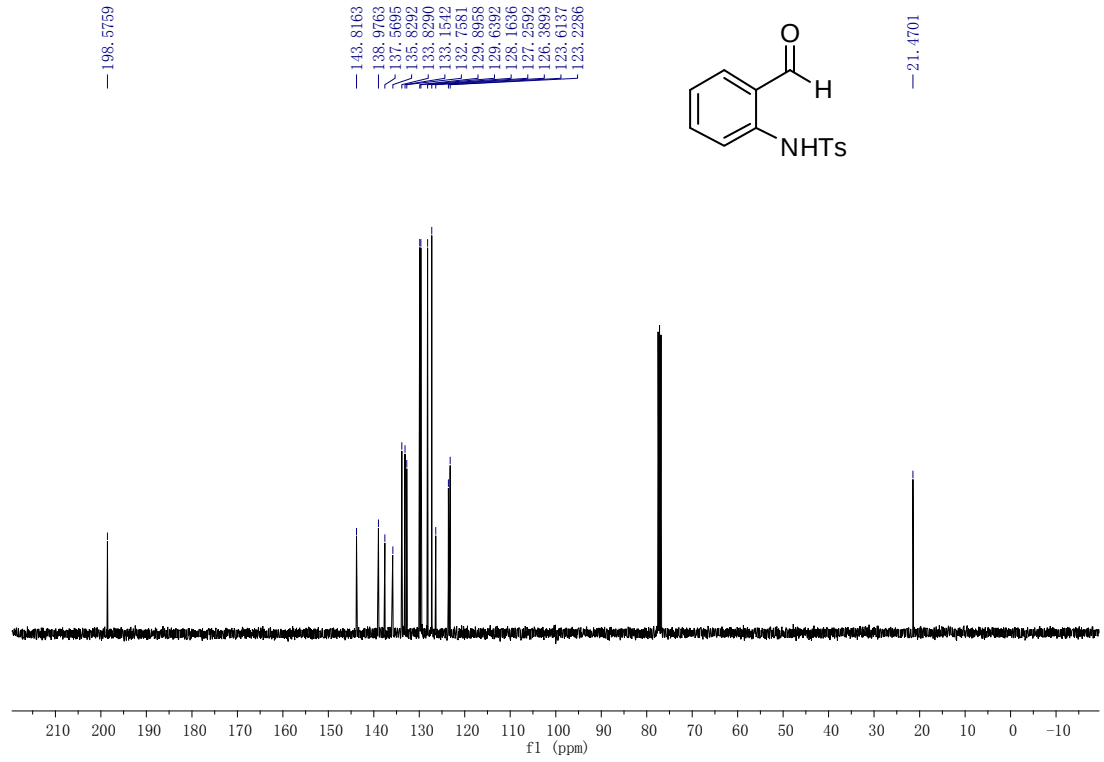


^{1}H and ^{13}C NMR Spectra of Compound **3at**

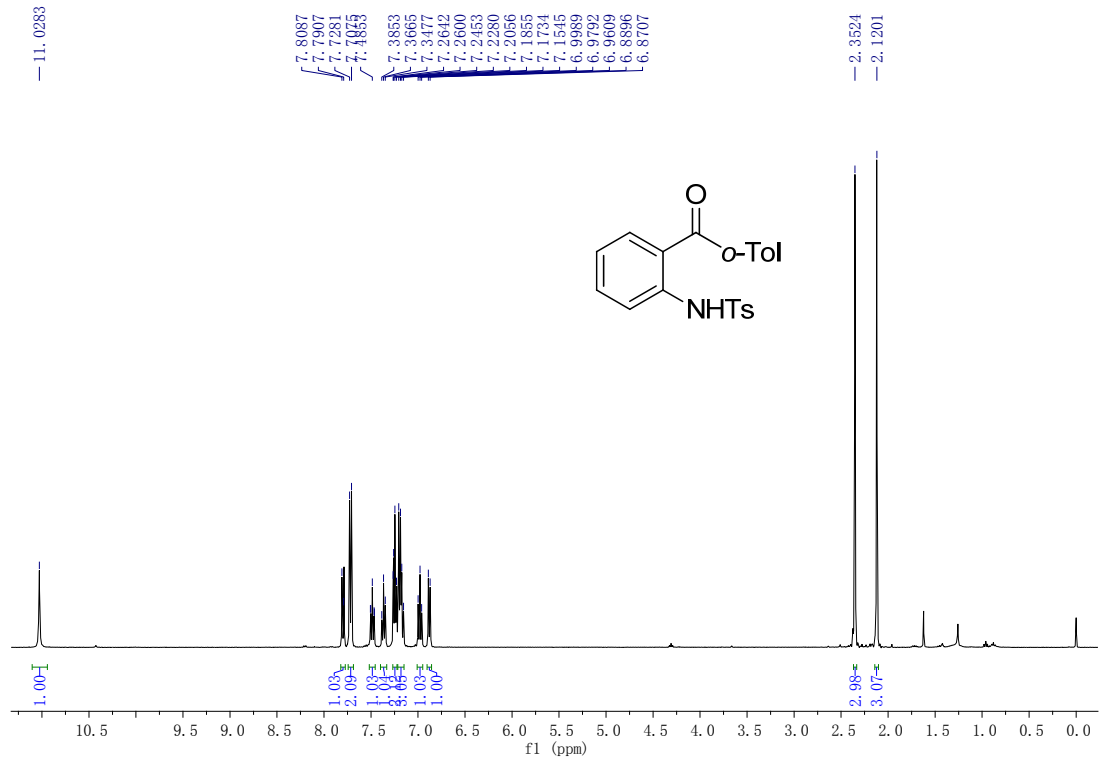


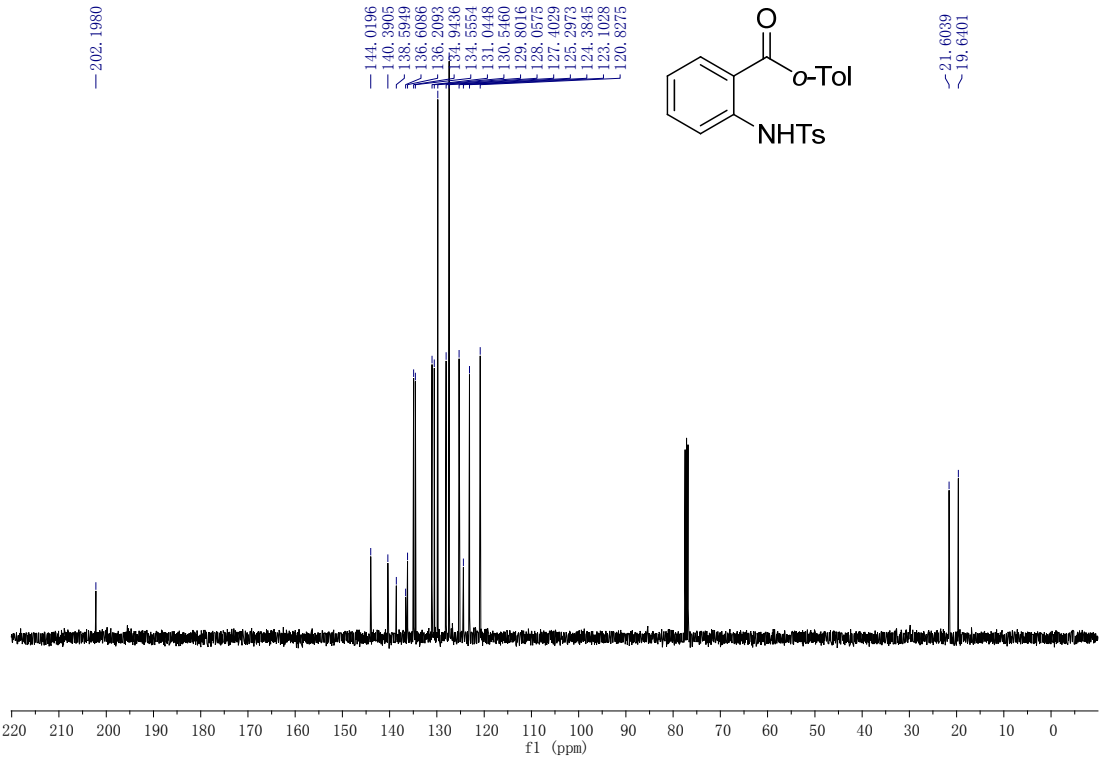
^{1}H and ^{13}C NMR Spectra of Compound **5aa**



