

Supporting Information

Dual Roles of Methyl Ketones in Radziszewski-Type Reaction: Formal [2 + 1 + 1 + 1] Synthesis of 1,2,5-Trisubstituted Imidazoles

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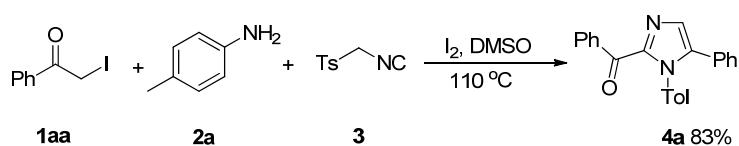
1. General

All substrates and reagents were commercially available and used without further purification. TLC analysis was performed using pre-coated glass plates. Column chromatography was performed using silica gel (200–300 mesh). IR spectra were recorded on a Perkin-Elmer PE-983 infrared spectrometer as KBr pellets with absorption in cm^{-1} . ^1H spectra were recorded in CDCl_3 on 600/400 MHz NMR spectrometers and resonances (δ) are given in parts per million relative to tetramethylsilane. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet), coupling constants (Hz) and integration. ^{13}C spectra were recorded in CDCl_3 on 150/100 MHz NMR spectrometers and resonances (δ) are given in ppm. HRMS were obtained on a Bruker 7-tesla FT-ICR MS equipped with an electrospray source. Melting points were determined using XT-4 apparatus and not corrected.

2. General procedure for the synthesis of 4 (4a as an example)

A sealed tube was charged with acetophenone (**1a**) (120 mg, 1.0 mmol), iodine (203 mg, 0.8 mmol) at room temperature, and DMSO (2 mL) was added. The resulting mixture was stirred at 110 °C, after disappearance of the reactant (monitored by TLC), then added *p*-toluidine (**2a**) (53.5 mg, 0.5 mmol) and TosMIC (**3a**) (97.5 mg, 0.5 mmol) at 110 °C for another 2 h. After the reaction completed, and added 50mL water to the mixture, then extracted with EtOAc 3 times (3 × 50 mL). The extract was washed with 10% $\text{Na}_2\text{S}_2\text{O}_3$ solution (w/w), dried over anhydrous Na_2SO_4 and evaporation. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 20:1) to yield the desired product **4a** as a light yellow solid (135.2 mg, 80% yield).

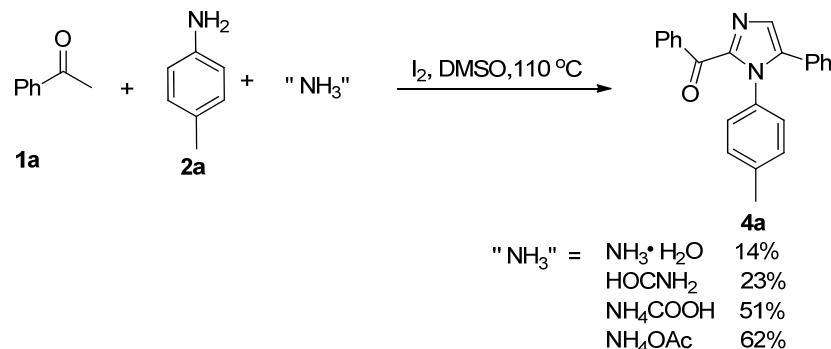
3. The procedure for the Scheme 4a



A sealed tube was charged with 2-iodo-1-phenylethanone (**1aa**) (246 mg, 1.0 mmol), iodine (203 mg, 0.8 mmol) at room temperature, and DMSO (2 mL) was added. The resulting mixture was stirred at 110 °C, after disappearance of the reactant (monitored by TLC), then added *p*-toluidine (**2a**) (53.5 mg, 0.5 mmol) and TosMIC (**3a**) (97.5 mg, 0.5 mmol) at 110 °C for another 2 h. After the reaction completed, and added 50 mL water to the mixture, then extracted with EtOAc 3 times (3 × 50 mL). The extract was washed with 10% $\text{Na}_2\text{S}_2\text{O}_3$ solution (w/w), dried over anhydrous Na_2SO_4 and evaporation. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 20:1) to yield the desired product **4a** as a light yellow solid (142 mg, 83% yield).

4. Control experiments

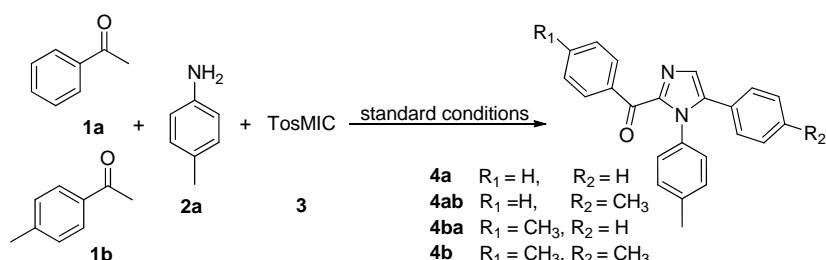
We performed other ammoniums instead of TosMIC. Reactions performed with formamide or ammonium hydroxide under the standard conditions led to sharp decreases in yields of **4a**. When TosMIC was changed to ammonium acetate or ammonium formate, the **4a** can be detected in moderate yield. These results supported that the release of ammonia could be involved in this process.



Scheme S1. Control experiments

5. Cross-coupling reaction

We investigated the cross-coupling reaction using acetophenone (**1a**, 0.5 mmol), 1-(*p*-tolyl)ethanone (**1b**, 0.5 mmol), **2a**, and **3** under the standard conditions to support our mechanism. According to our proposed reaction mechanism, the reaction of equimolar amounts of **1a** and **1b** would give three or four imidazole products. All the products were successfully identified by HRMS analysis of the crude reaction extract; this clearly confirms our proposed mechanism (Scheme S1).



Scheme S1. Cross-coupling reaction

HRMS (ESI): m/z [M_{4a} + H]⁺ calcd for C₂₃H₁₉N₂O: 339.1491; found: 339.15095. m/z [M_{4ab} + H]⁺ or [M_{4ba} + H]⁺ calcd for C₂₄H₂₁N₂O: 353.1648; found: 353.16753. m/z [M_{4b} + H]⁺ calcd for C₂₅H₂₃N₂O: 367.1804; found: 367.18303 (Figure S1).

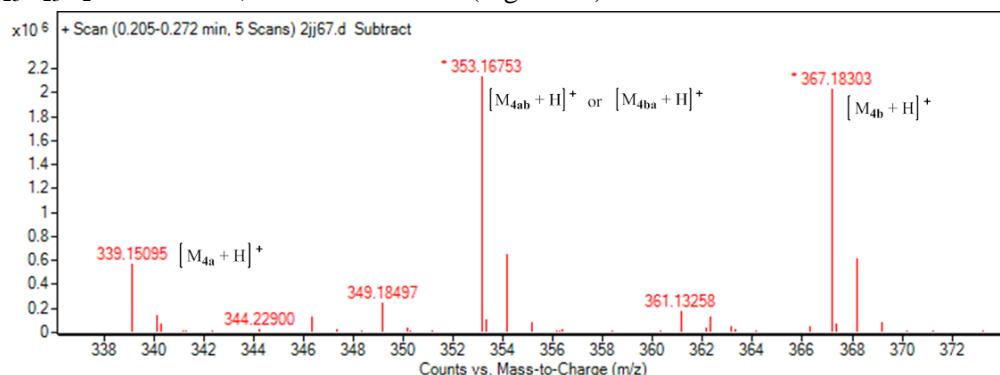
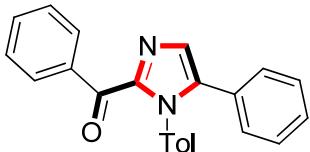
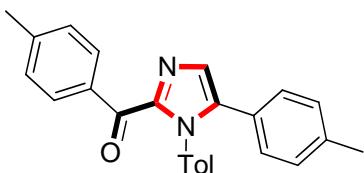


Figure S1. the spectrogram of HRMS

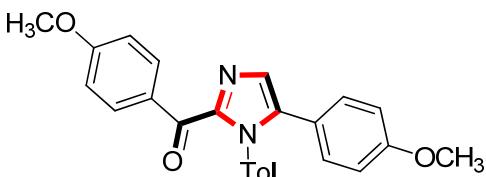
6. Characterization data for compounds 4



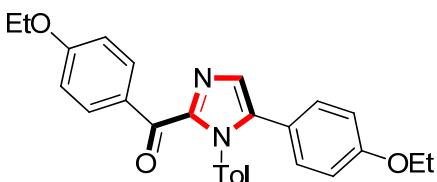
phenyl(5-phenyl-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4a): Yield 80% (142 mg); light yellow solid; mp 173–175 °C; IR (KBr): 3448, 1648, 1631 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.25 (d, *J* = 7.8 Hz, 2H), 7.59–7.55 (m, 1H), 7.48 (t, *J* = 7.8 Hz, 2H), 7.45 (s, 1H), 7.28–7.24 (m, 3H), 7.19 (d, *J* = 8.4 Hz, 2H), 7.17–7.15 (m, 2H), 7.12 (d, *J* = 7.8 Hz, 2H), 2.39 (s, 3H); ¹³C NMR (100 MHz, CDCl₃): δ (ppm) 183.1, 144.3, 138.6, 138.4, 137.2, 134.6, 132.8, 130.8, 129.7, 129.0, 128.6, 128.5, 128.4, 128.2, 128.1, 127.2, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₉N₂O: 339.1491; found: 339.1495.



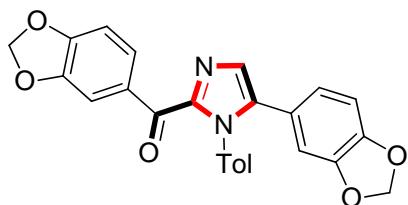
(1,5-di-p-tolyl-1H-imidazol-2-yl)(p-tolyl)methanone (4b): Yield 59% (108 mg); white solid; mp 195–197 °C; IR (KBr): 3443, 1643, 1605, 899 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.15 (d, *J* = 8.4 Hz, 2H), 7.40 (s, 1H), 7.28 (d, *J* = 8.4 Hz, 2H), 7.19 (d, *J* = 8.4 Hz, 2H), 7.11 (d, *J* = 8.4 Hz, 2H), 7.07–7.03 (m, 4H), 2.42 (s, 3H), 2.39 (s, 3H), 2.31 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 182.8, 144.3, 143.6, 138.5, 138.3, 138.2, 134.7, 134.6, 130.9, 129.7, 129.1, 128.8, 128.6, 128.4, 127.2, 125.6, 21.7, 21.3, 21.2; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₅H₂₃N₂O: 367.1804; found: 367.1801.



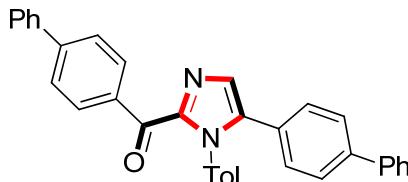
(4-methoxyphenyl)(5-(4-methoxyphenyl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4c): Yield 52% (103.5 mg); white solid; mp 256–258 °C; IR (KBr): 3447, 2360, 2342, 1635, 897 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.29 (d, *J* = 9.0 Hz, 2H), 7.37 (s, 1H), 7.19 (d, *J* = 8.4 Hz, 2H), 7.11–7.07 (m, 4H), 6.96 (d, *J* = 9.0 Hz, 2H), 6.78 (d, *J* = 9.0 Hz, 2H), 3.88 (s, 3H), 3.77 (s, 3H), 2.39 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 181.5, 163.4, 159.5, 144.1, 138.4, 138.0, 134.7, 133.2, 130.0, 129.9, 129.7, 128.0, 127.2, 120.9, 113.9, 113.4, 55.5, 55.2, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₅H₂₃N₂O₃: 399.1703; found: 399.1698.



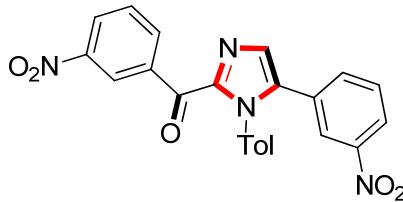
(4-ethoxyphenyl)(5-(4-ethoxyphenyl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4d): Yield 51% (106.5 mg); light yellow solid; mp 208–210 °C; IR (KBr): 3448, 1633, 1432, 1255, 900 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.28 (d, J = 9.0 Hz, 2H), 7.37 (s, 1H), 7.18 (d, J = 7.8 Hz, 2H), 7.10 (d, J = 7.8 Hz, 2H), 7.06 (d, J = 8.4 Hz, 2H), 6.94 (d, J = 9.0 Hz, 2H), 6.76 (d, J = 8.4 Hz, 2H), 4.10 (q, J = 6.6 Hz, 2H), 3.98 (q, J = 6.6 Hz, 2H), 2.38 (s, 3H), 1.43 (t, J = 7.2 Hz, 3H), 1.38 (t, J = 7.2 Hz, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 181.5, 162.8, 158.8, 144.2, 138.3, 138.0, 134.7, 133.2, 132.0, 129.8, 129.6, 128.0, 127.2, 120.8, 114.3, 113.8, 63.6, 63.3, 21.2, 14.7, 14.6; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₇H₂₇N₂O₃: 427.2016; found: 427.2013.



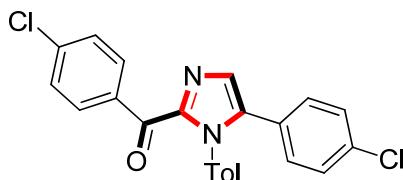
benzo[d][1,3]dioxol-5-yl(5-(benzo[d][1,3]dioxol-5-yl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4e) : Yield 72% (153.4 mg); yellow solid; mp > 300 °C; IR (KBr): 3443, 1644, 1632, 1420, 1262, 1038, 929, 857 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.00 (d, J = 8.4 Hz, 1H), 7.72 (s, 1H), 7.34 (s, 1H), 7.20 (d, J = 7.2 Hz, 2H), 7.09 (d, J = 6.6 Hz, 2H), 6.89 (d, J = 7.8 Hz, 1H), 6.72-6.64 (m, 2H), 6.59 (s, 1H), 6.03 (s, 2H), 5.93 (s, 2H), 2.39 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 181.1, 151.7, 147.6(3), 147.5(8), 147.5, 144.1, 138.6, 137.9, 134.5, 131.6, 129.7, 128.3, 127.8, 127.1, 122.8, 122.2, 110.4, 108.9, 108.4, 107.7, 101.7, 101.2, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₅H₁₉N₂O₅: 427.1288; found: 427.1284.



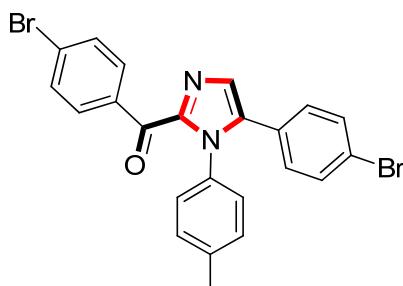
[1,1'-biphenyl]-4-yl(5-([1,1'-biphenyl]-4-yl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4f): Yield 67% (164 mg); light yellow solid; mp 195–198 °C ; IR (KBr): 3449, 1631, 1431, 900 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.35 (d, J = 7.8 Hz, 2H), 7.71 (d, J = 8.4 Hz, 2H), 7.65 (d, J = 7.2 Hz, 2H), 7.55 (d, J = 7.8 Hz, 2H), 7.53 (s, 1H), 7.51–7.44 (m, 4H), 7.44–7.37 (m, 3H), 7.36–7.32 (m, 1H), 7.25–7.22 (m, 4H), 7.18 (d, J = 8.4 Hz, 2H), 2.41 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 182.5, 145.5, 144.4, 142.2, 140.9, 140.1, 140.0, 138.7, 138.1, 135.9, 134.6, 131.4, 129.8, 129.0, 128.9, 128.8, 128.0, 127.6, 127.3(4), 127.2(9), 127.2, 127.0, 126.9, 126.8, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₃₅H₂₇N₂O: 491.2117; found: 491.2121.



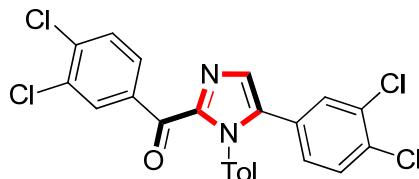
(3-nitrophenyl)(5-(3-nitrophenyl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4g) : Yield 71% (152 mg); yellow solid; mp > 300 °C; IR (KBr): 1653, 1521, 1349 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 9.22 (s, 1H), 8.63 (d, *J* = 7.8 Hz, 1H), 8.44 (d, *J* = 7.8 Hz, 1H), 8.15 (d, *J* = 7.2 Hz, 1H), 8.05 (s, 1H), 7.72–7.67 (m, 1H), 7.62 (s, 1H), 7.51–7.45 (m, 2H), 7.28 (d, *J* = 7.8 Hz, 2H), 7.17 (d, *J* = 8.4 Hz, 2H), 2.43 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 180.1, 148.1, 147.9, 143.9, 139.8, 138.1, 136.7, 136.3, 134.1, 133.6, 130.3, 130.2, 129.8, 129.6, 129.3, 127.2, 127.0, 126.1, 123.3, 123.2, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₇N₄O₅: 429.1193; found: 429.1194.



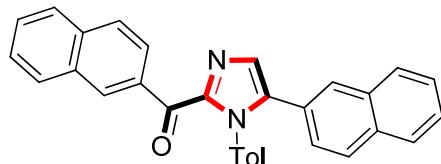
(4-chlorophenyl)(5-(4-chlorophenyl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4h): Yield 72% (146.5 mg); white solid; mp 208–211 °C; IR (KBr): 3448, 1631, 897 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.23 (d, *J* = 9.0 Hz, 2H), 7.46–7.43 (m, 3H), 7.23 (t, *J* = 7.8 Hz, 4H), 7.12–7.06 (m, 4H), 2.41 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 181.5, 144.1, 139.4, 139.0, 137.6, 135.3, 134.5, 134.2, 132.3, 129.9, 129.7, 129.2, 128.8, 128.4, 127.1, 126.8, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₇Cl₂N₂O: 407.0712; found: 407.0717.



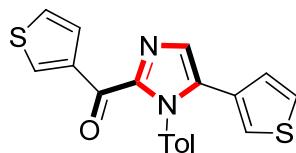
(4-bromophenyl)(5-(4-bromophenyl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4i) : Yield 80% (198.4 mg); white solid; mp 220–221 °C; IR (KBr): 3443, 1642, 895 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.15 (d, *J* = 8.4 Hz, 2H), 7.62 (d, *J* = 7.8 Hz, 2H), 7.45 (s, 1H), 7.39 (d, *J* = 8.4 Hz, 2H), 7.22 (d, *J* = 7.2 Hz, 2H), 7.10 (d, *J* = 7.8 Hz, 2H), 7.01 (d, *J* = 7.8 Hz, 2H), 2.41 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 181.6, 144.0, 139.1, 137.6, 135.7, 134.1, 132.3, 131.7, 131.4, 130.0, 129.9, 129.1, 128.3, 127.2, 127.1, 122.8, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₇Br₂N₂O: 494.9702; found: 494.9699.



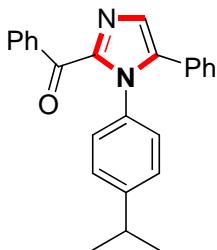
(3,4-dichlorophenyl)(5-(3,4-dichlorophenyl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4j) : Yield 67% (159.4 mg); yellow solid; mp 175–178 °C; IR (KBr): 3450, 1650, 1419, 925 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.44 (s, 1H), 8.16 (d, *J* = 8.4 Hz, 1H), 7.56 (d, *J* = 8.4 Hz, 1H), 7.48 (s, 1H), 7.31 (d, *J* = 7.2 Hz, 2H), 7.27–7.24 (m, 2H), 7.10 (d, *J* = 7.2 Hz, 2H), 6.90 (d, *J* = 8.4 Hz, 1H), 2.43 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 180.0, 143.9, 139.4, 137.6, 136.6, 136.4, 133.9, 132.9 (x 2), 132.6, 130.5, 130.3 (x 2), 130.0, 129.9, 129.7, 128.2, 127.5, 127.0, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₅Cl₄N₂O: 474.9933; found: 474.9931.