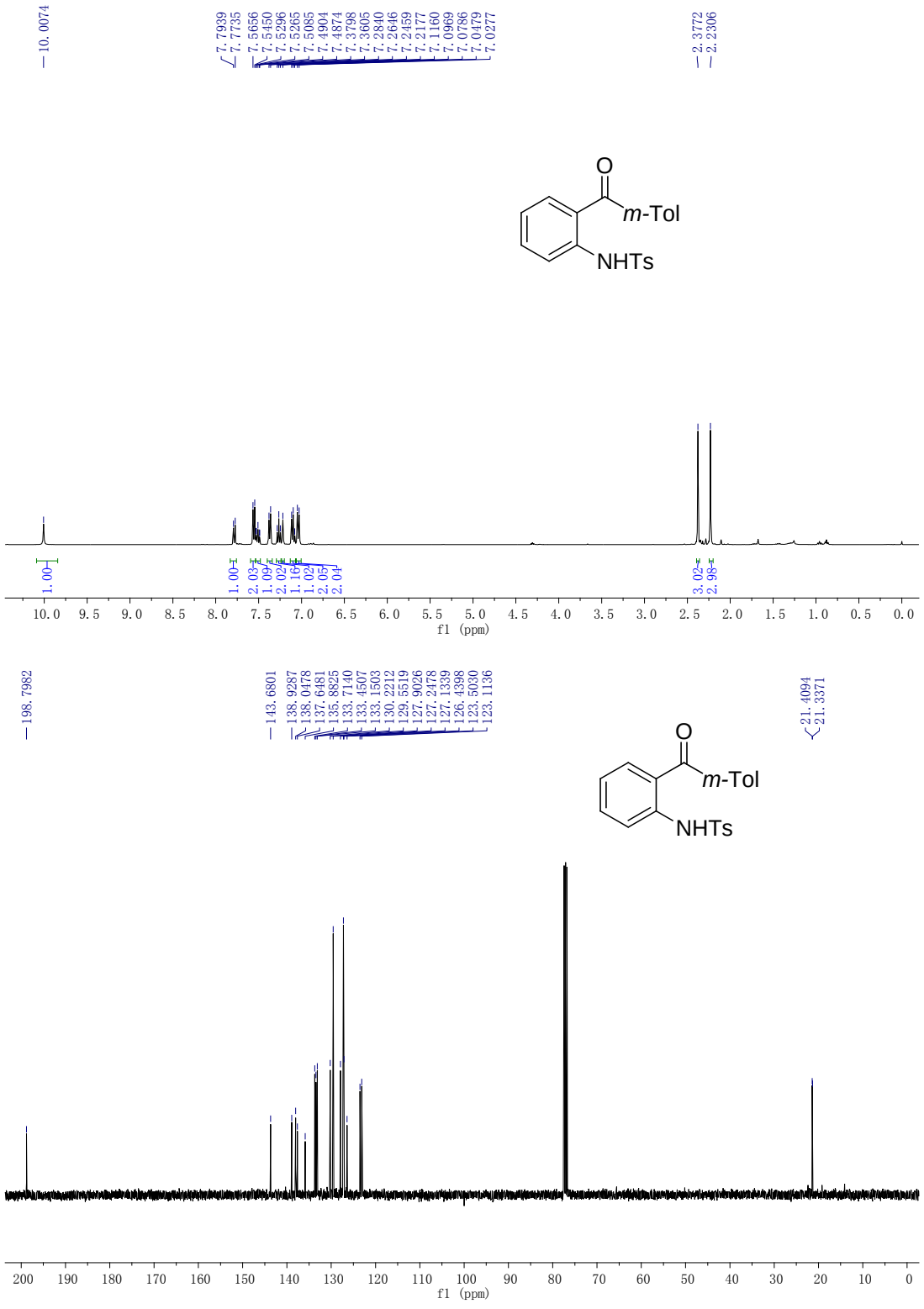


^{1}H and ^{13}C NMR Spectra of Compound **5ab**

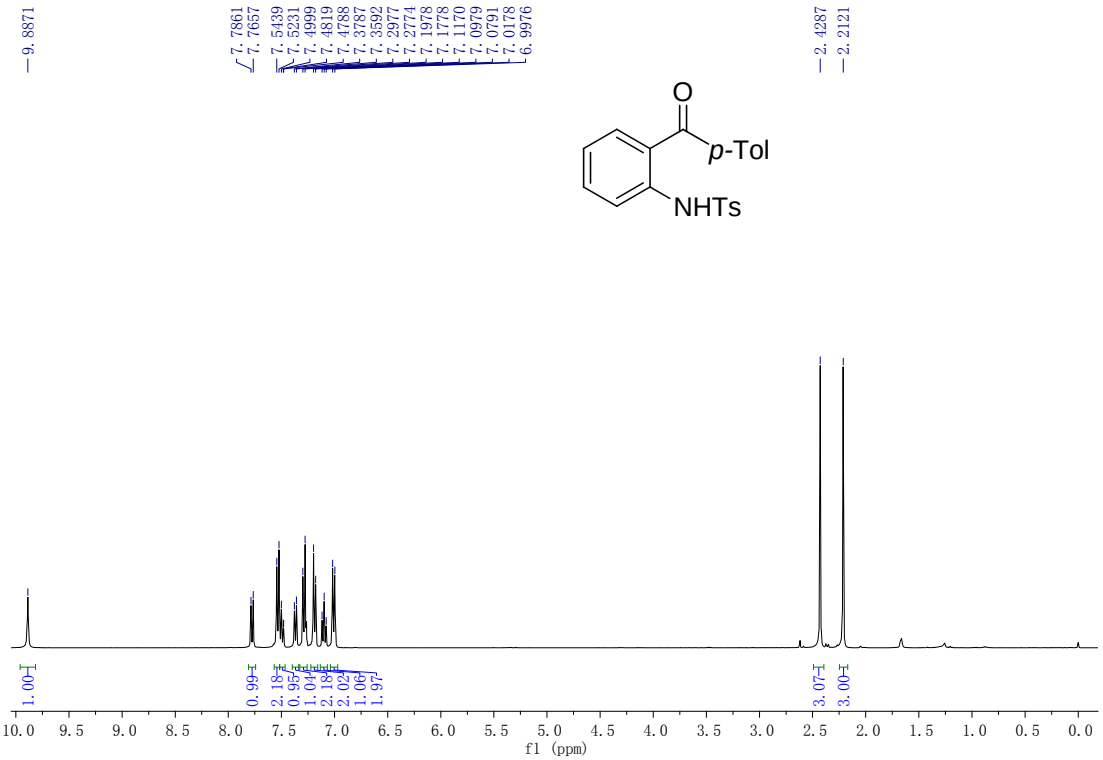


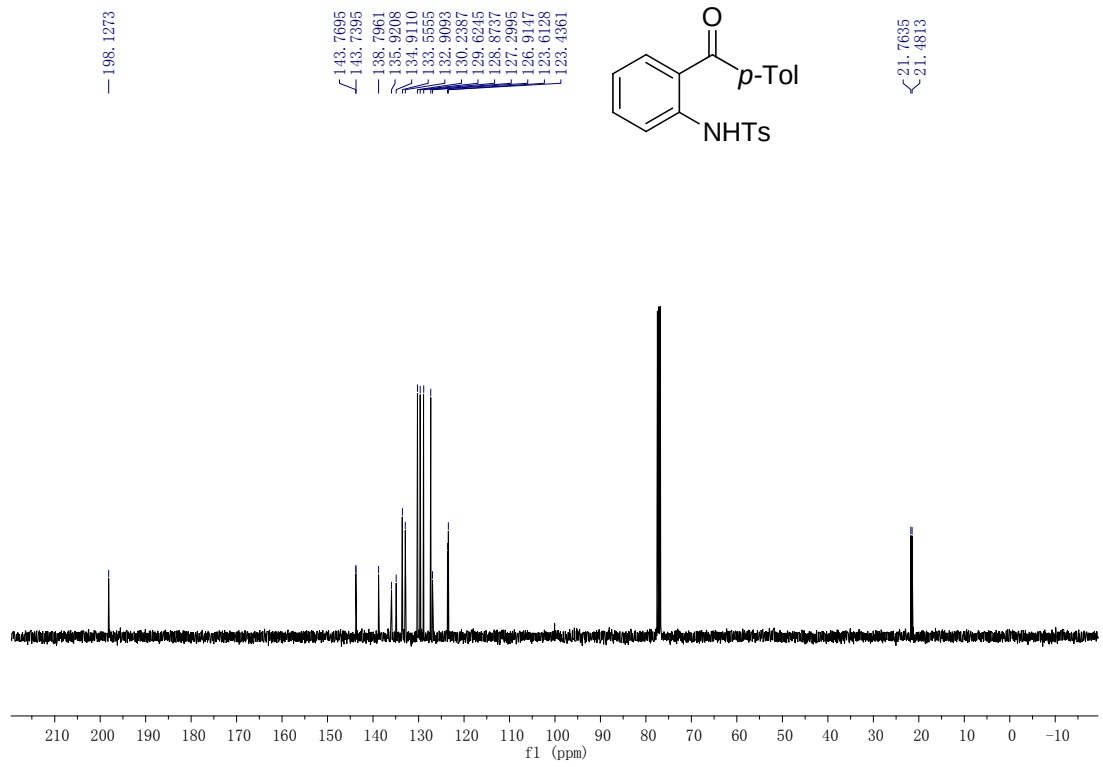


^{1}H and ^{13}C NMR Spectra of Compound **5ac**

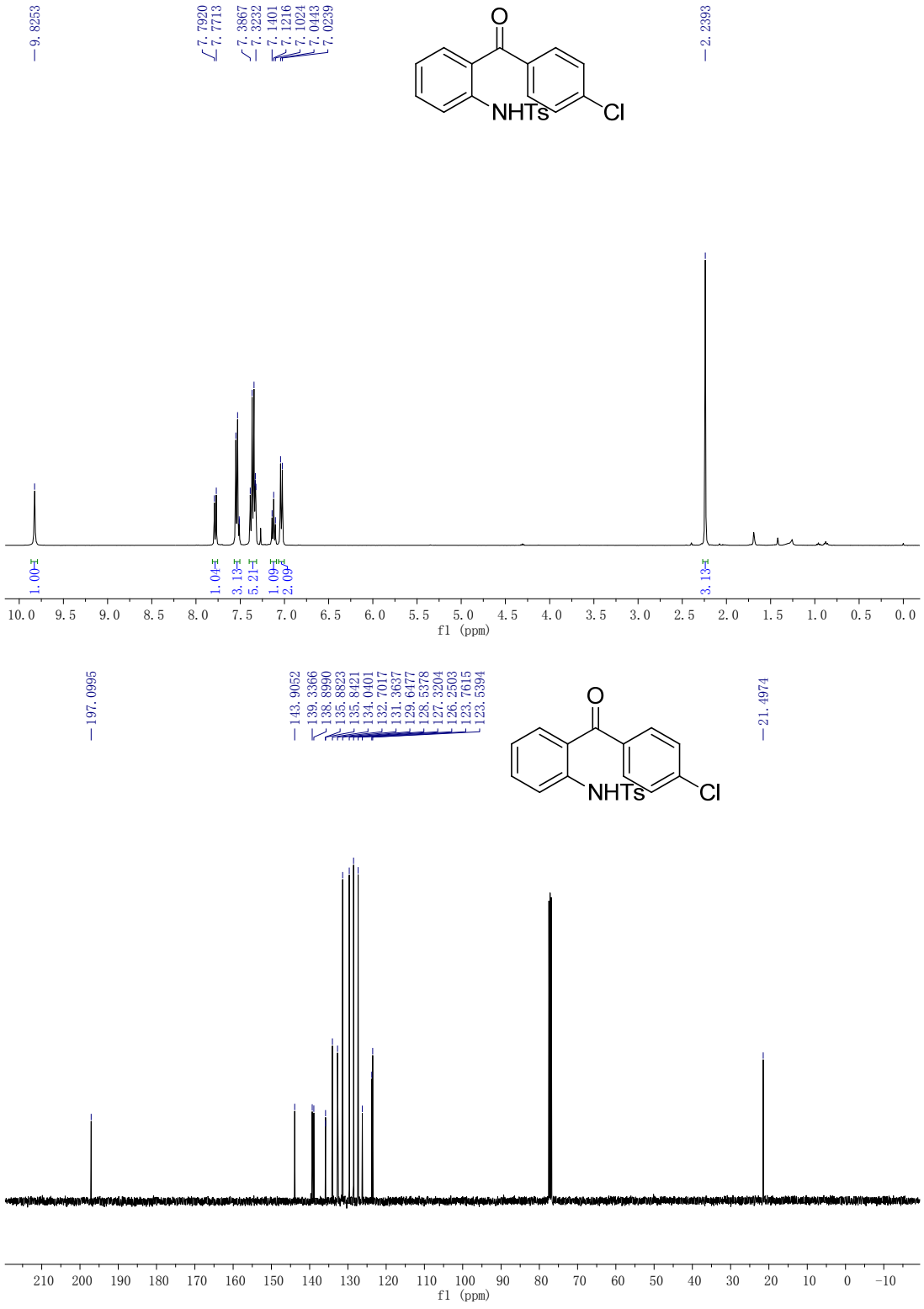


^{1}H and ^{13}C NMR Spectra of Compound **5ad**

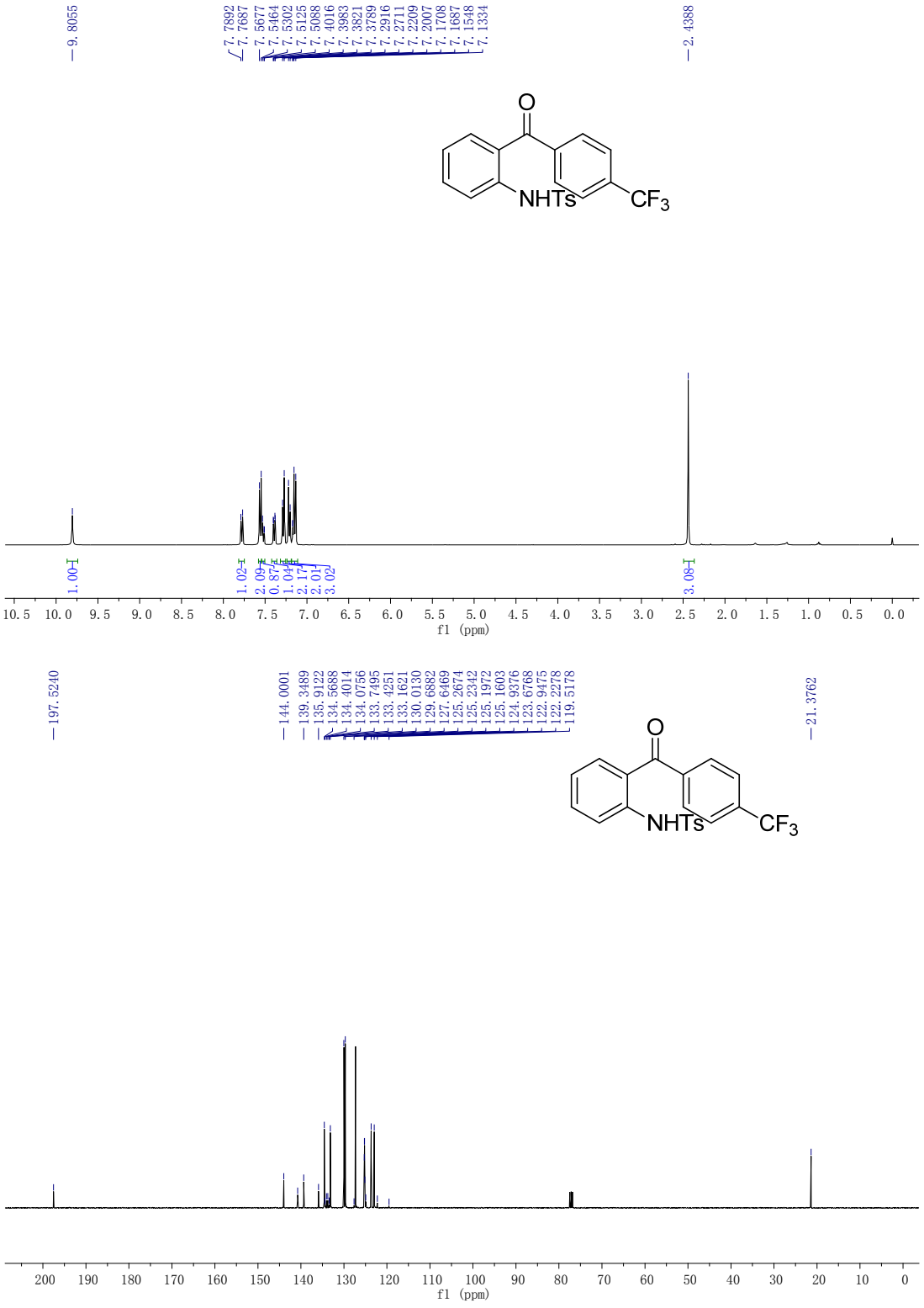




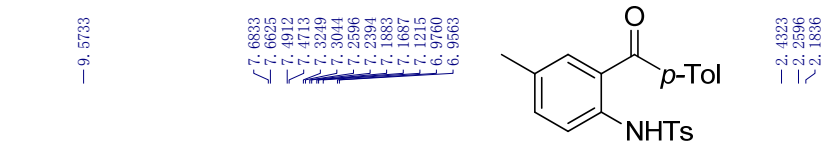
^{1}H and ^{13}C NMR Spectra of Compound **5ae**

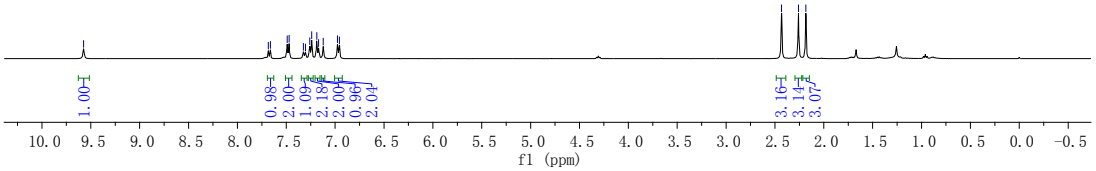


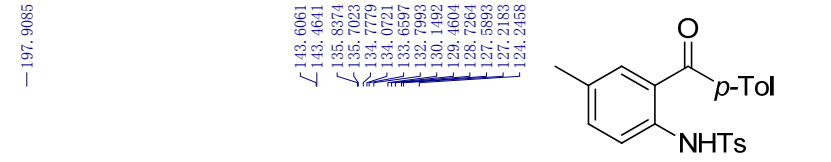
^{1}H and ^{13}C NMR Spectra of Compound **5af**