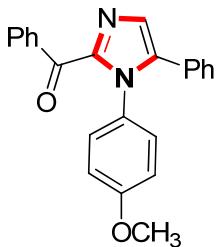
naphthalen-2-yl(5-(naphthalen-2-yl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4k) : Yield 77% (168.6 mg); light yellow solid; mp 206–208 °C; IR (KBr): 3448, 1630, 1424, 1329, 1123, 899, 827 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 9.00 (s, 1H), 8.24 (d, *J* = 8.4 Hz, 1H), 8.02 (d, *J* = 8.4 Hz, 1H), 7.90 (d, *J* = 8.4 Hz, 1H), 7.87 (d, *J* = 7.8 Hz, 1H), 7.79–7.74 (m, 1H), 7.73–7.67 (m, 3H), 7.61 (s, 1H), 7.58 (t, *J* = 7.2 Hz, 1H), 7.55–7.50 (m, 1H), 7.49–7.44 (m, 2H), 7.24–7.19 (m, 5H), 2.38 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 182.9, 144.6, 138.7, 138.4, 135.5, 134.6, 134.4, 133.5, 132.9, 132.6, 132.3, 130.0, 129.8, 129.4, 128.4, 128.1(3), 128.0(6), 128.0, 127.9, 127.6(2), 127.5(8), 127.2, 126.7, 126.5, 126.4, 126.0, 125.9, 125.8, 21.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₃₁H₂₃N₂O: 439.1804; found: 439.1811.



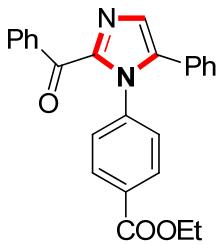
thiophen-3-yl(5-(thiophen-3-yl)-1-(p-tolyl)-1H-imidazol-2-yl)methanone (4l) : Yield 42% (73.5 mg); light yellow solid; mp 186–188 °C; IR (KBr): 3449, 1639, 850 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.91 (d, *J* = 3.0 Hz, 1H), 7.80 (d, *J* = 4.8 Hz, 1H), 7.50 (s, 1H), 7.30–7.27 (m, 3H), 7.24–7.22 (m, 1H), 7.18 (d, *J* = 7.8 Hz, 2H), 6.97 (d, *J* = 5.4 Hz, 1H), 6.73–6.72 (m, 1H), 2.45 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 175.5, 144.0, 140.7, 139.2, 136.2, 135.1, 134.4, 130.0, 128.8(2), 128.7(6), 128.3, 127.2, 126.9, 125.7, 125.1, 122.9, 21.4; HRMS (ESI): m/z [M + H]⁺ calcd for C₁₉H₁₅N₂OS₂: 351.0620; found: 351.0631.



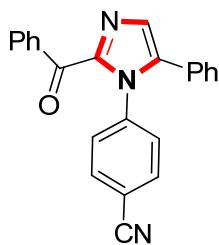
(1-(4-isopropylphenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4m) : Yield 72% (131.8 mg); white solid; mp 158–160 °C; IR (KBr): 3450, 1647, 1630, 1428, 896 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.24–8.21 (m, 2H), 7.58 (t, J = 7.2 Hz, 1H), 7.48 (t, J = 7.8 Hz, 2H), 7.46 (s, 1H), 7.28–7.23 (m, 5H), 7.16–7.13 (m, 4H), 2.97–2.92 (m, 1H), 1.27 (d, J = 6.6 Hz, 6H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 183.2, 149.4, 144.2, 138.5, 137.2, 134.6, 132.8, 130.8, 128.9, 128.6, 128.5, 128.4, 128.2, 128.1, 127.2, 127.0, 33.7, 23.8; HRMS (ESI): m/z [M + Na]⁺ calcd for C₂₅H₂₂N₂ONa: 389.1624; found: 389.1620.



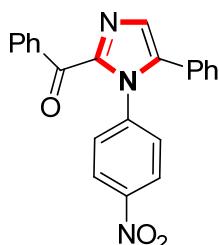
(1-(4-methoxyphenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4n) : Yield 81% (143.4 mg); white solid; mp 160–163 °C; IR (KBr): 3448, 1637, 1426, 896 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.24 (d, J = 7.8 Hz, 2H), 7.58 (t, J = 7.2 Hz, 1H), 7.51–7.45 (m, 3H), 7.27 (d, J = 8.4 Hz, 3H), 7.18–7.14 (m, 4H), 6.91 (d, J = 8.4 Hz, 2H), 3.83 (s, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 183.1, 159.5, 144.2, 138.6, 137.1, 132.9, 130.8, 129.7, 128.7, 128.6, 128.5, 128.4, 128.3, 128.1, 114.2, 55.4; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₉N₂O₂: 355.1441; found: 355.1457.



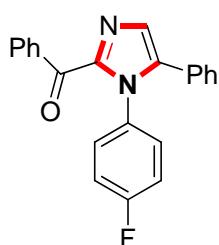
ethyl 4-(2-benzoyl-5-phenyl-1H-imidazol-1-yl)benzoate (4o) : Yield 68% (134.6 mg); white solid; mp 144–145 °C; IR (KBr): 3444, 1713, 1644, 1451, 1429, 1272, 895, 698 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.27 (d, J = 7.8 Hz, 2H), 8.09 (d, J = 8.4 Hz, 2H), 7.60 (t, J = 7.2 Hz, 1H), 7.51–7.47 (m, 3H), 7.31 (d, J = 8.4 Hz, 2H), 7.29–7.24 (m, 3H), 7.13 (d, J = 7.2 Hz, 2H), 4.39 (q, J = 7.2 Hz, 2H), 1.39 (t, J = 7.2 Hz, 3H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 182.8, 165.6, 144.1, 141.1, 138.4, 136.8, 133.1, 130.8 (x 2), 130.6, 130.5, 129.4, 128.7, 128.6, 128.2, 128.0, 127.5, 61.3, 14.3; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₅H₂₁N₂O₃: 397.1546; found: 397.1550.



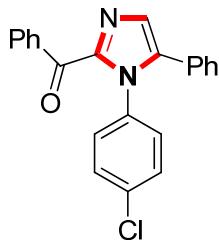
4-(2-benzoyl-5-phenyl-1H-imidazol-1-yl)benzonitrile (4p) : Yield 65% (113.4 mg); light yellow solid; mp 198–200 °C; IR (KBr): 1632, 1429, 896 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.28 (d, *J* = 7.2 Hz, 2H), 7.71 (d, *J* = 8.4 Hz, 2H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.52–7.48 (m, 3H), 7.36 (d, *J* = 9.0 Hz, 2H), 7.33–7.27 (m, 3H), 7.12–7.08 (m, 2H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 182.8, 143.9, 141.2, 138.4, 136.5, 133.3, 133.0, 130.9, 130.8, 129.6, 128.9, 128.7, 128.6, 128.3, 127.6, 117.9, 112.7; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₃H₁₆N₃O: 350.1287; found: 350.1290.



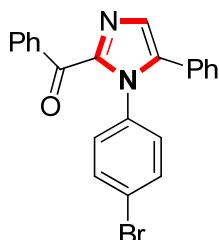
(1-(4-nitrophenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4q) : Yield 62% (114.3 mg); white solid; mp 204–206 °C; IR (KBr): 3448, 1637, 1518, 1448, 1429, 1344, 897, 759, 691 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.30–8.25 (m, 4H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.53–7.47 (m, 3H), 7.41 (d, *J* = 8.4 Hz, 2H), 7.33–7.27 (m, 3H), 7.12 (d, *J* = 7.2 Hz, 2H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 182.7, 147.4, 144.0, 142.9, 138.5, 136.4, 133.3, 130.8, 129.7, 128.9, 128.8, 128.7, 128.6, 128.3, 127.5, 124.5; HRMS (ESI): m/z [M + Na]⁺ calcd for C₂₂H₁₅N₃O₃Na: 392.1005; found: 392.1005.



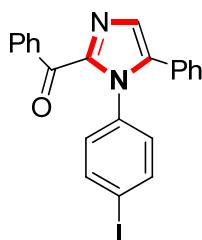
(1-(4-fluorophenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4r) : Yield 78% (133.4 mg); white solid; mp 160–161 °C; IR (KBr): 3451, 1641, 1510, 1448, 1428, 1339, 897, 838, 693 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.25 (d, *J* = 7.2 Hz, 2H), 7.62–7.56 (m, 1H), 7.54–7.48 (m, 2H), 7.47 (s, 1H), 7.32–7.25 (m, 3H), 7.23 (s, 2H), 7.18–7.12 (m, 2H), 7.12–7.06 (m, 2H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 183.0, 163.1, 161.4, 144.2, 138.6, 137.0, 133.2, 133.0, 130.8, 129.3, 129.2, 129.1, 128.6, 128.5(2), 128.5(0), 128.2, 116.2, 116.0; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₂H₁₆FN₂O: 343.1241; found: 343.1252.



(1-(4-chlorophenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4s) : Yield 81% (145 mg); white solid; mp 196–199 °C; IR (KBr): 3452, 1643, 1447, 1428, 896 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.26 (d, *J* = 7.2 Hz, 2H), 7.60–7.57 (m, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.46 (s, 1H), 7.37 (d, *J* = 8.4 Hz, 2H), 7.30–7.27 (m, 3H), 7.18 (d, *J* = 8.4 Hz, 2H), 7.15–7.12 (m, 2H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 183.0, 144.1, 138.5, 136.9, 135.7, 134.6, 133.0, 130.8, 129.3, 129.2, 128.8, 128.7, 128.6, 128.5, 128.2, 128.0; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₂H₁₆ClN₂O: 359.0945; found: 359.0950.



(1-(4-bromophenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4t) : Yield 79% (159 mg); white solid; mp 202–204 °C; IR (KBr): 3449, 1631, 1431, 900, 750 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.26 (d, *J* = 7.8 Hz, 2H), 7.60–7.57 (m, 1H), 7.53 (d, *J* = 8.4 Hz, 2H), 7.51–7.47 (m, 2H), 7.46 (s, 1H), 7.32–7.27 (m, 3H), 7.16–7.13 (m, 2H), 7.12 (d, *J* = 8.4 Hz, 2H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 183.0, 144.0, 138.4, 136.8, 136.2, 133.1, 132.3, 130.8, 129.3, 129.1, 128.7, 128.6(0), 128.5(6), 128.2, 128.0, 122.7; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₂H₁₆BrN₂O: 403.0440; found: 403.0445.



(1-(4-iodophenyl)-5-phenyl-1H-imidazol-2-yl)(phenyl)methanone (4u) : Yield 79% (177.7 mg); white solid; mp 189–190 °C; IR (KBr): 3447, 1643, 1426, 896 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.25 (d, *J* = 7.8 Hz, 2H), 7.72 (d, *J* = 8.4 Hz, 2H), 7.61–7.57 (m, 1H), 7.52–7.47 (m, 2H), 7.45 (s, 1H), 7.32–7.27 (m, 3H), 7.16–7.12 (m, 2H), 6.98 (d, *J* = 7.8 Hz, 2H); ¹³C NMR (150 MHz, CDCl₃): δ (ppm) 183.0, 144.1, 138.4, 138.3, 137.0, 136.9, 133.1, 130.8(x 2), 129.3, 128.7, 128.6(4), 128.6(0), 128.2, 128.0, 94.4; HRMS (ESI): m/z [M + H]⁺ calcd for C₂₂H₁₆IN₂O: 451.0301; found: 451.0308.