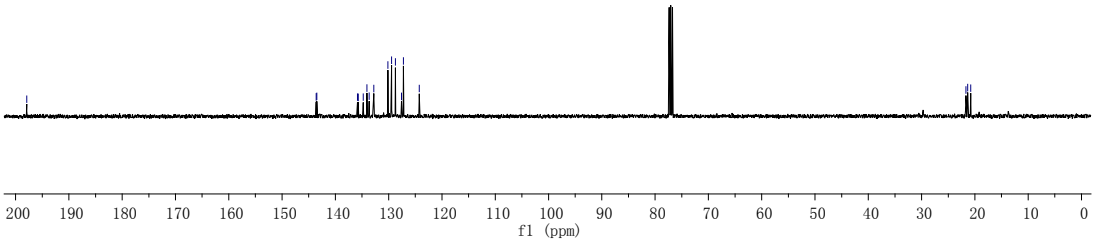


^{1}H and ^{13}C NMR Spectra of Compound **5ag**

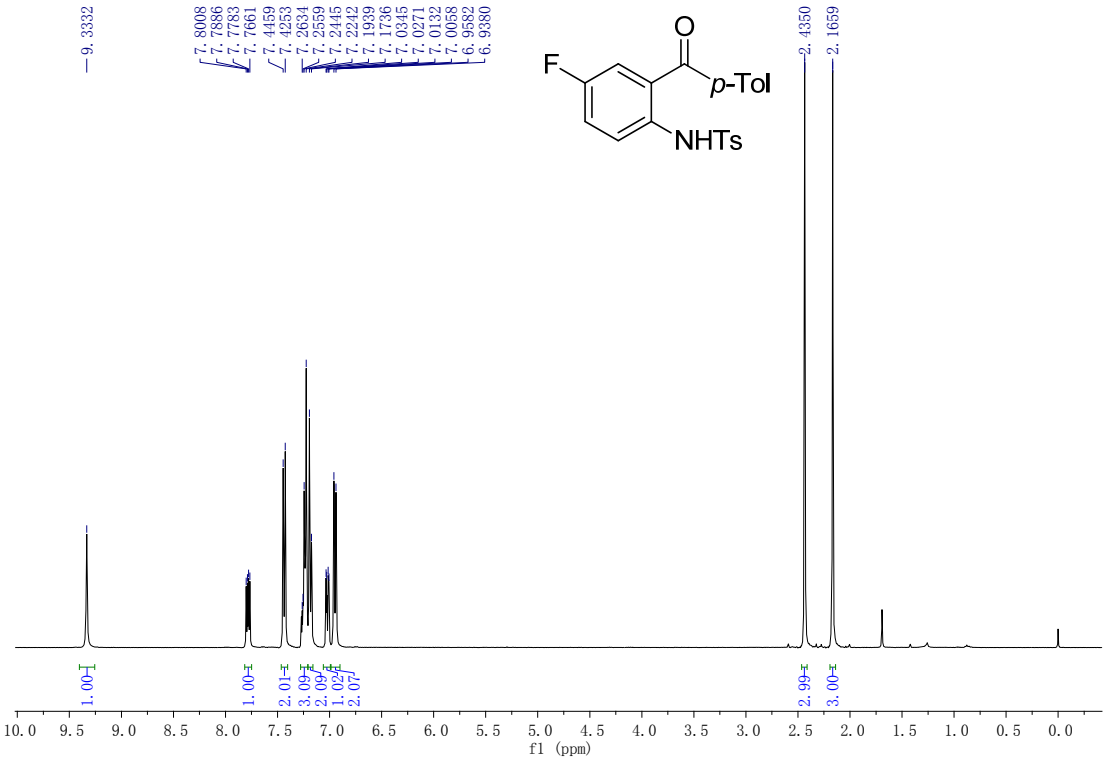


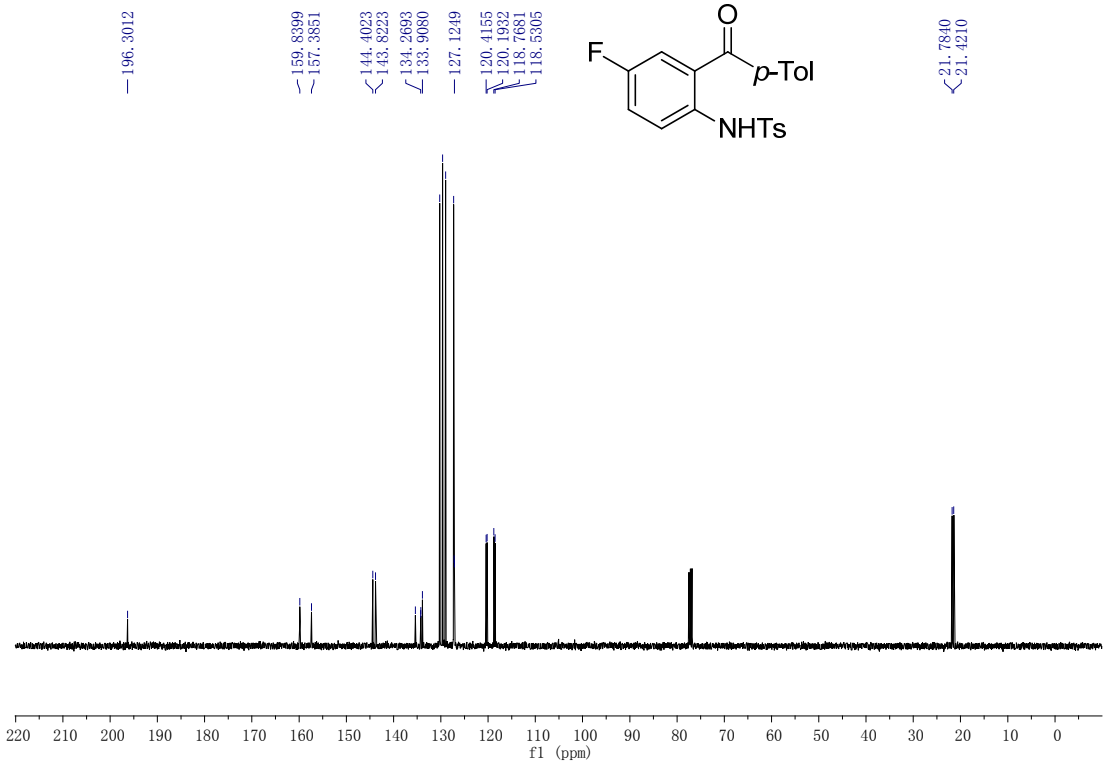




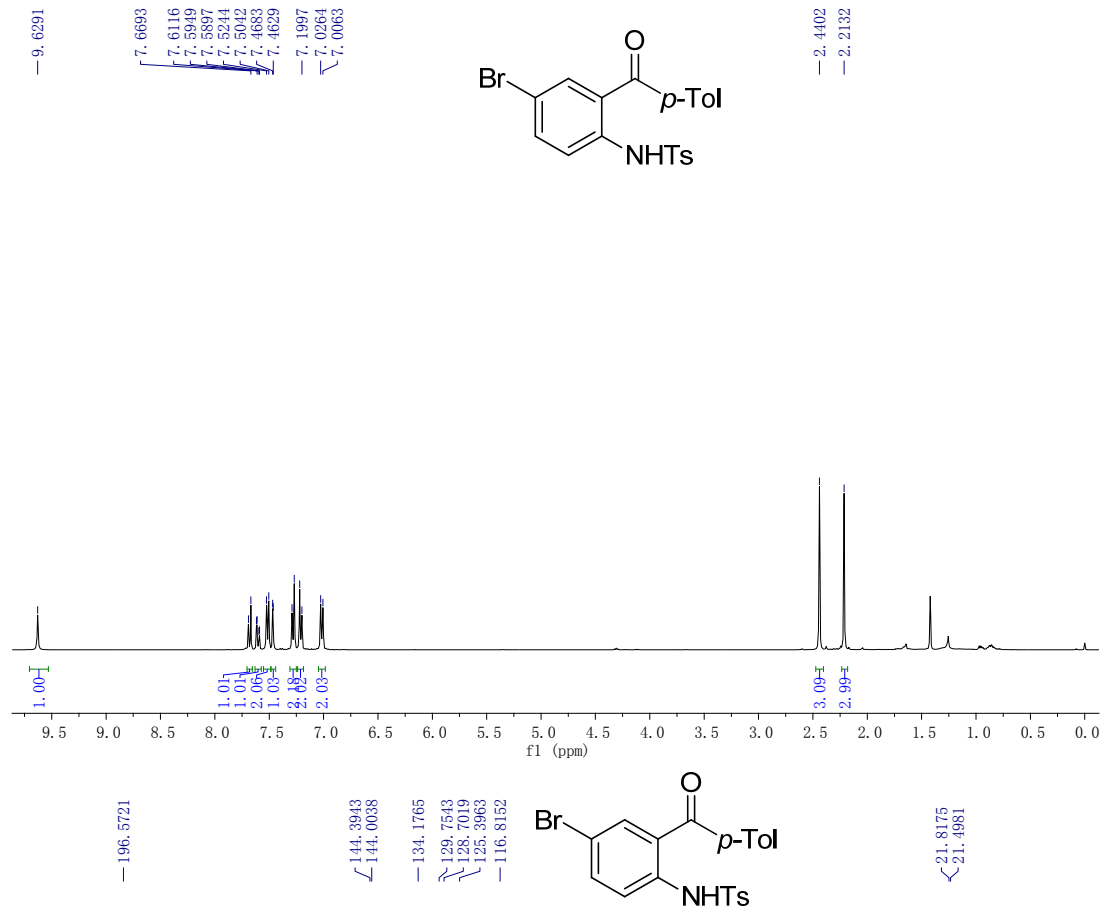


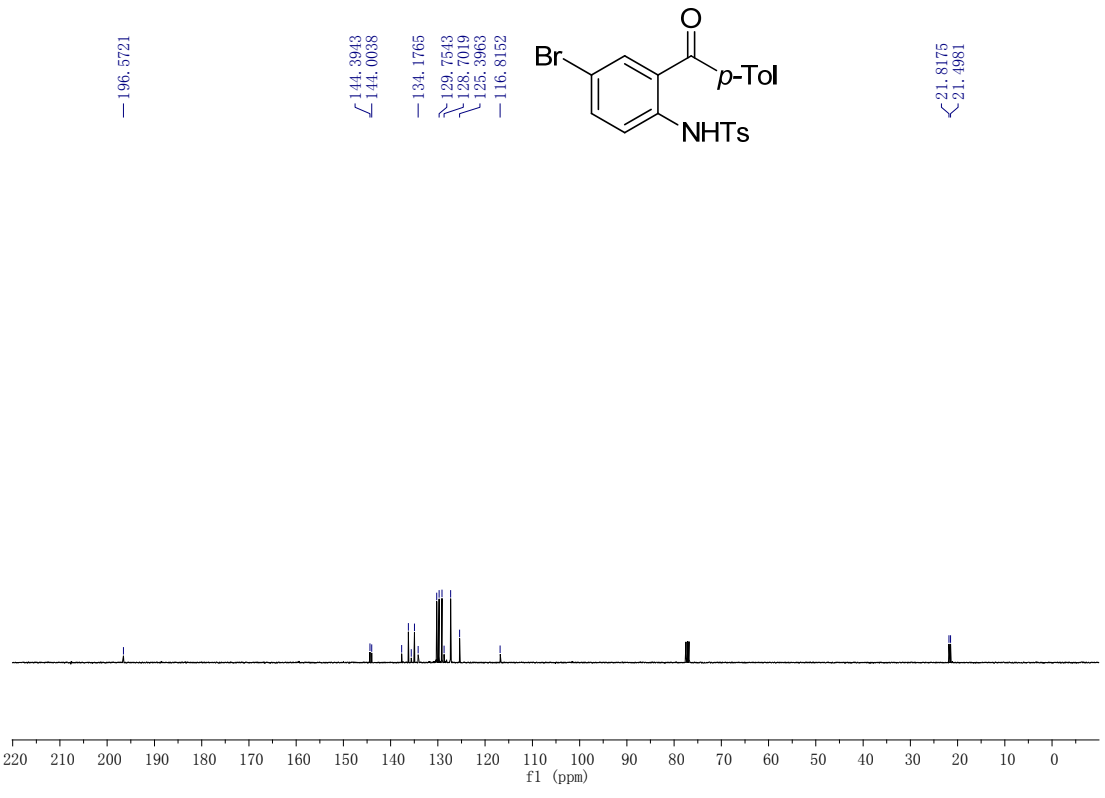
^{1}H and ^{13}C NMR Spectra of Compound **5ah**



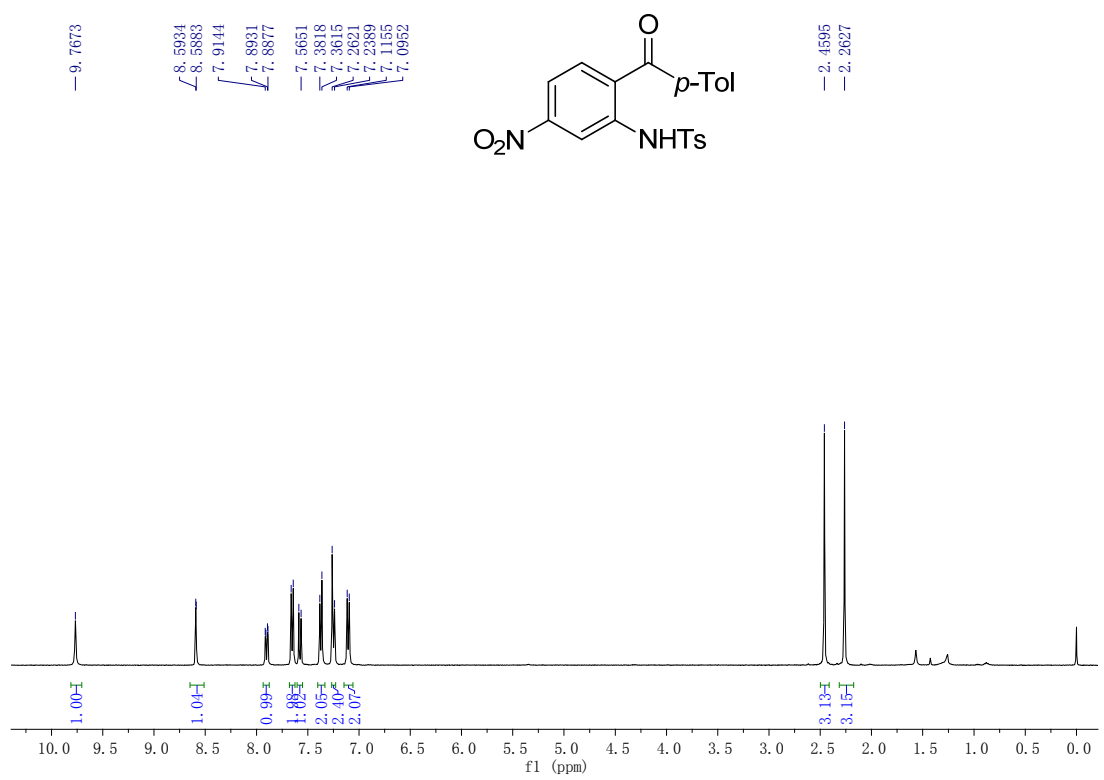


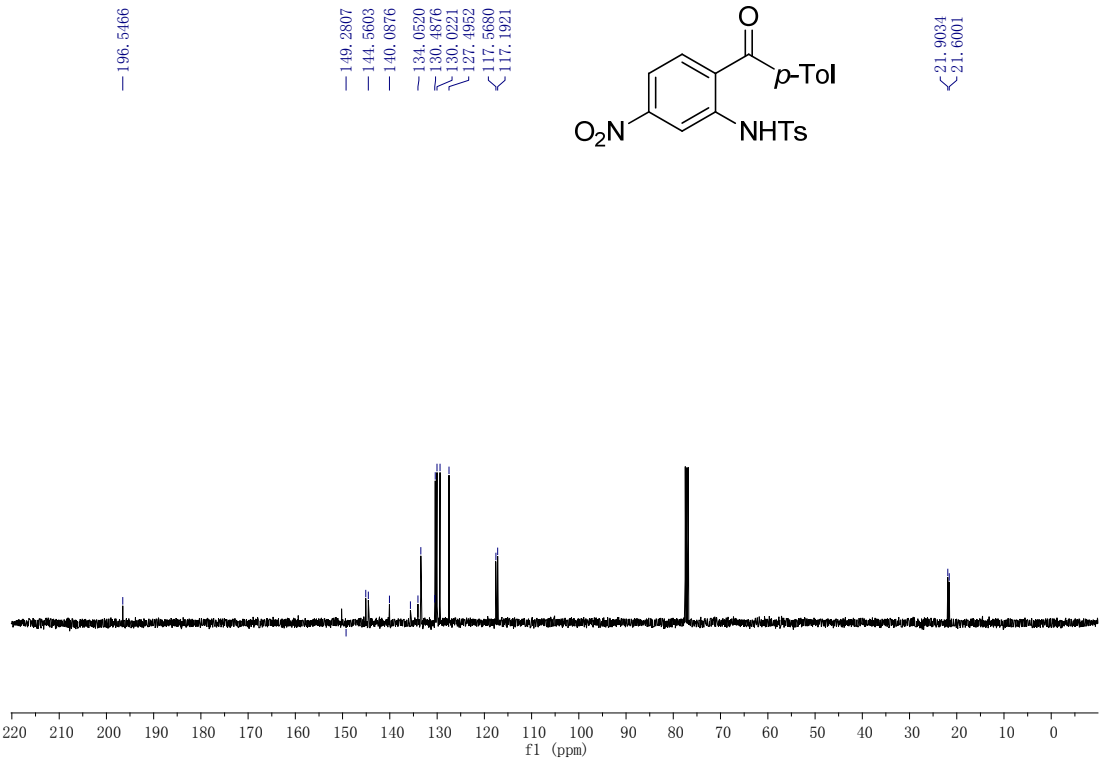
^{1}H and ^{13}C NMR Spectra of Compound **5ai**



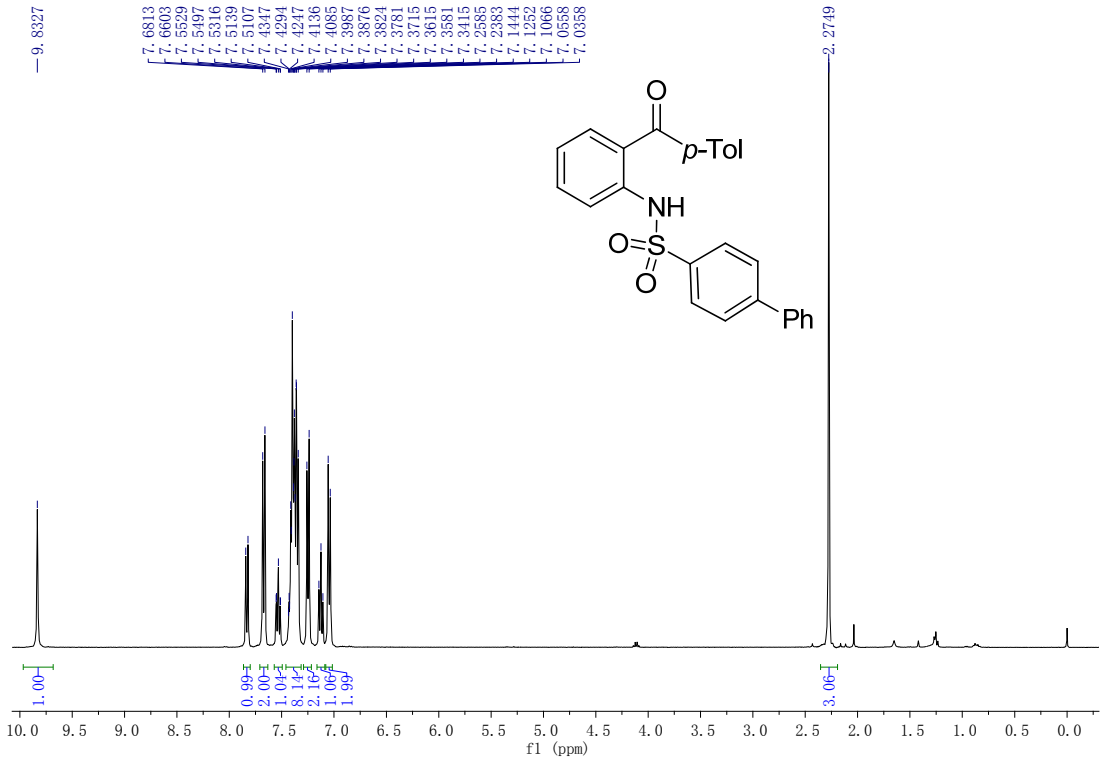


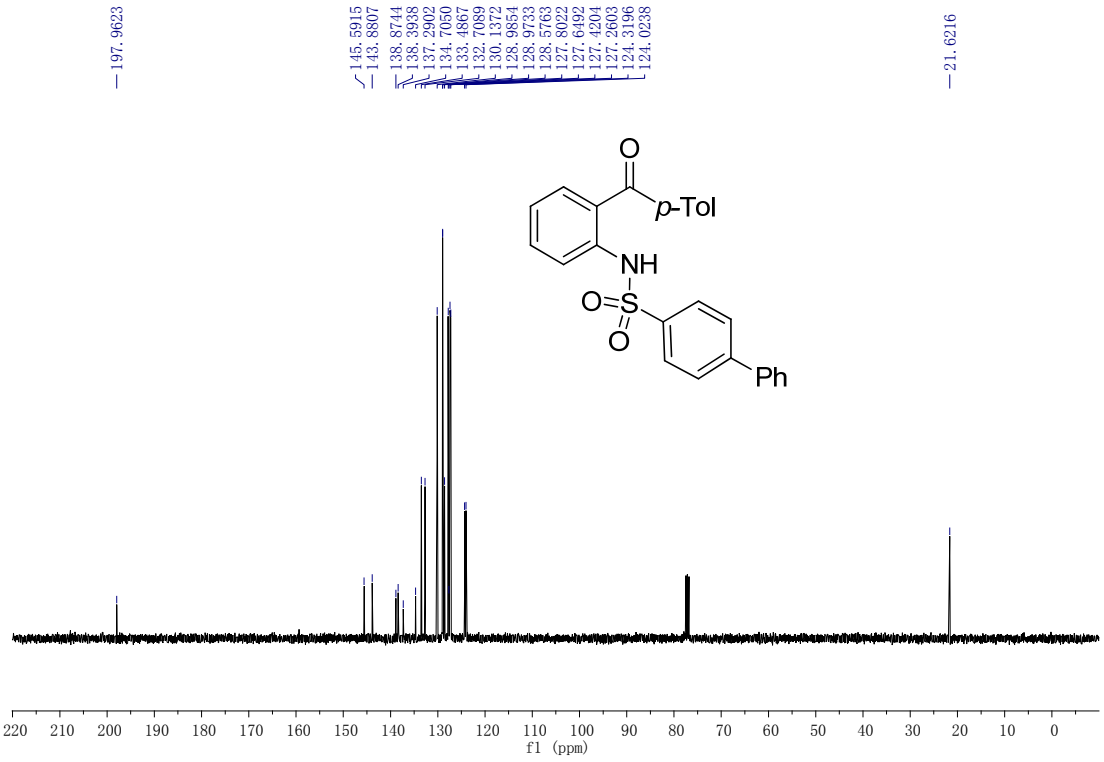
^{1}H and ^{13}C NMR Spectra of Compound **5aj**



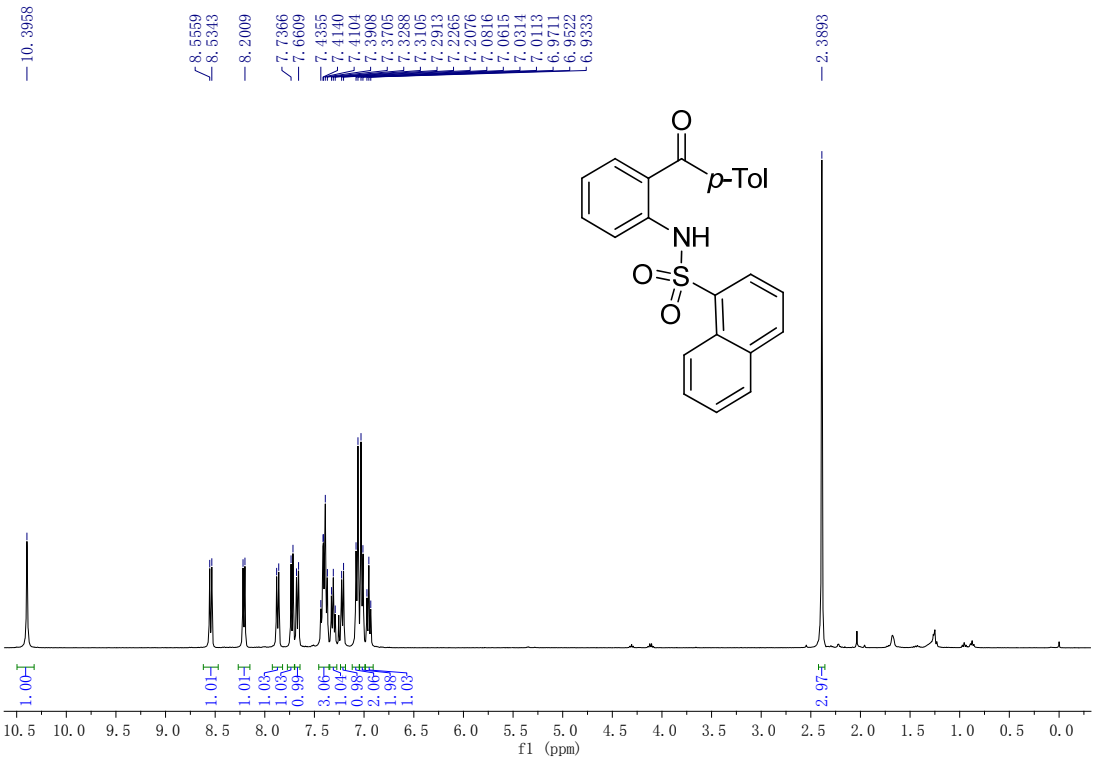


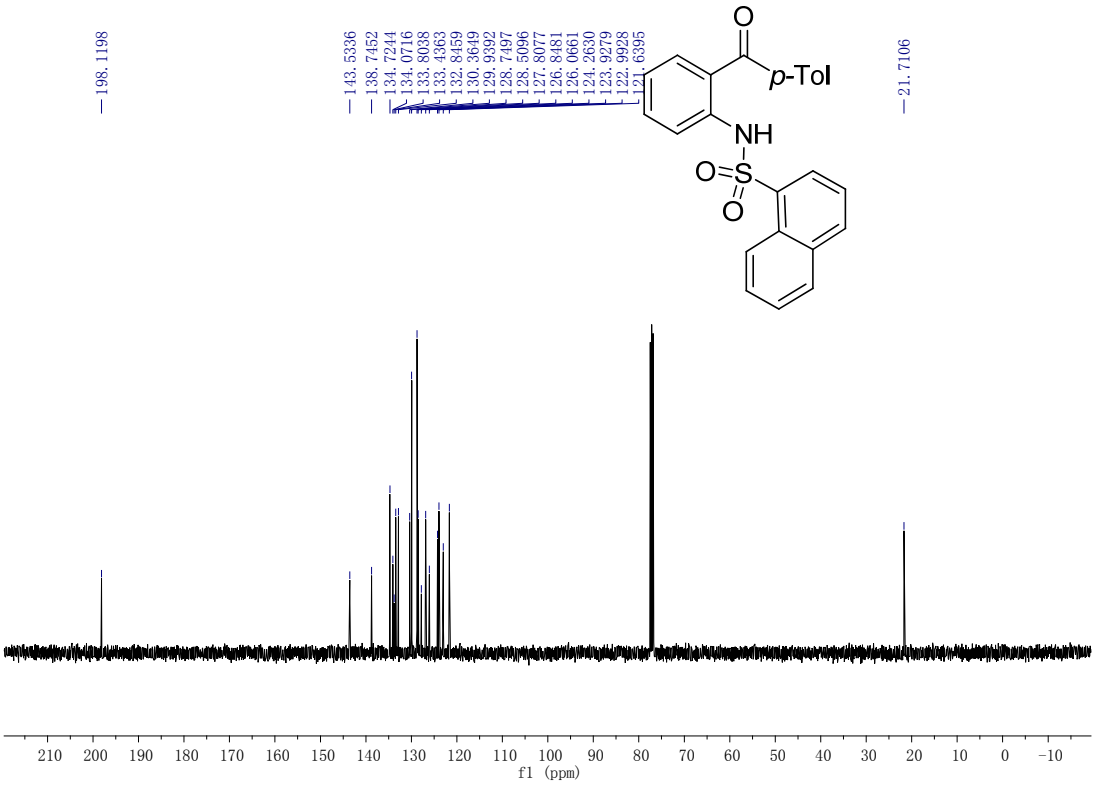
^{1}H and ^{13}C NMR Spectra of Compound **5ak**



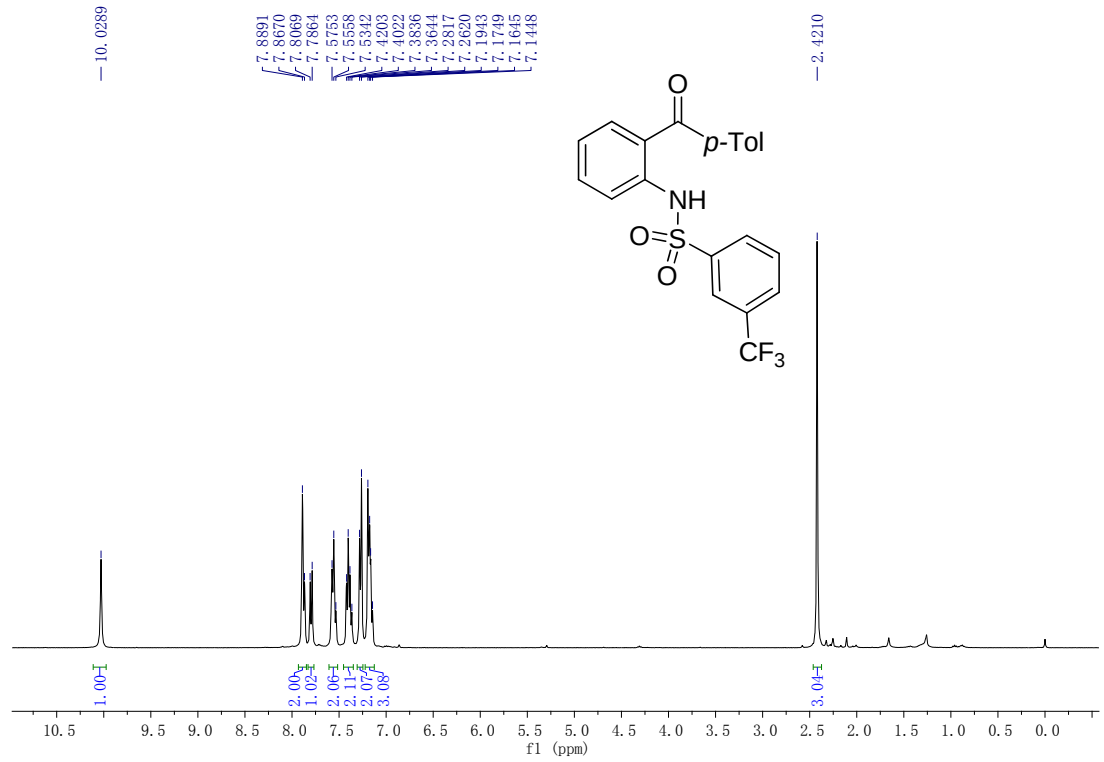


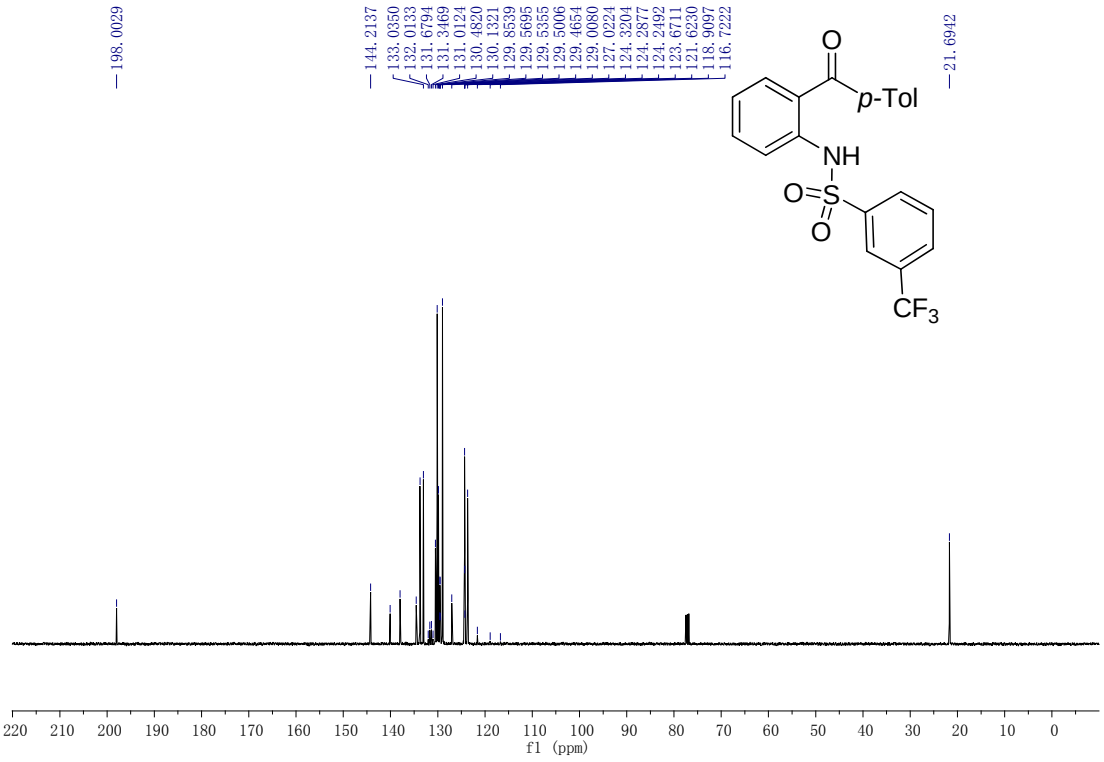
^{1}H and ^{13}C NMR Spectra of Compound **5al**