7. Crystallographic data and molecular structure of compounds 4a

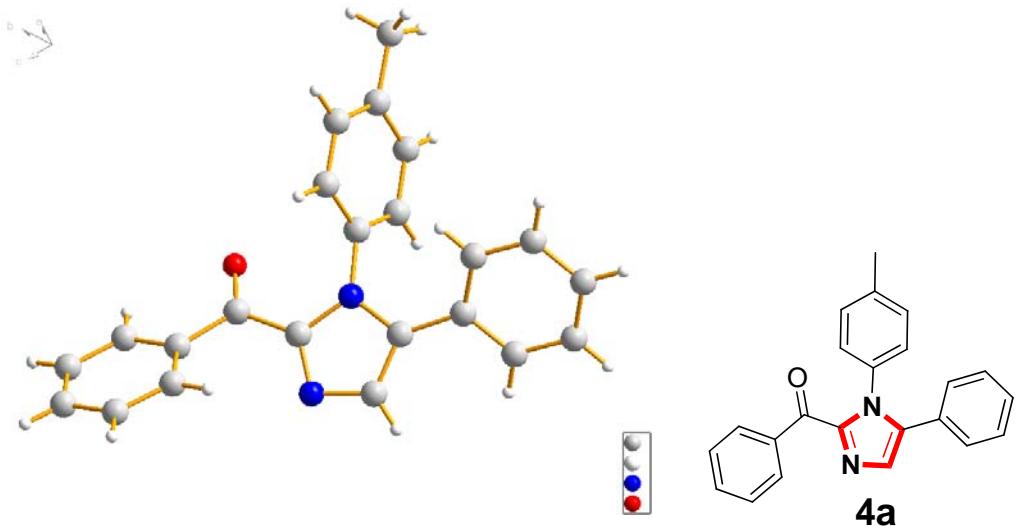
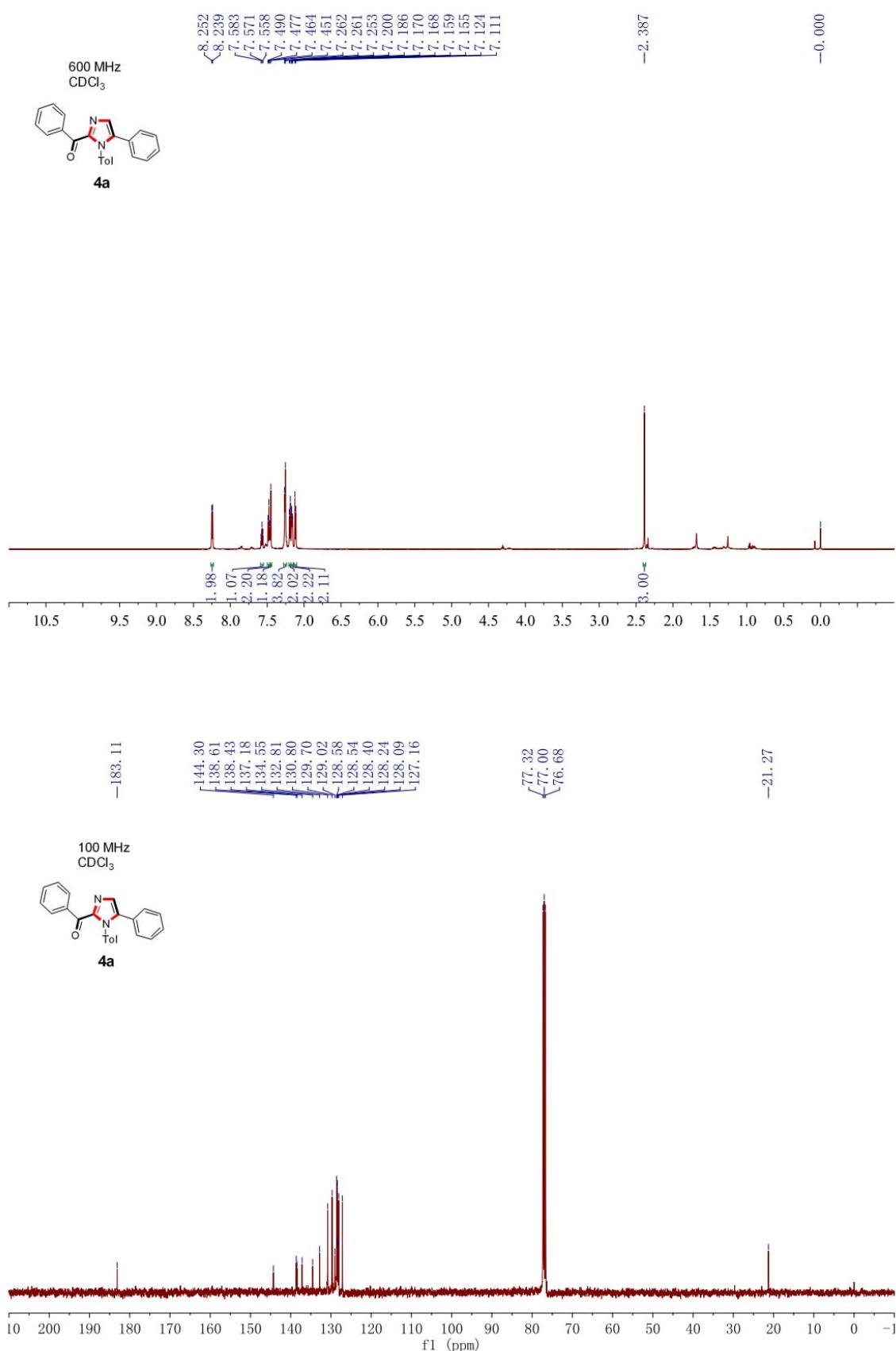
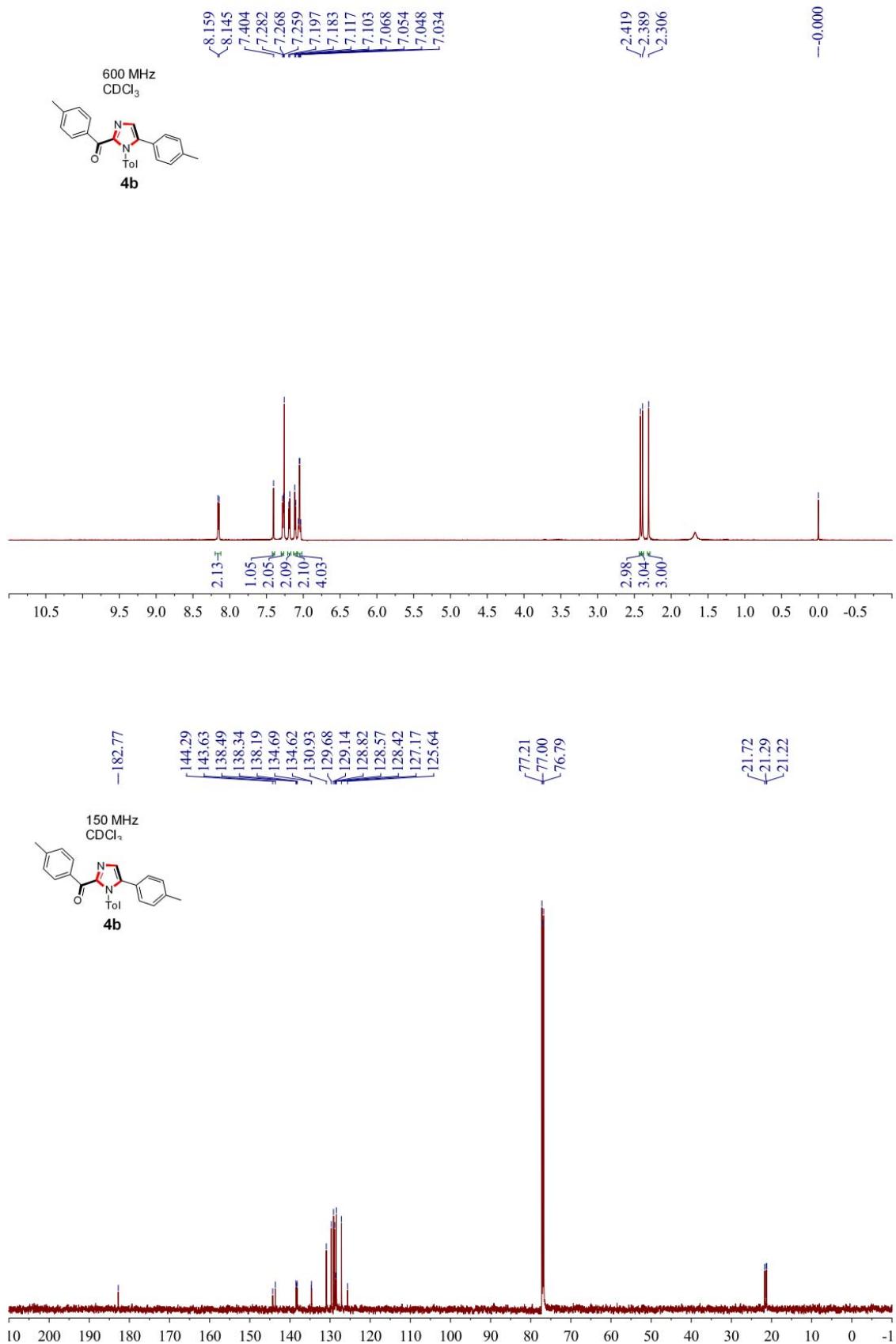