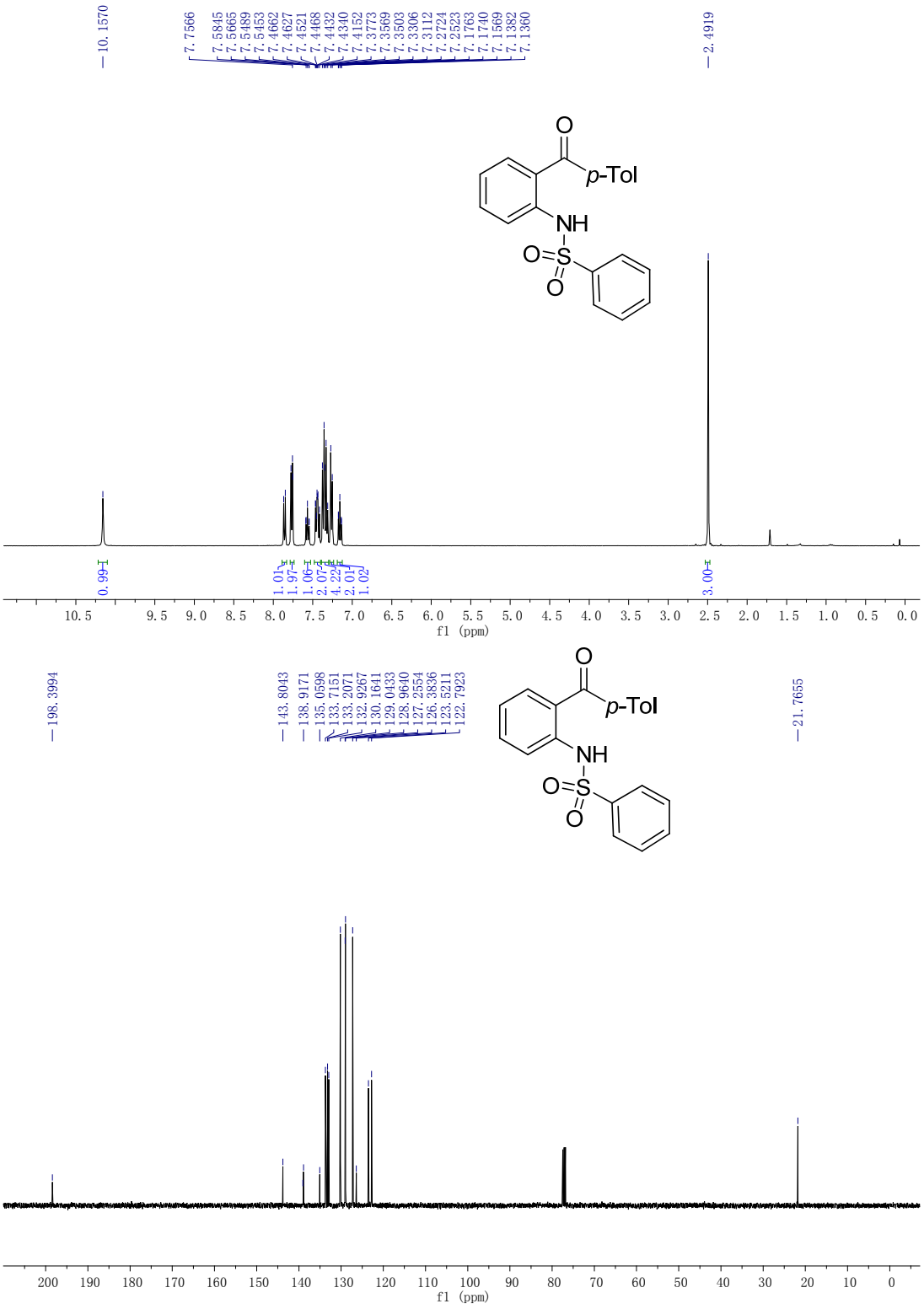


^{1}H and ^{13}C NMR Spectra of Compound **5am**

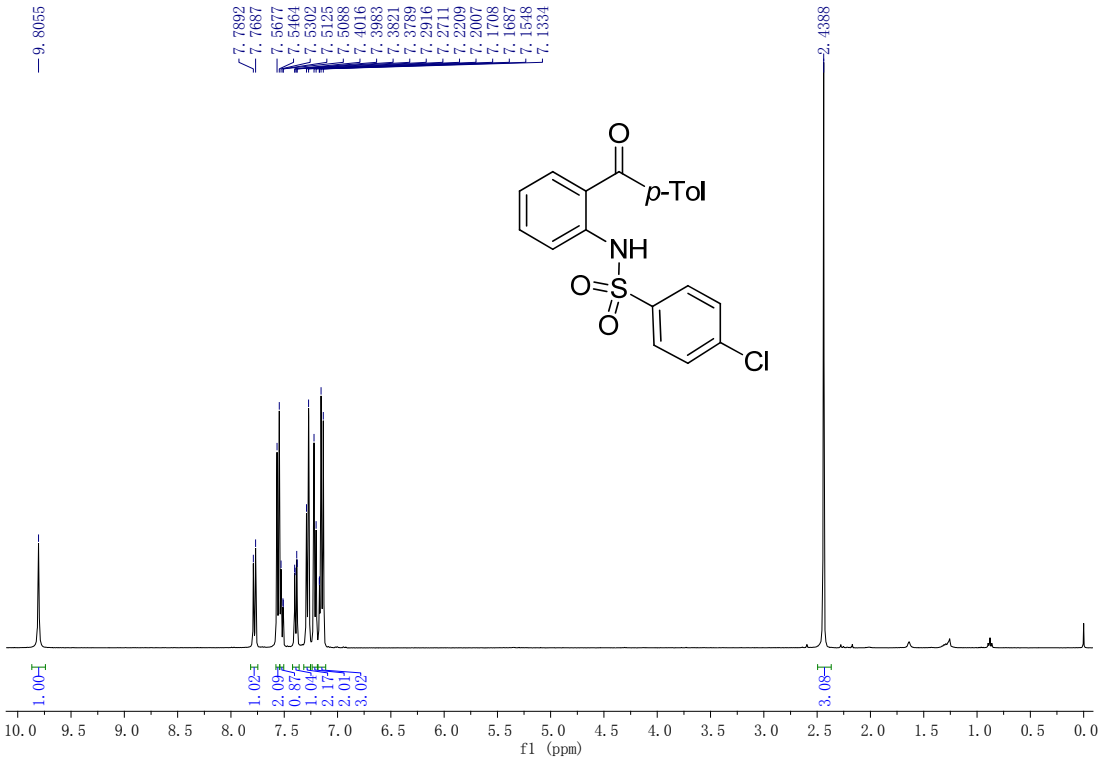


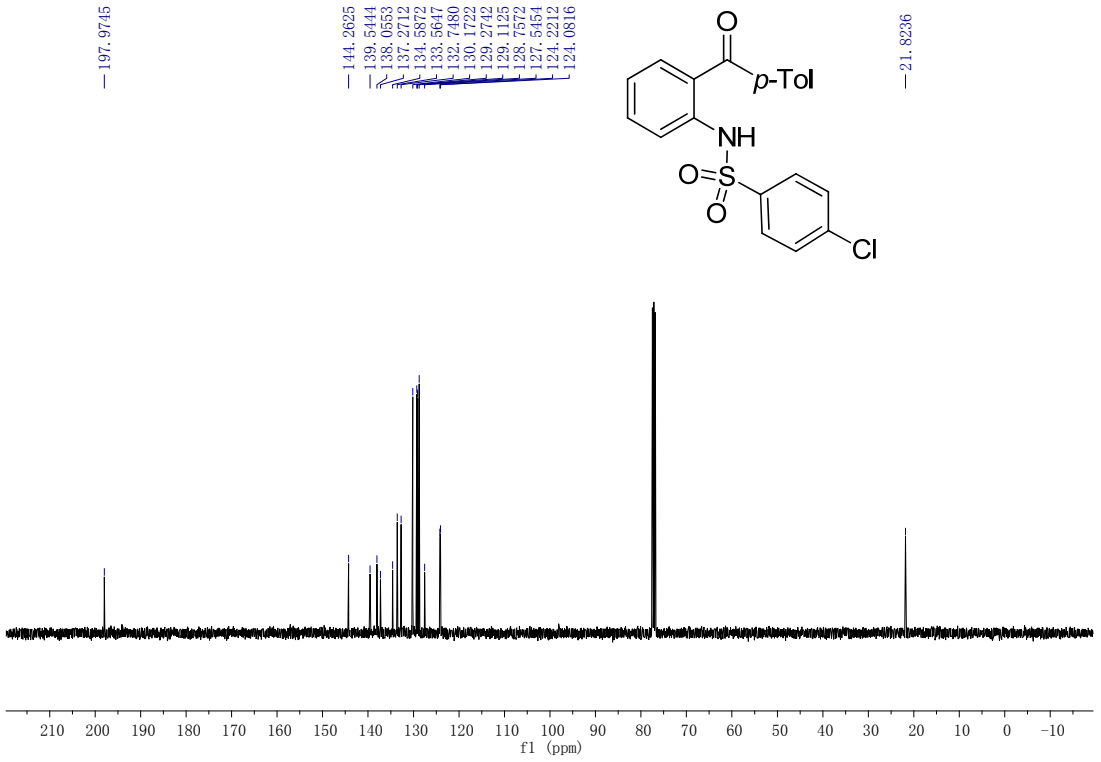


^{1}H and ^{13}C NMR Spectra of Compound **5an**

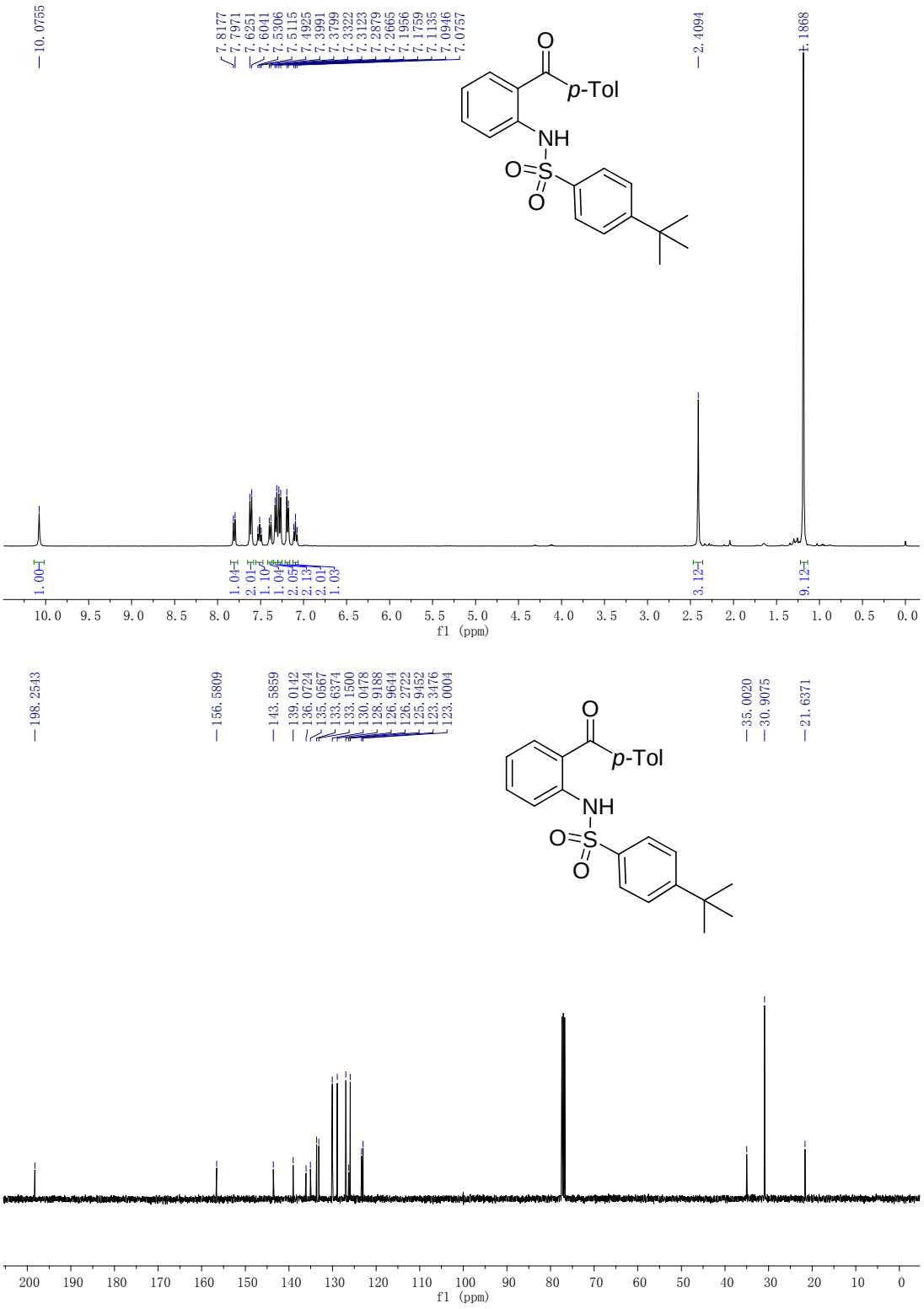


^{1}H and ^{13}C NMR Spectra of Compound **5ao**