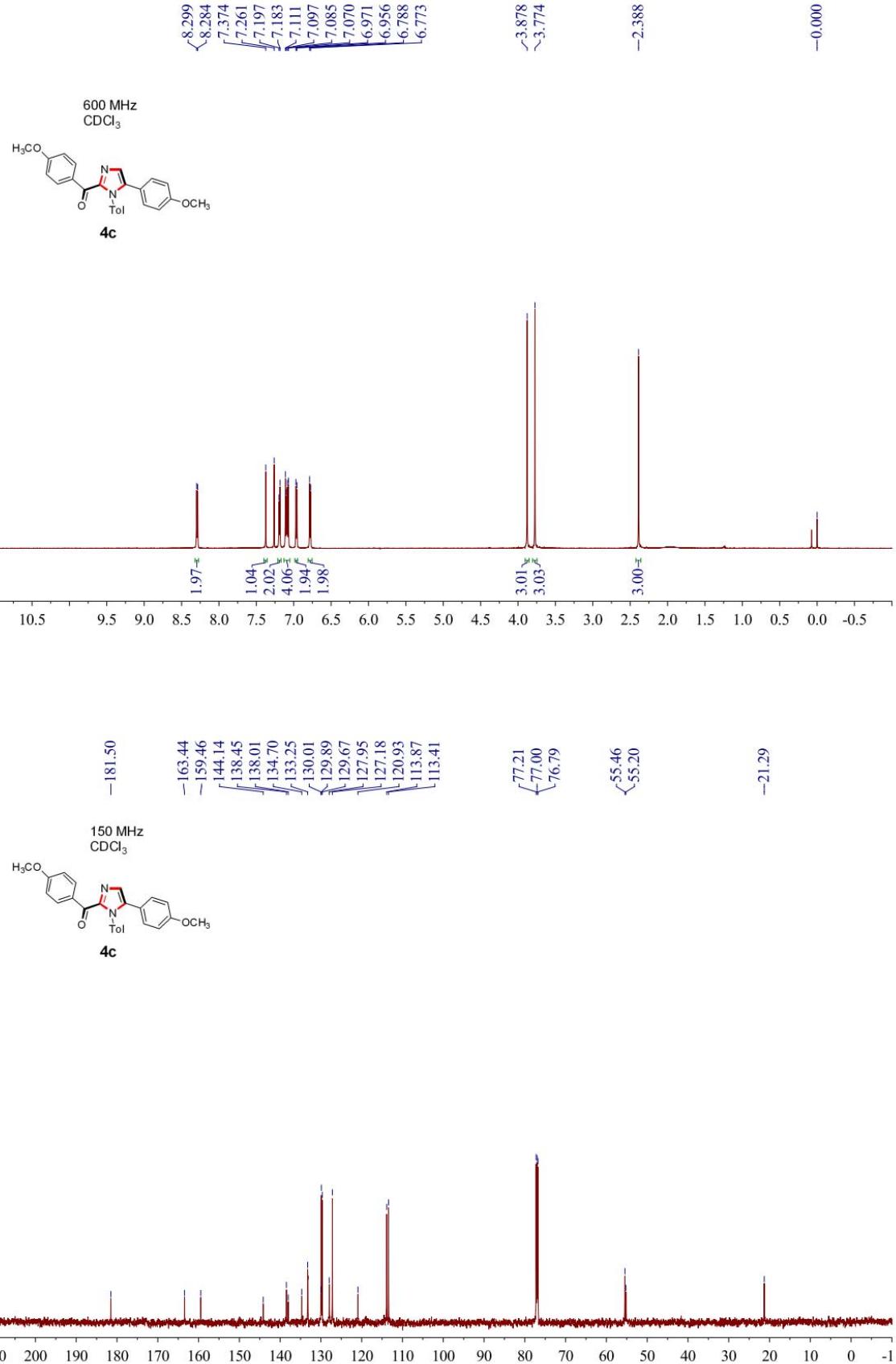
Figure S2. X-ray crystal structure of **4a**

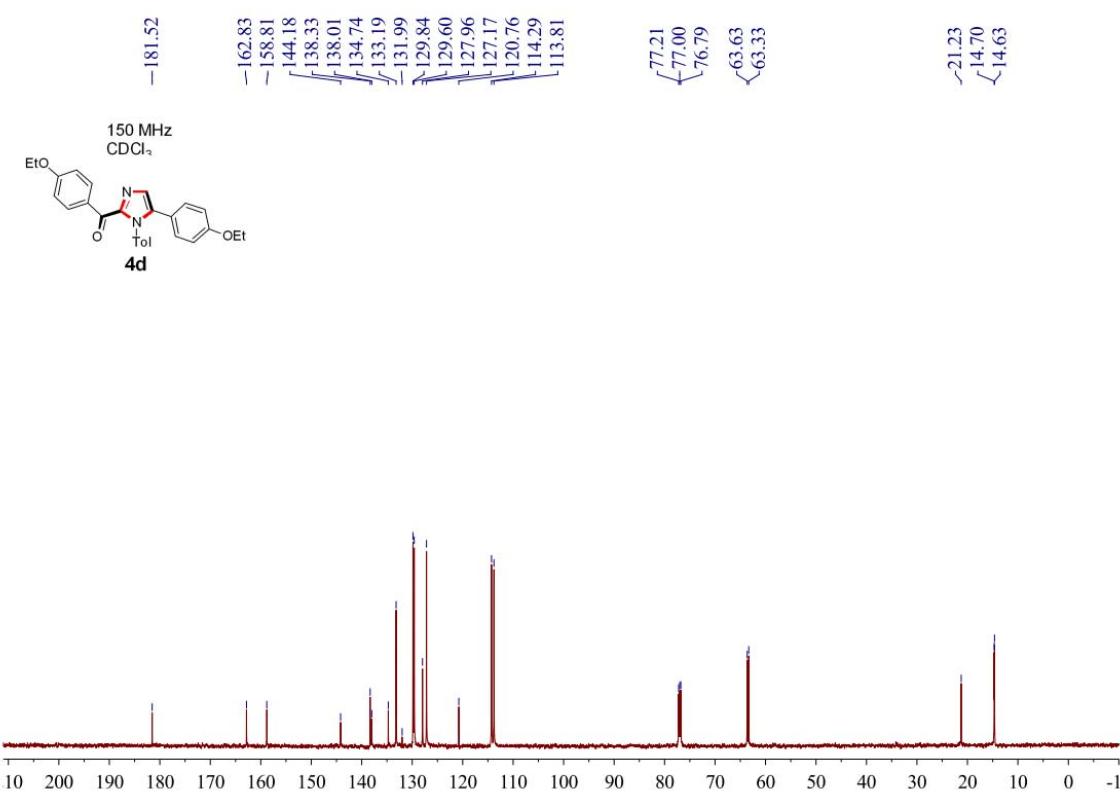
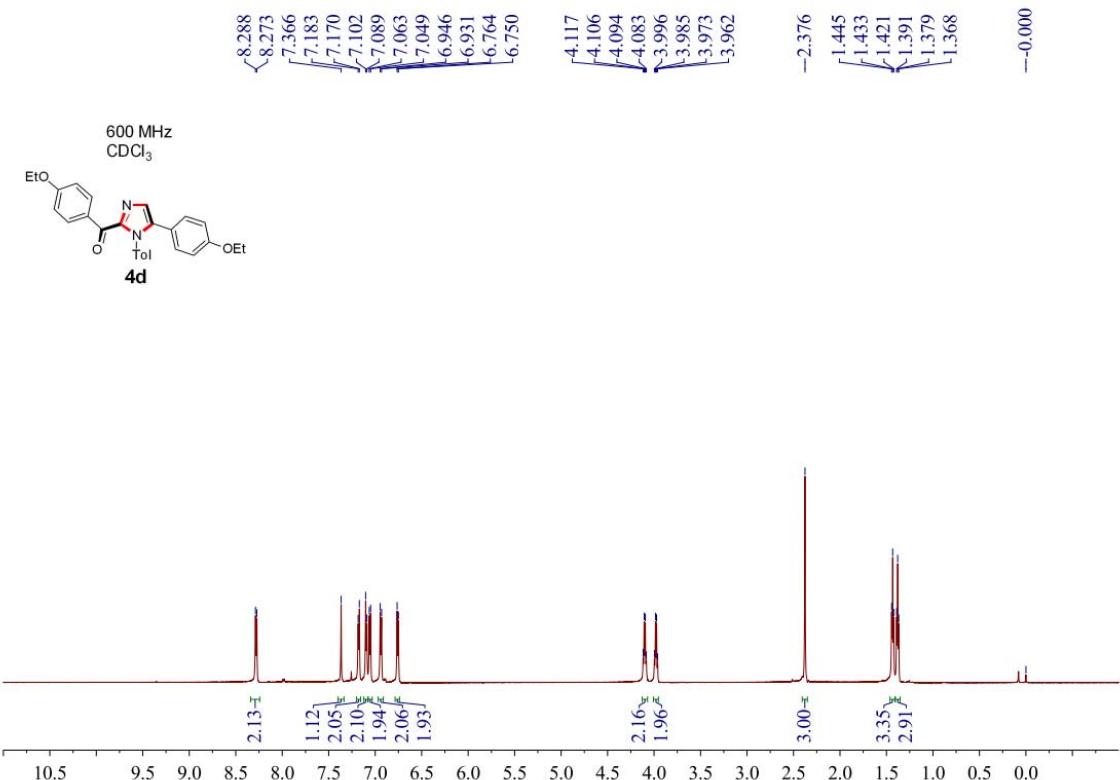
Crystal Data for Compound **4a**: C₂₃H₁₈N₂O, MW = 338.39, Triclinic, $a = 9.556(9)$ Å, $b = 10.061(10)$ Å, $c = 10.958(10)$ Å, $\alpha = 73.61(2)^\circ$, $\beta = 65.525(16)^\circ$, $\gamma = 68.71(2)^\circ$, $V = 882.6(15)$ Å³, $T = 293(2)$ K, space group P-1, $Z = 2$, $m(\text{Mo-K}\alpha) = 0.079$ mm⁻¹, 8060 Reflections collected, 3071 unique [R(int) = 0.0224] which were used in all calculations. The final wR2 (F2) was 0.1274. CCDC 1454210 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

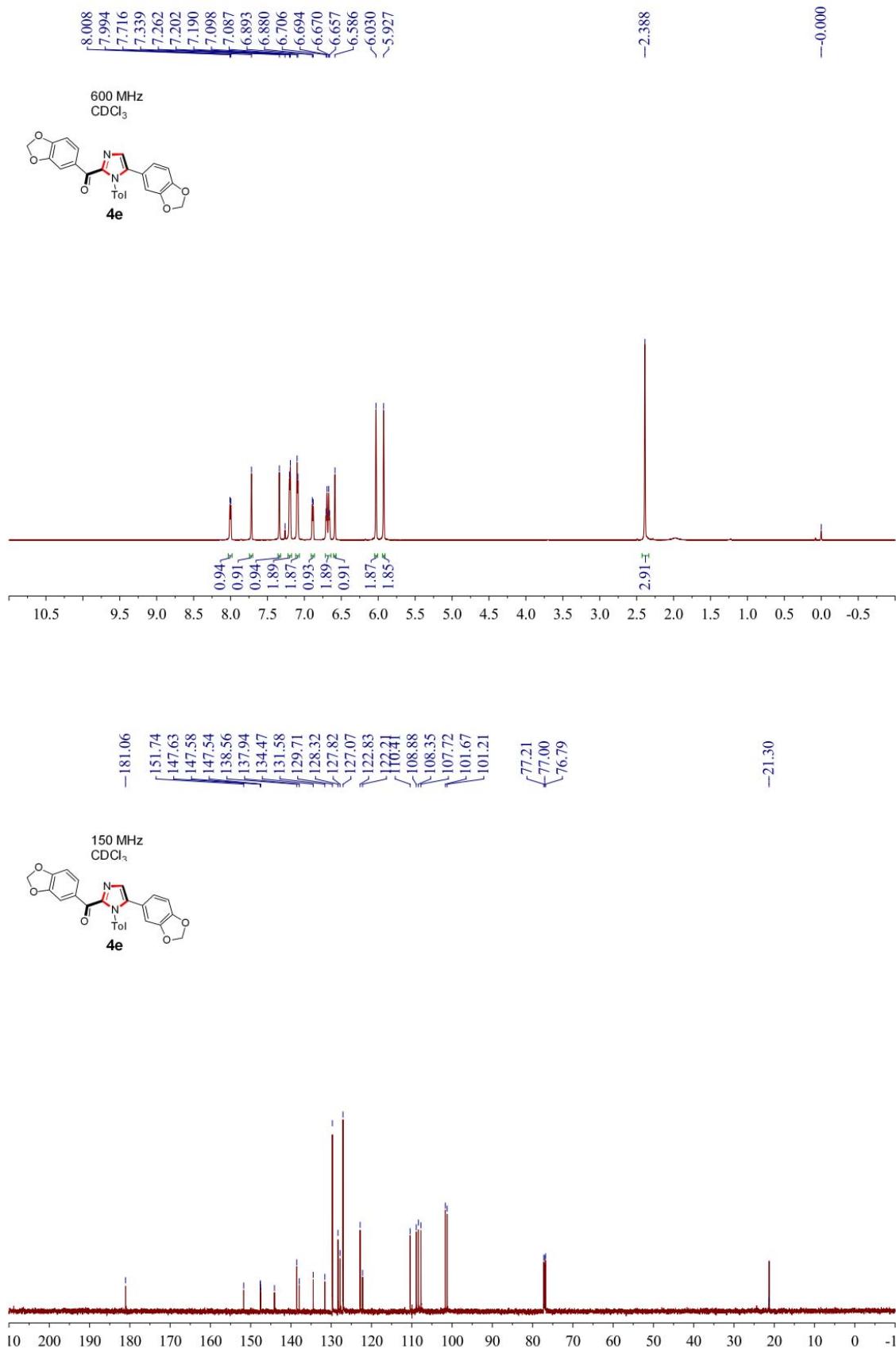
8. ^1H and ^{13}C NMR spectra of compounds 4

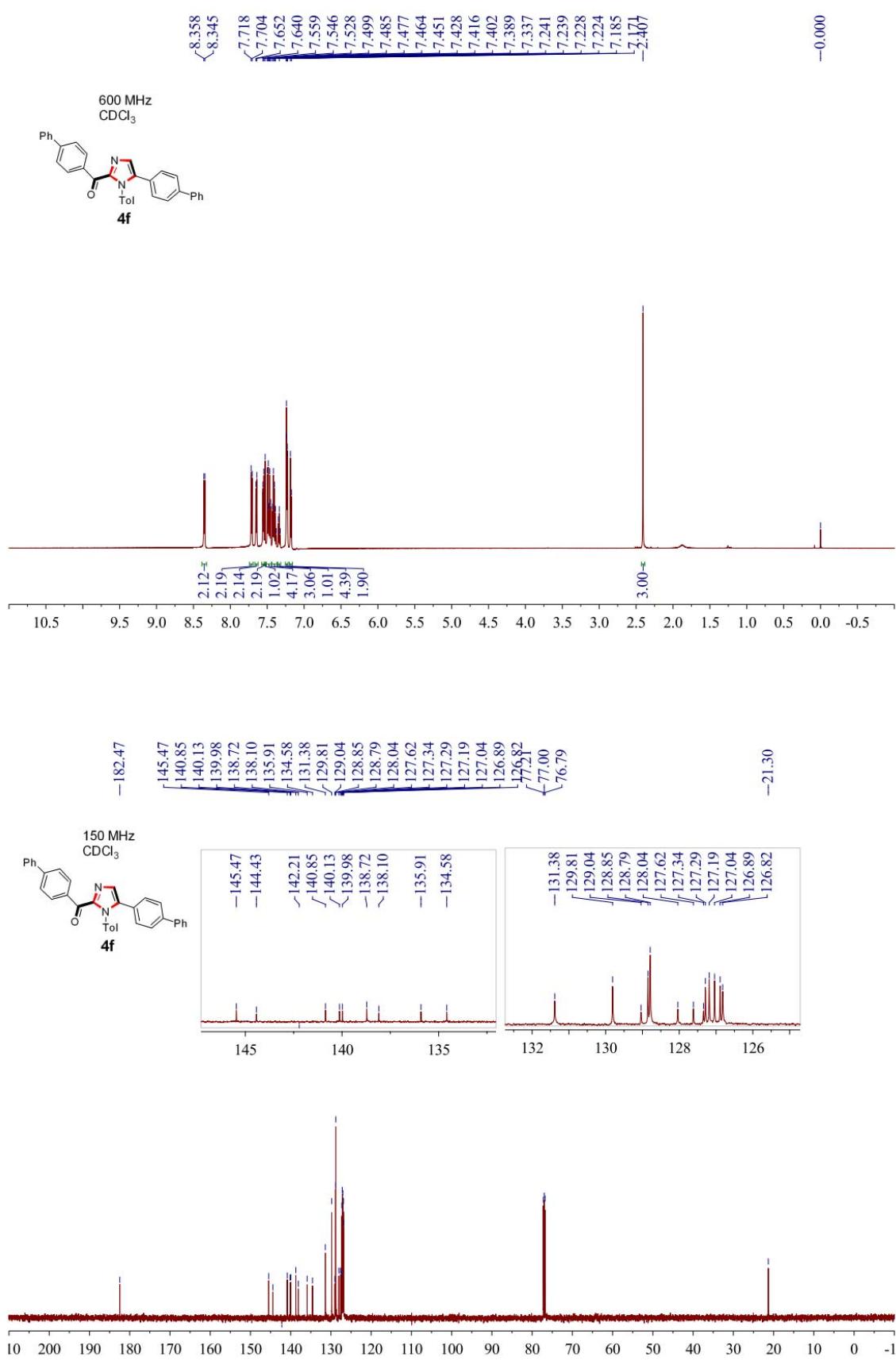


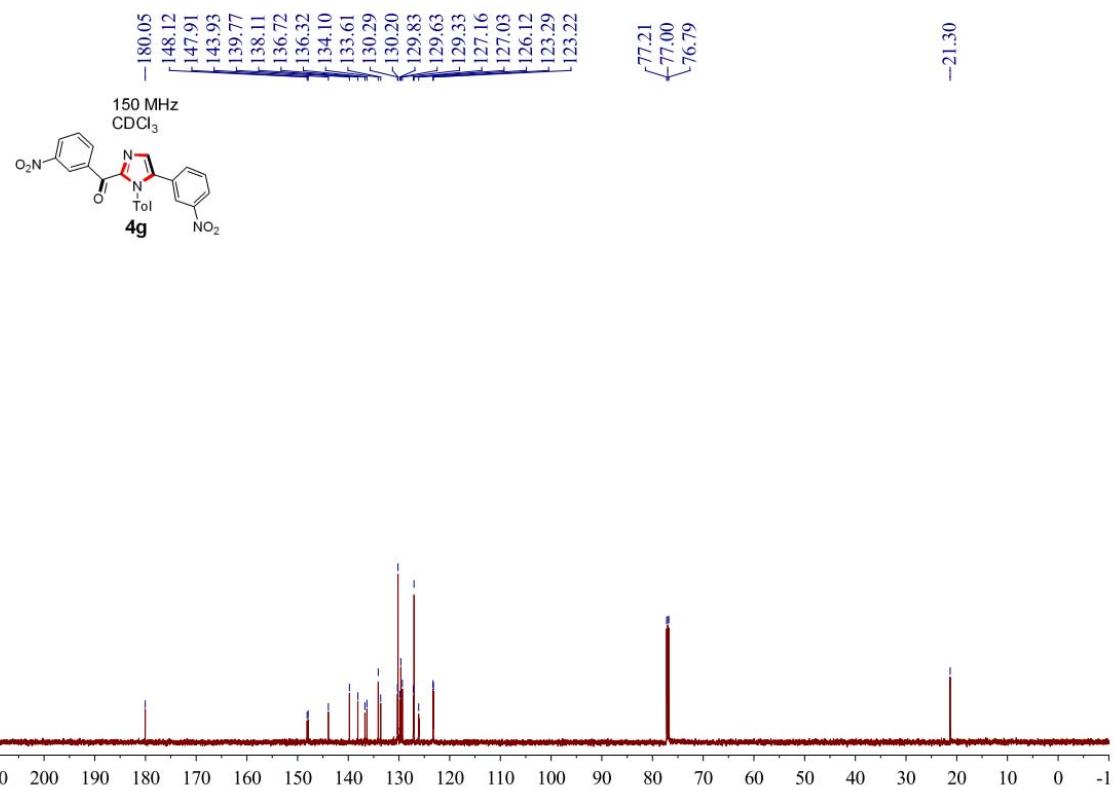
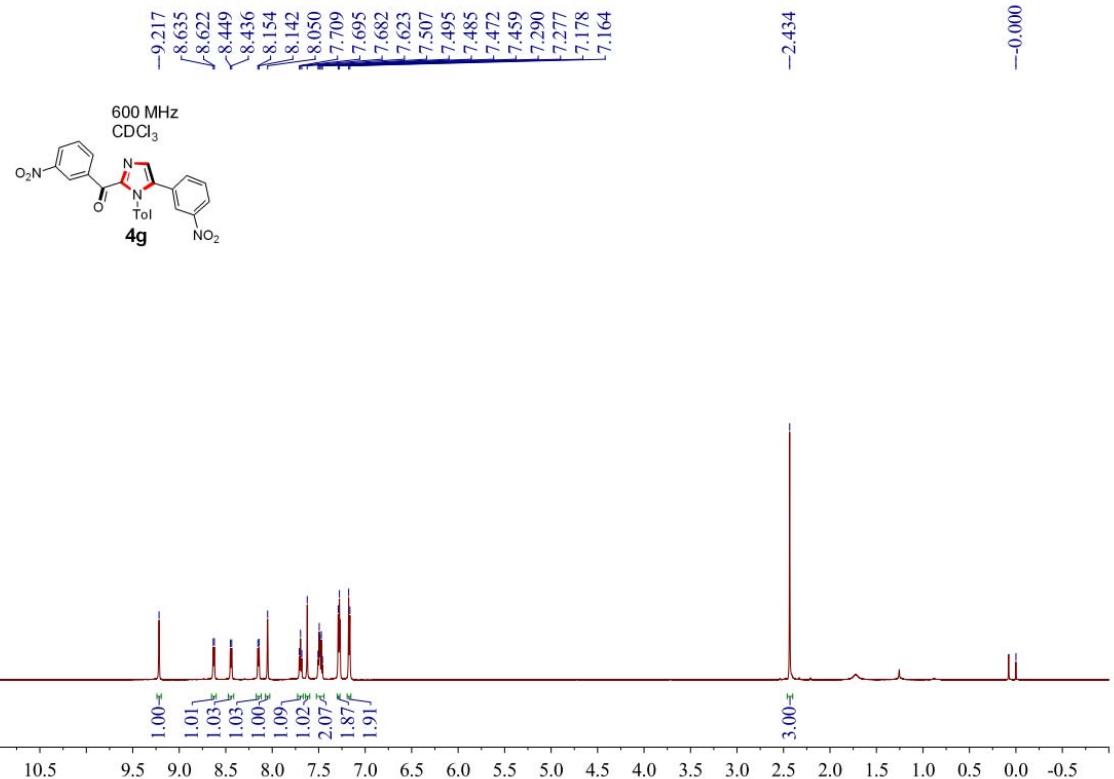