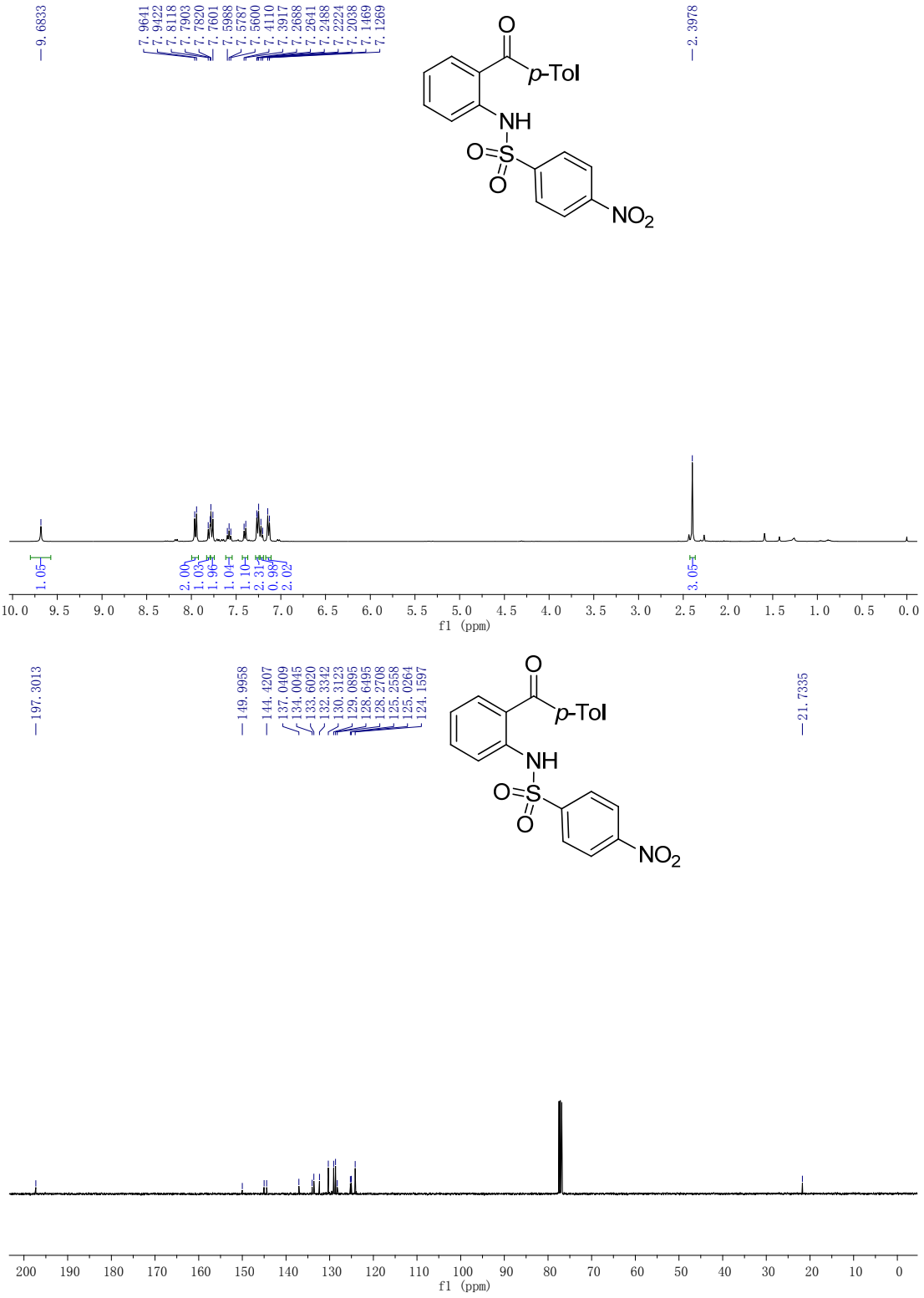




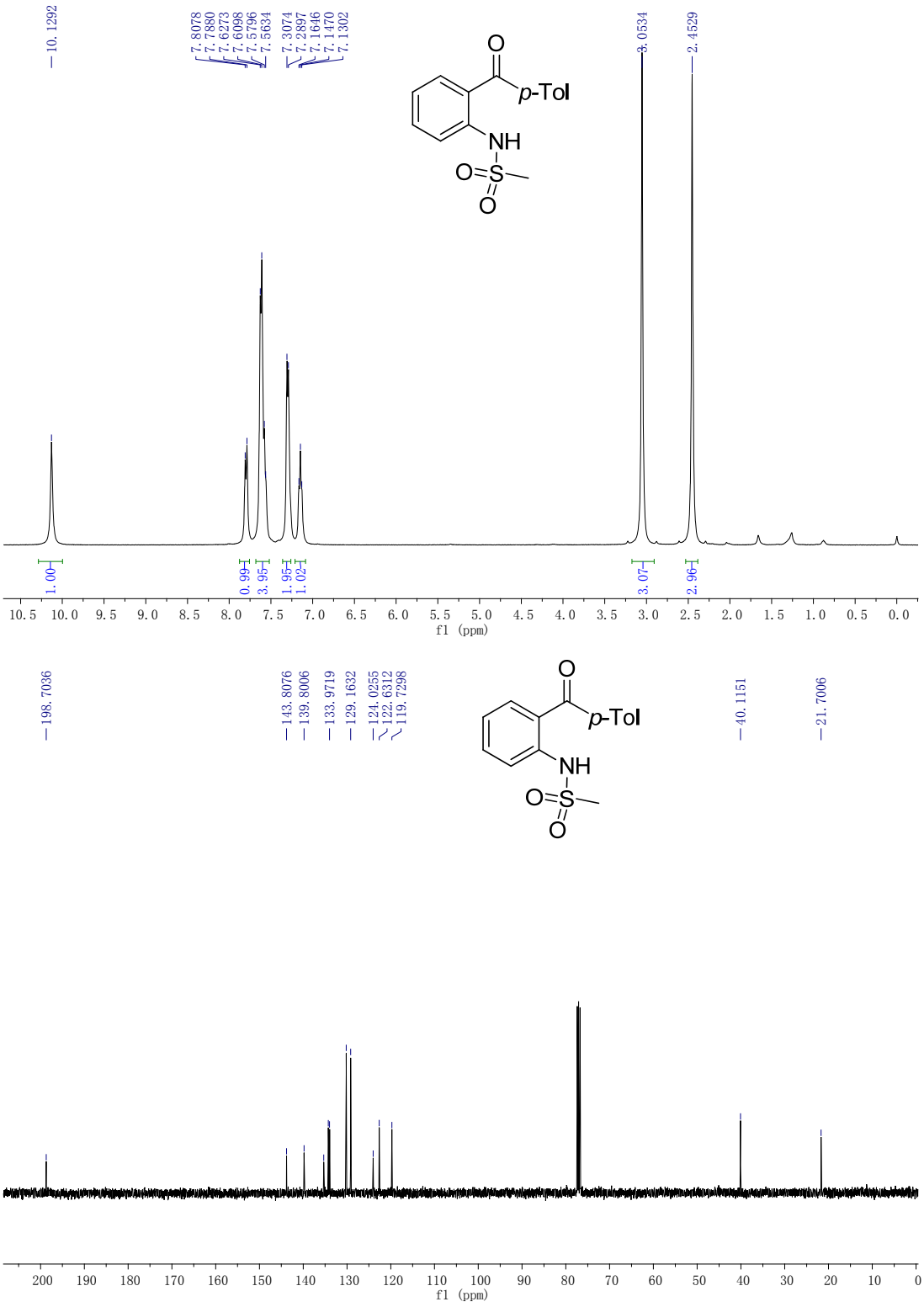
^{1}H and ^{13}C NMR Spectra of Compound **5ap**



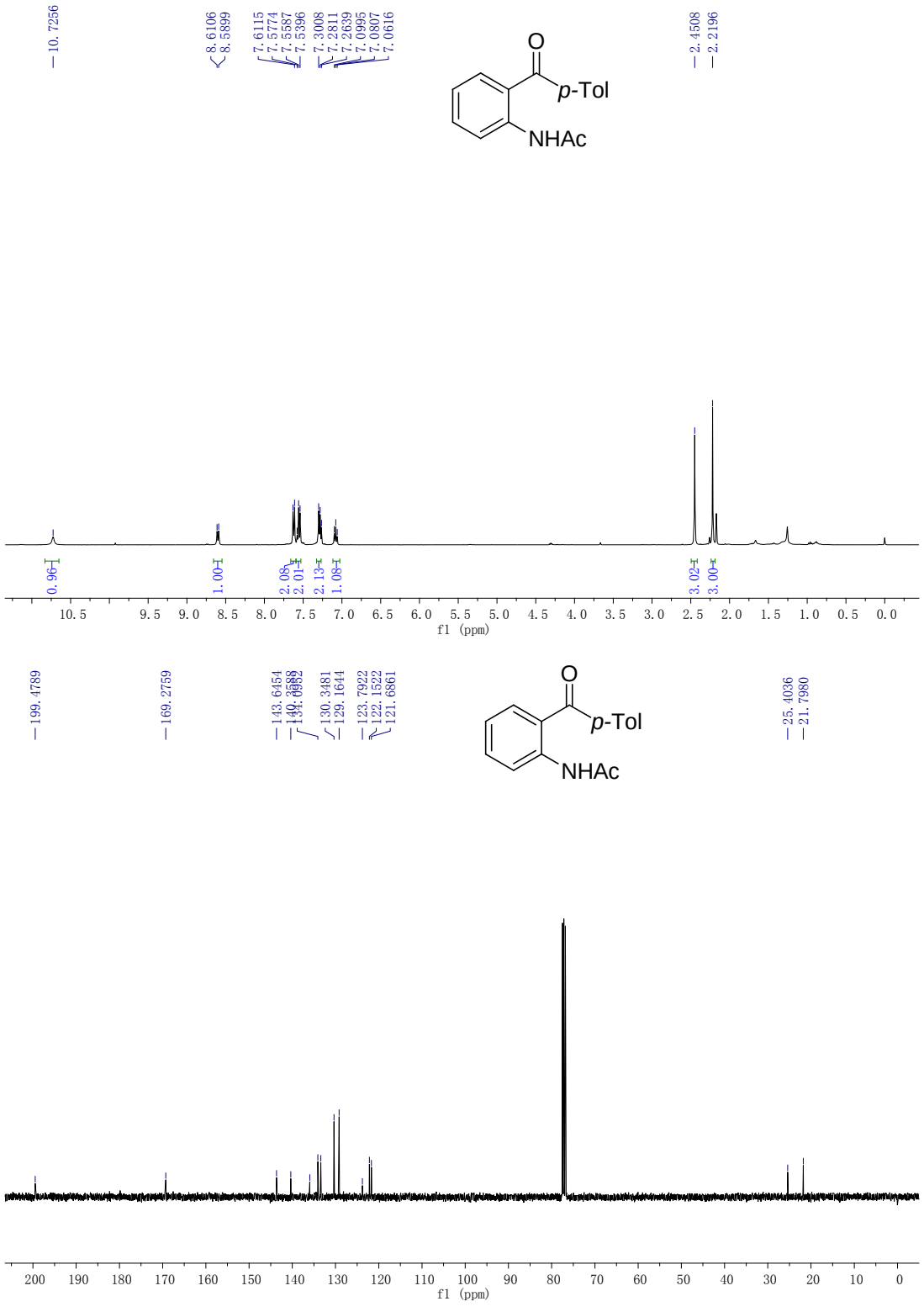
^{1}H and ^{13}C NMR Spectra of Compound **5aq**



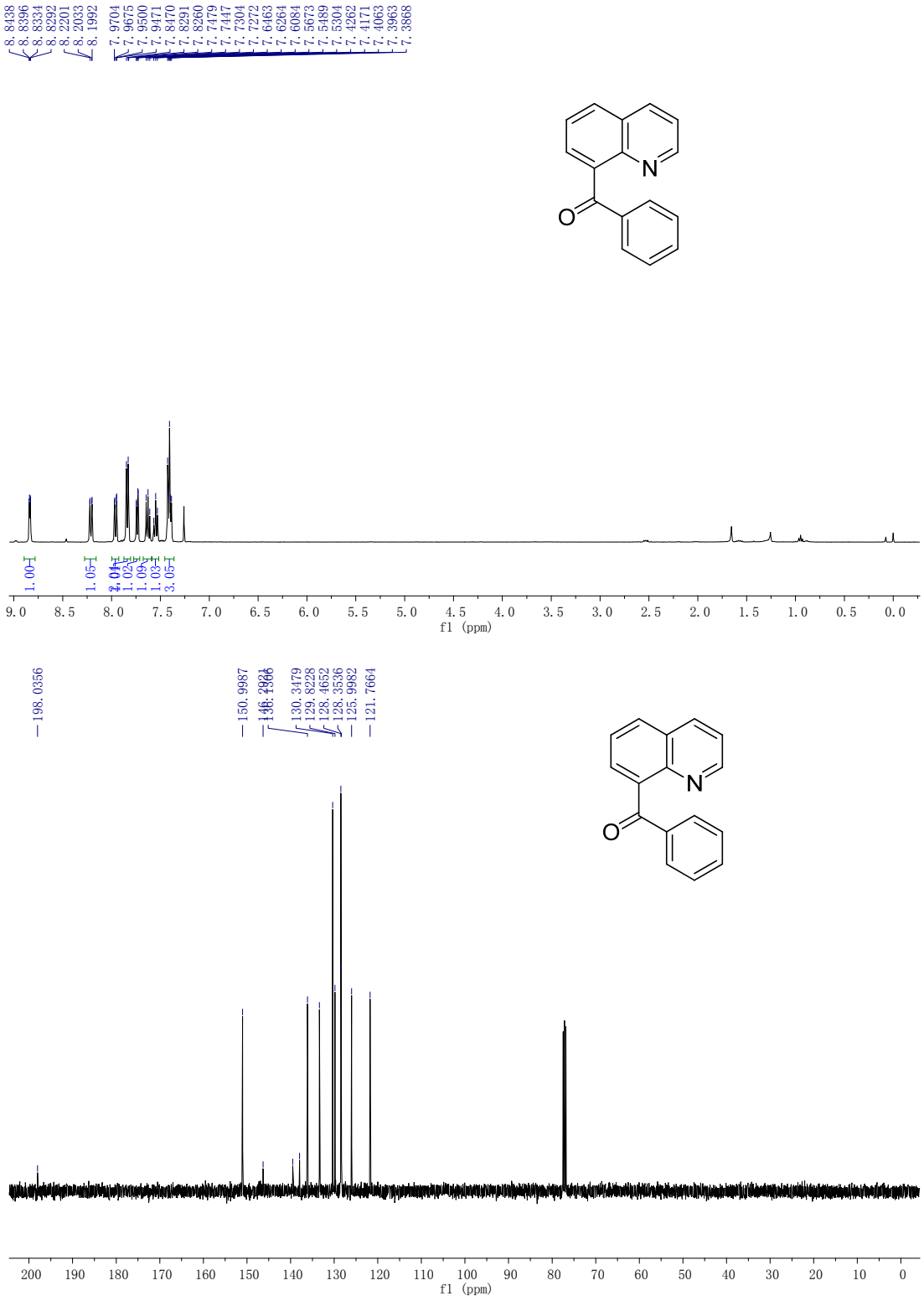
^{1}H and ^{13}C NMR Spectra of Compound **5ar**



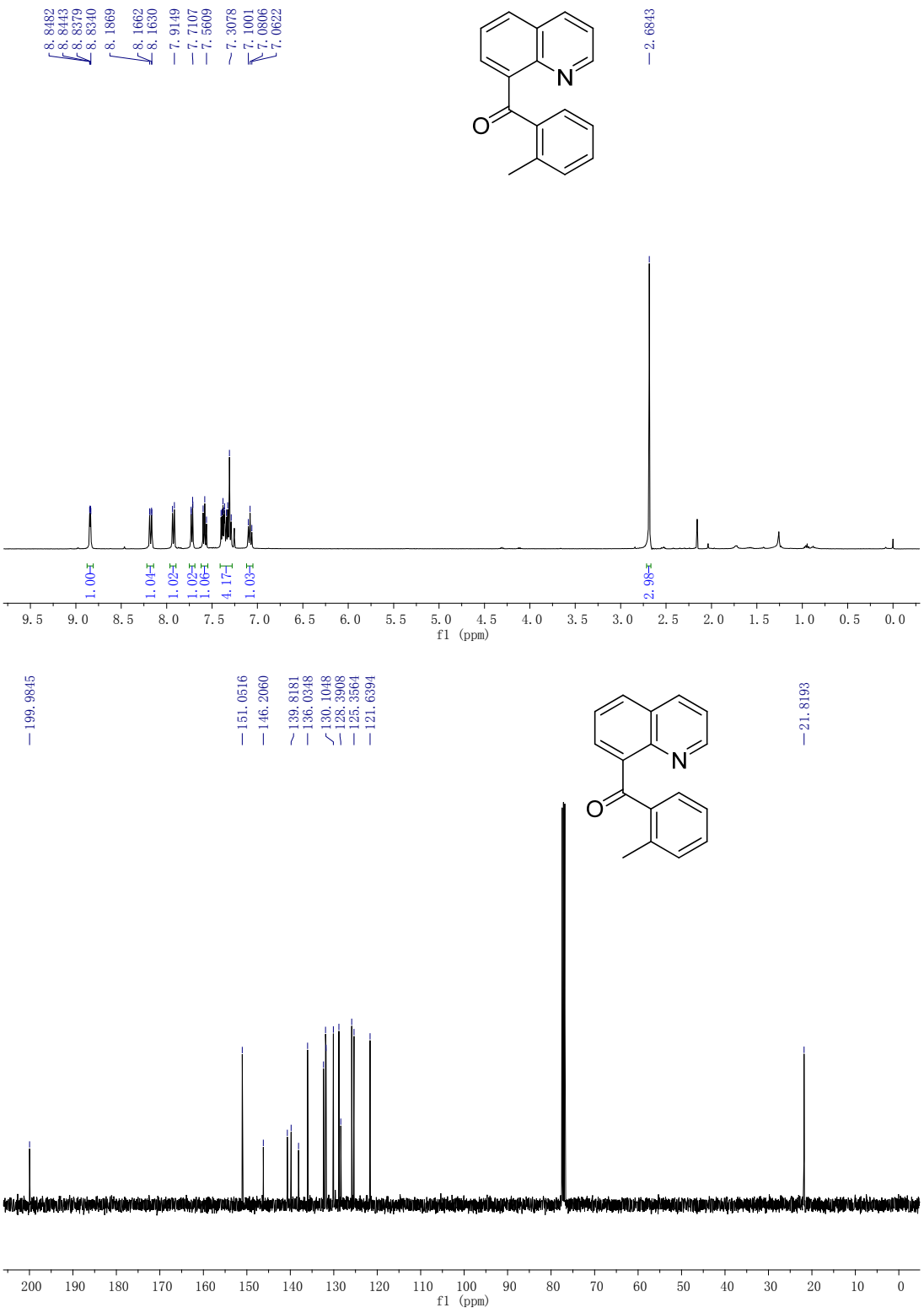
^{1}H and ^{13}C NMR Spectra of Compound **5as**



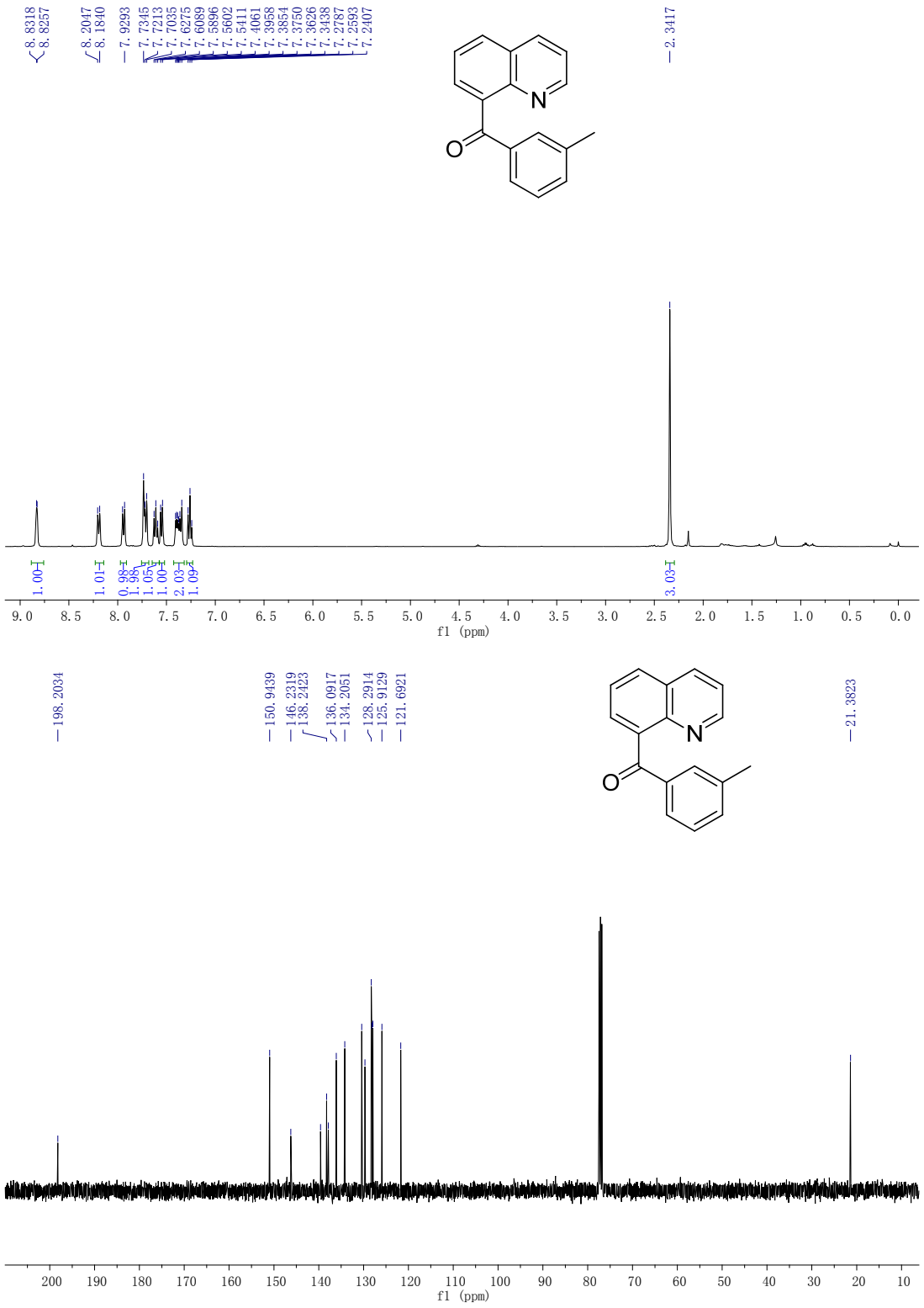
^{1}H and ^{13}C NMR Spectra of Compound **6aa**



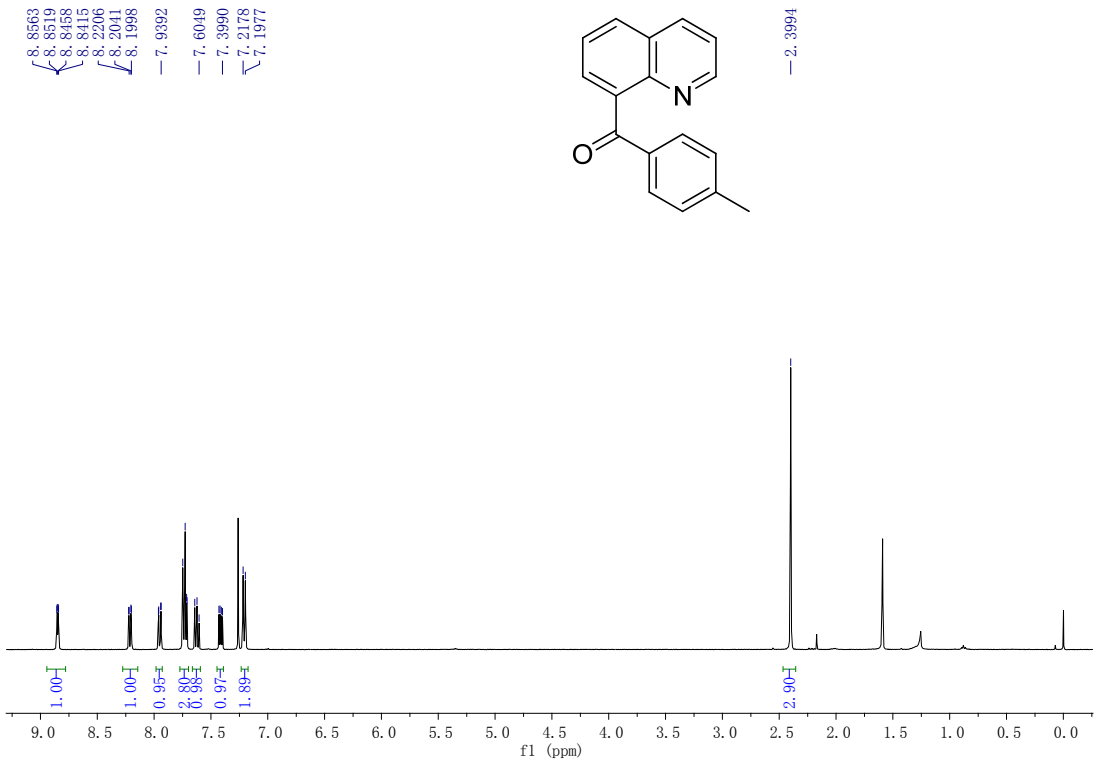
^{1}H and ^{13}C NMR Spectra of Compound **6ab**