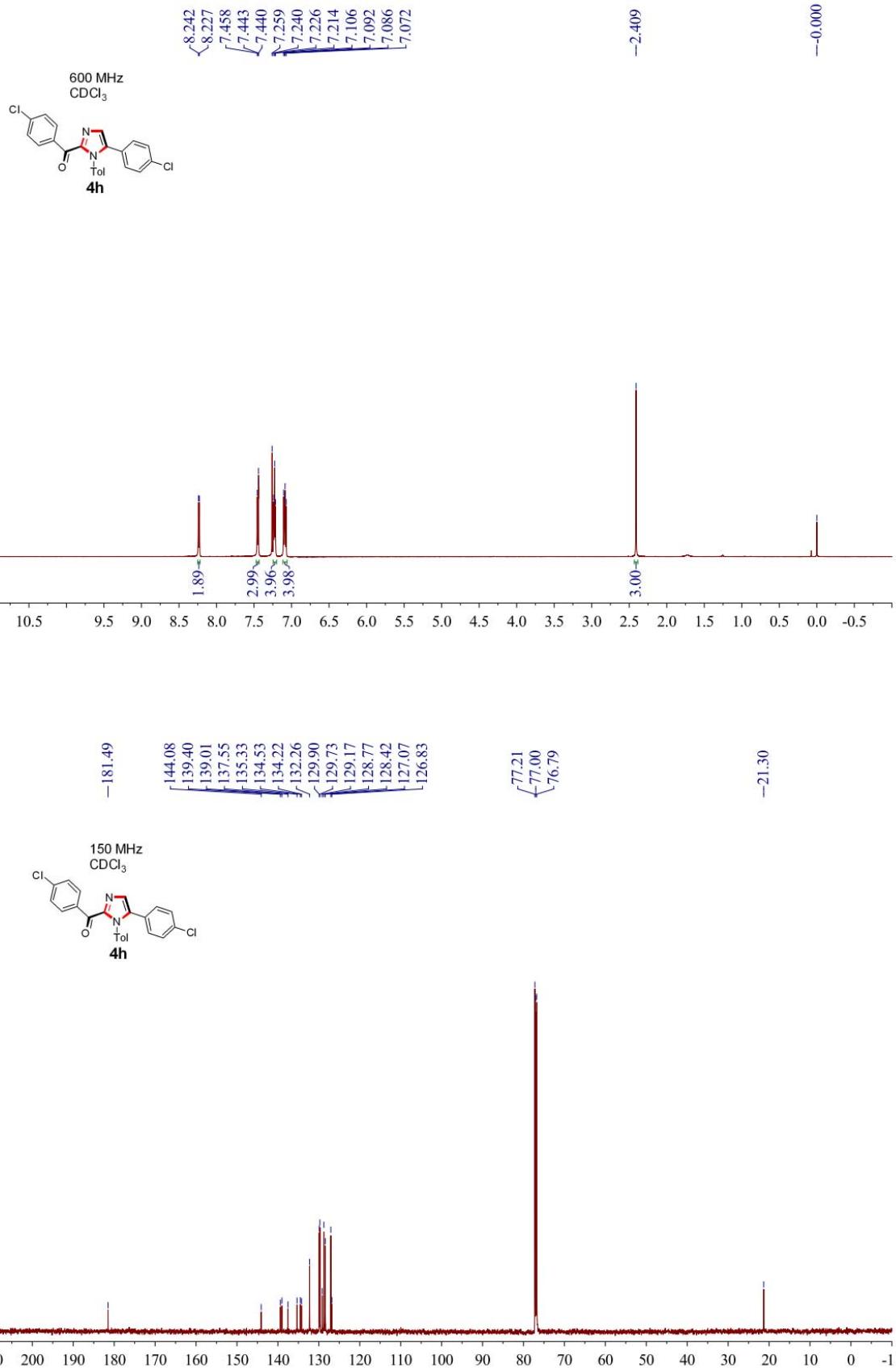


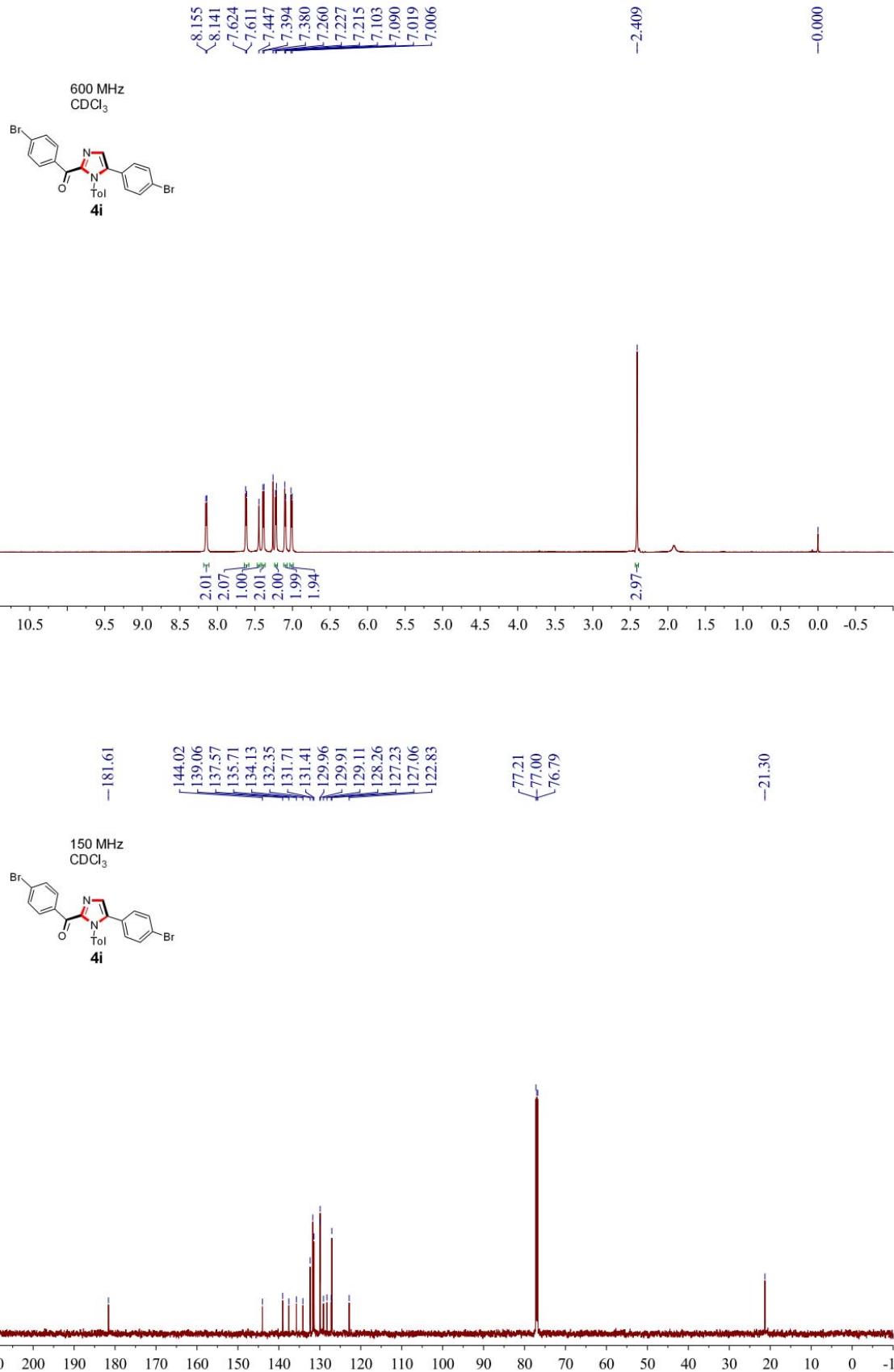


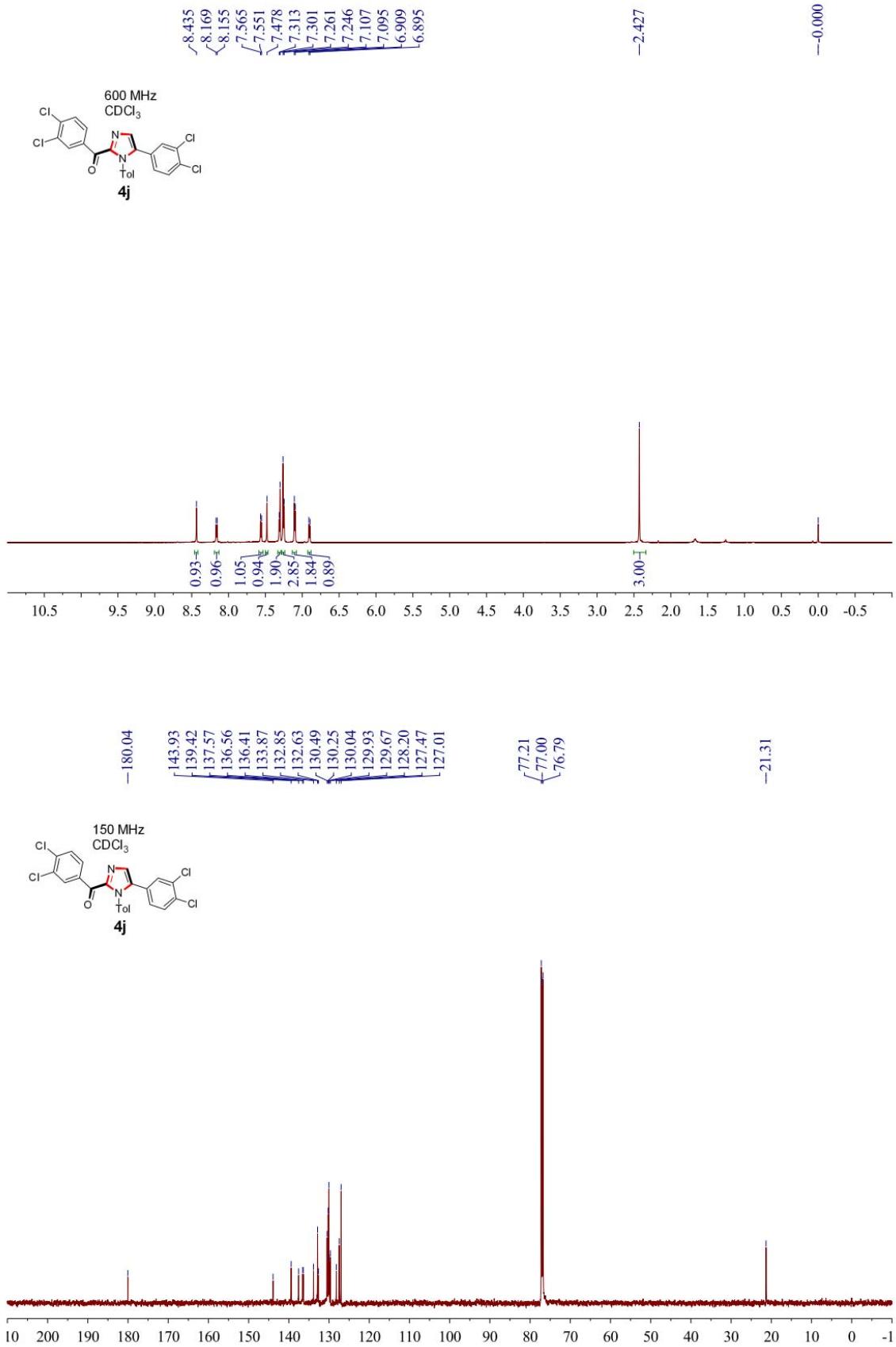