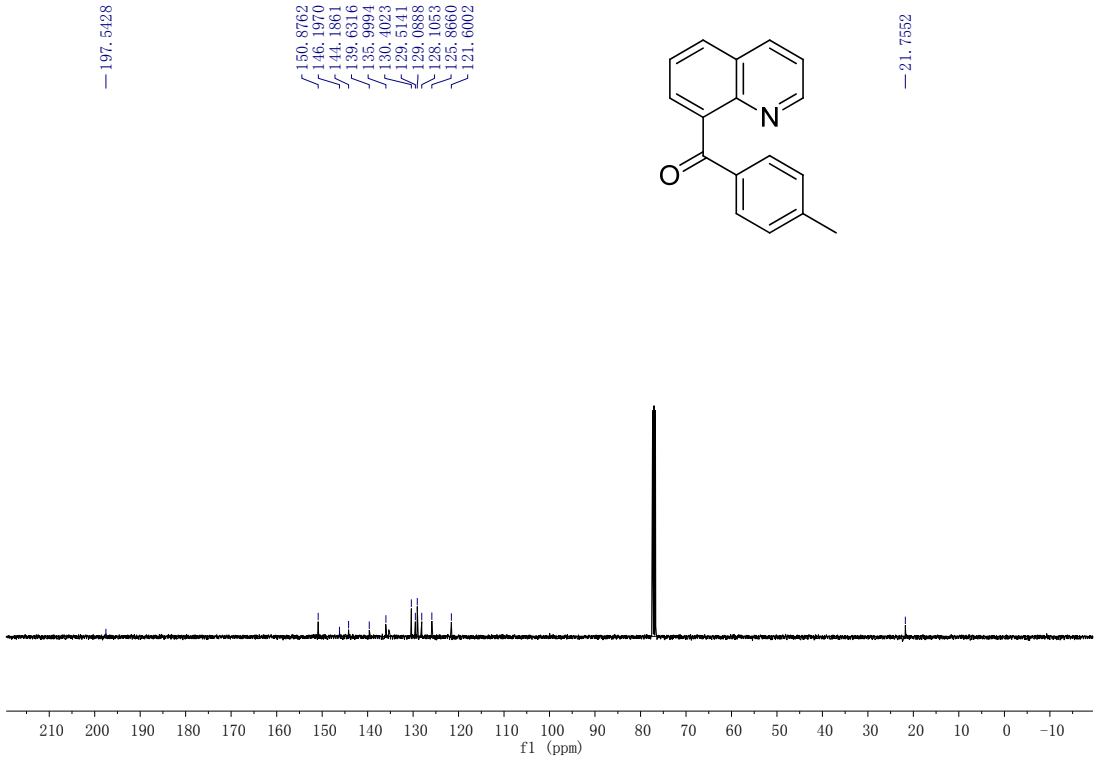


^{1}H and ^{13}C NMR Spectra of Compound **6ac**

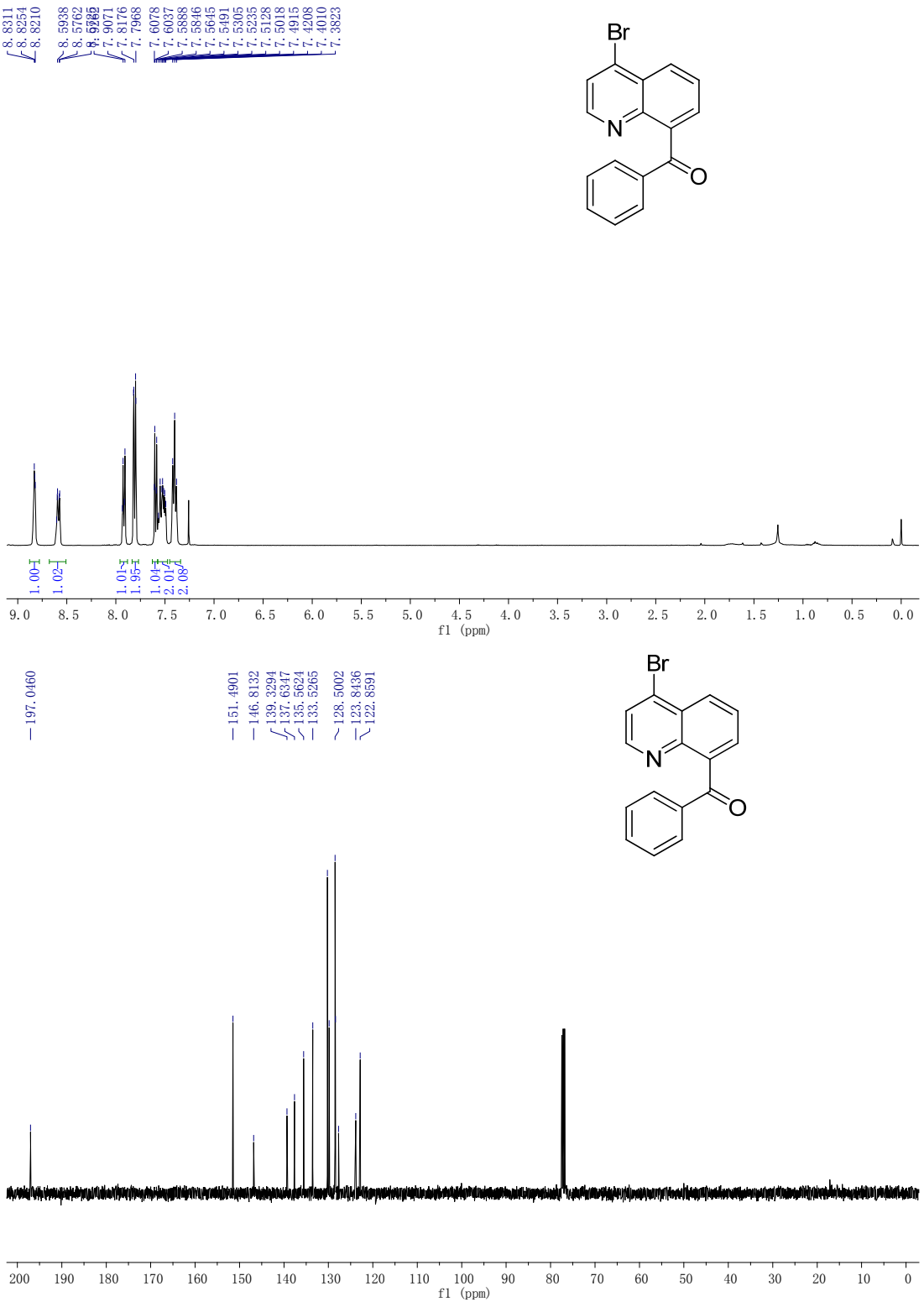


^{1}H and ^{13}C NMR Spectra of Compound **6ad**

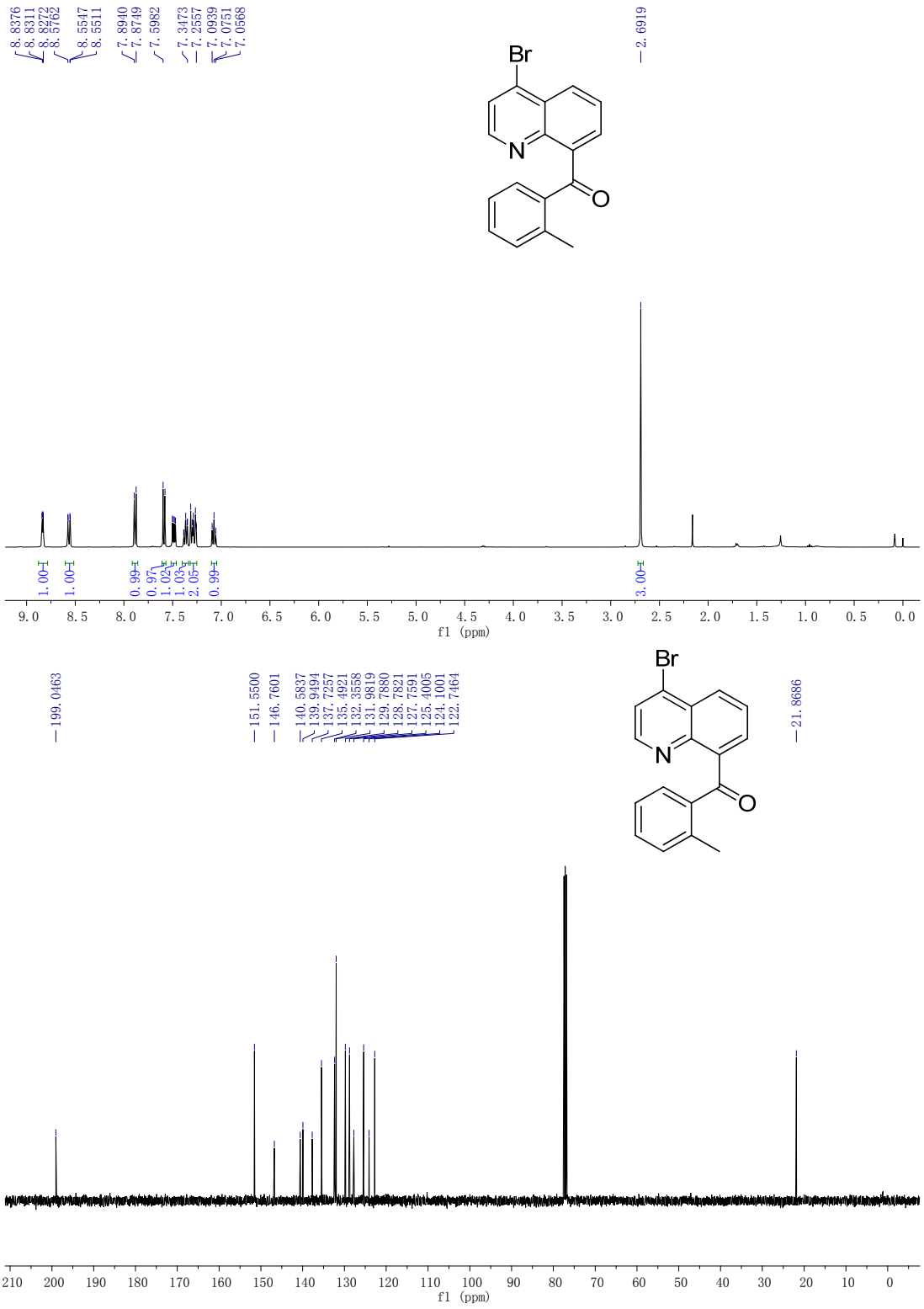




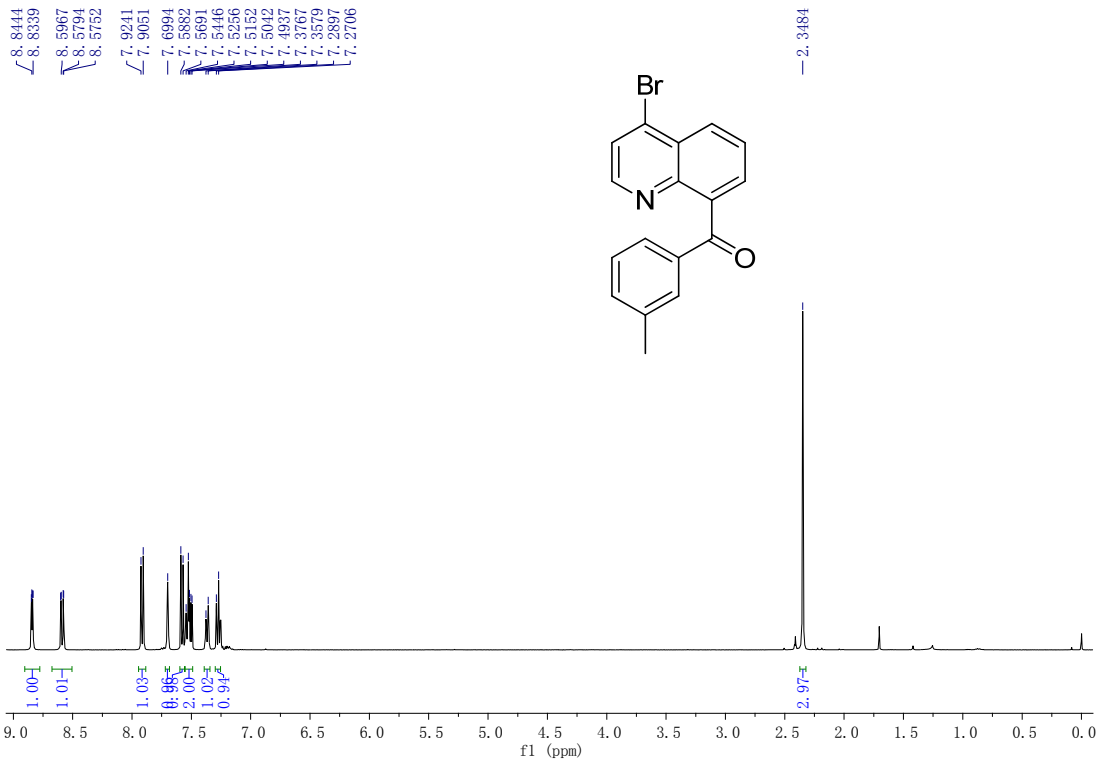
^{1}H and ^{13}C NMR Spectra of Compound **6ae**

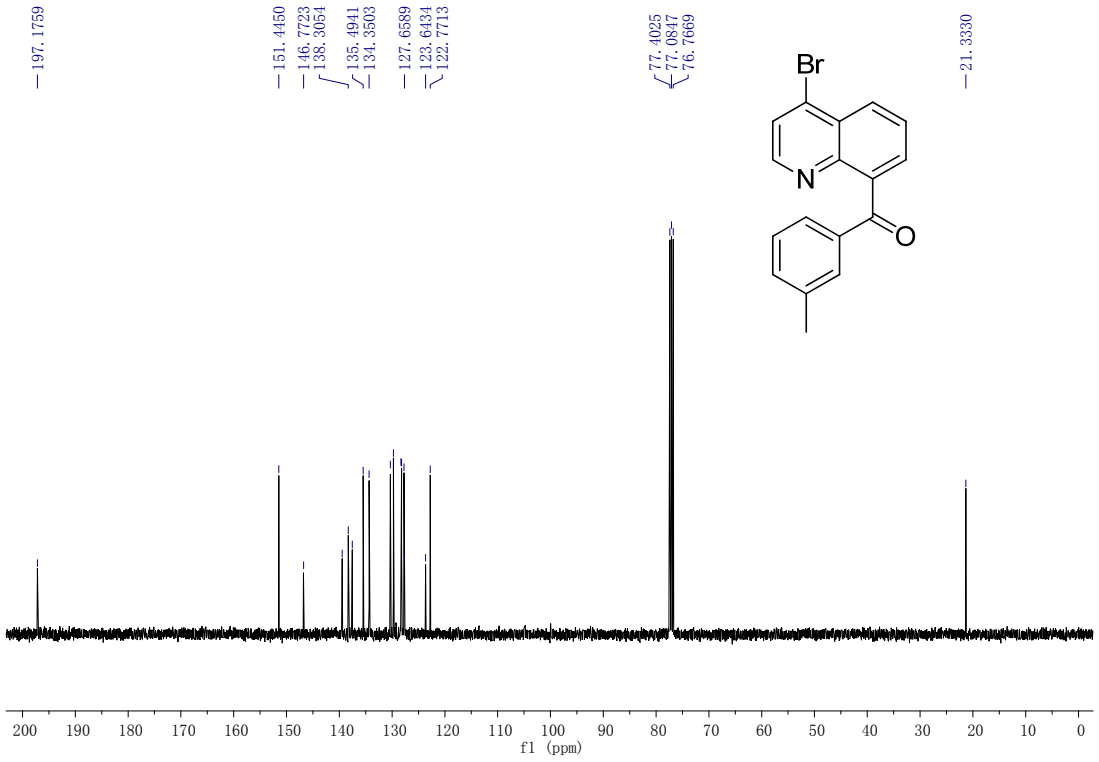


^{1}H and ^{13}C NMR Spectra of Compound **6af**

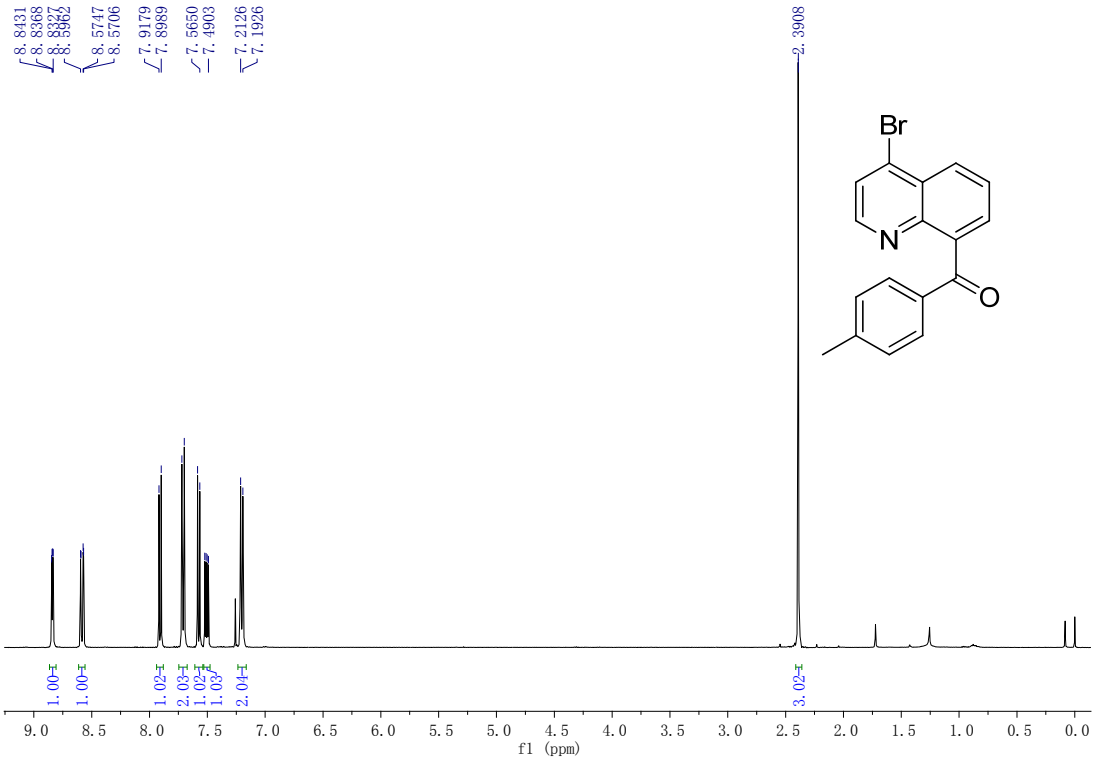


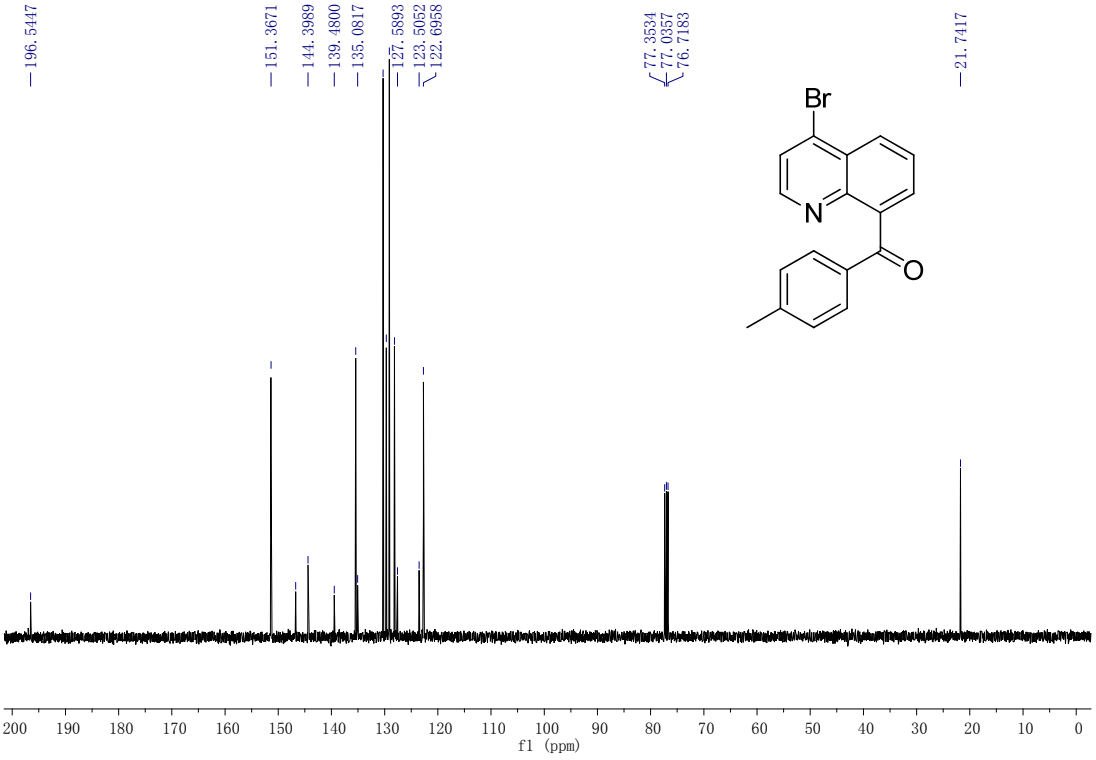
^{1}H and ^{13}C NMR Spectra of Compound **6ag**





^{1}H and ^{13}C NMR Spectra of Compound **6ah**


8.8431
8.8368
8.8327
8.5962
8.5747
8.5706
7.9179
7.8989
7.5650
7.4903
7.2126
7.1926
2.3908
Br
N
O
1.00
1.00
1.02
2.03
1.02
1.03
2.04
3.02
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


196.5447
151.3671
144.3989
139.4800
135.0817
127.5893
123.5052
122.6958
77.3534
77.0357
76.7183
21.7417
Br
N
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)