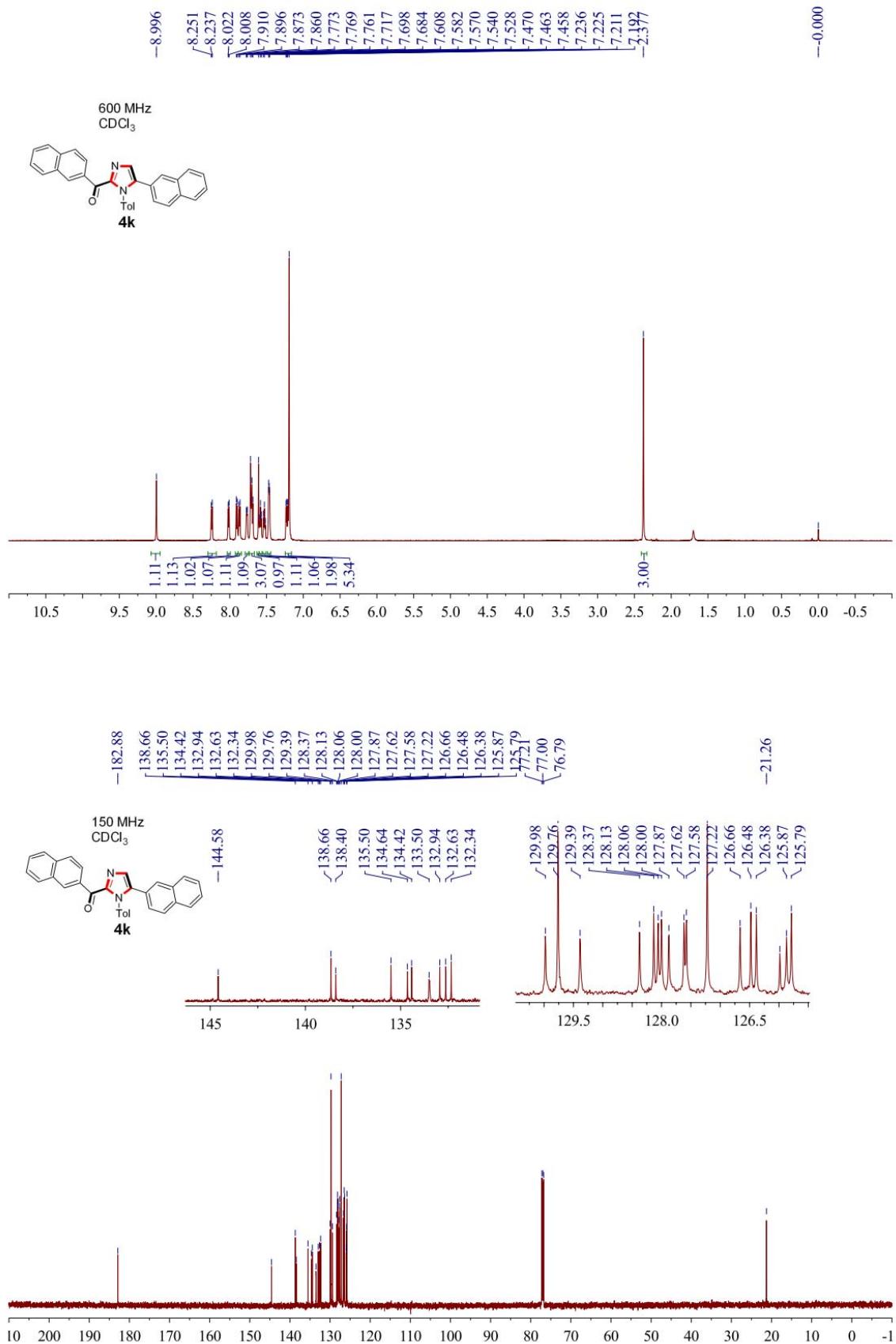


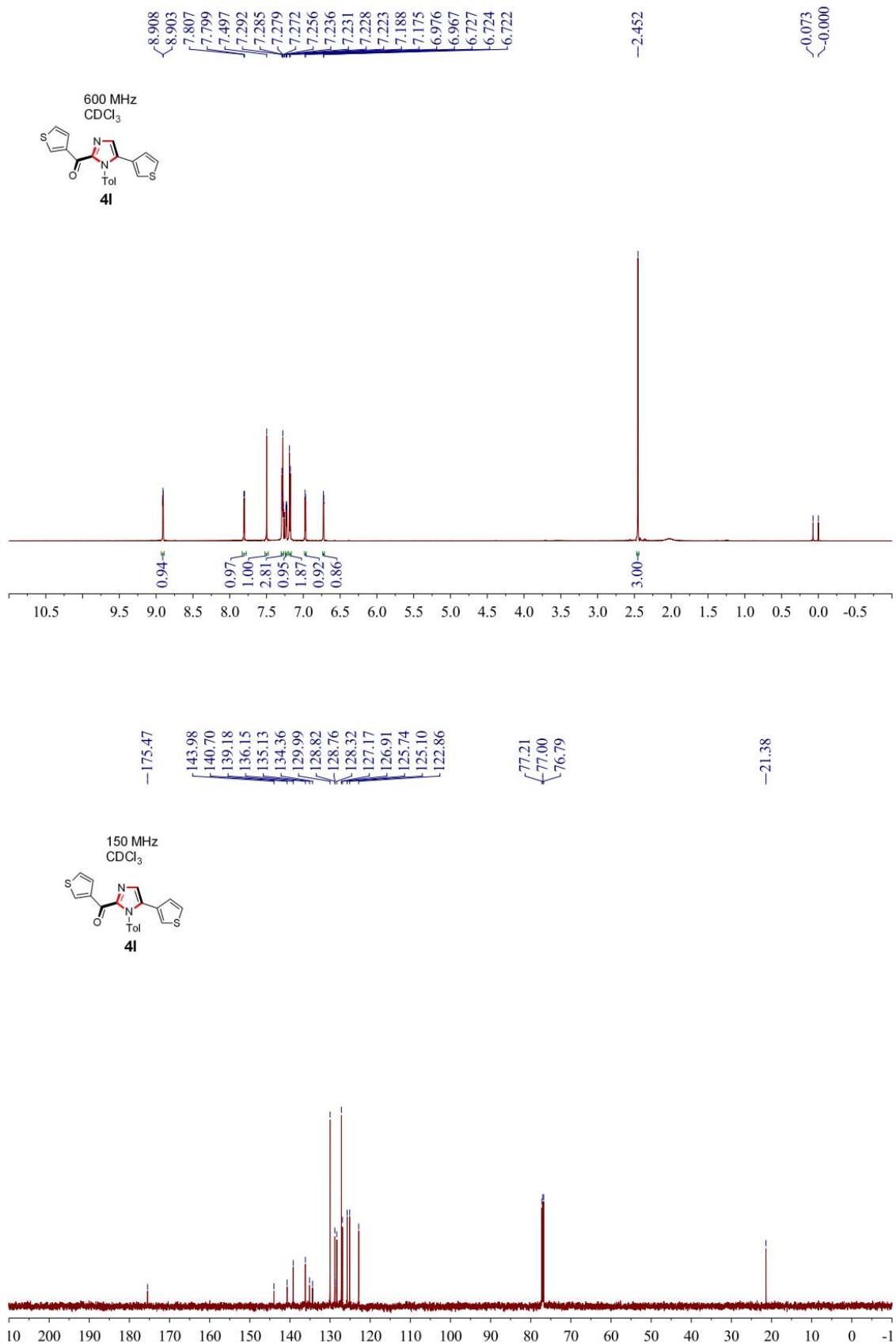


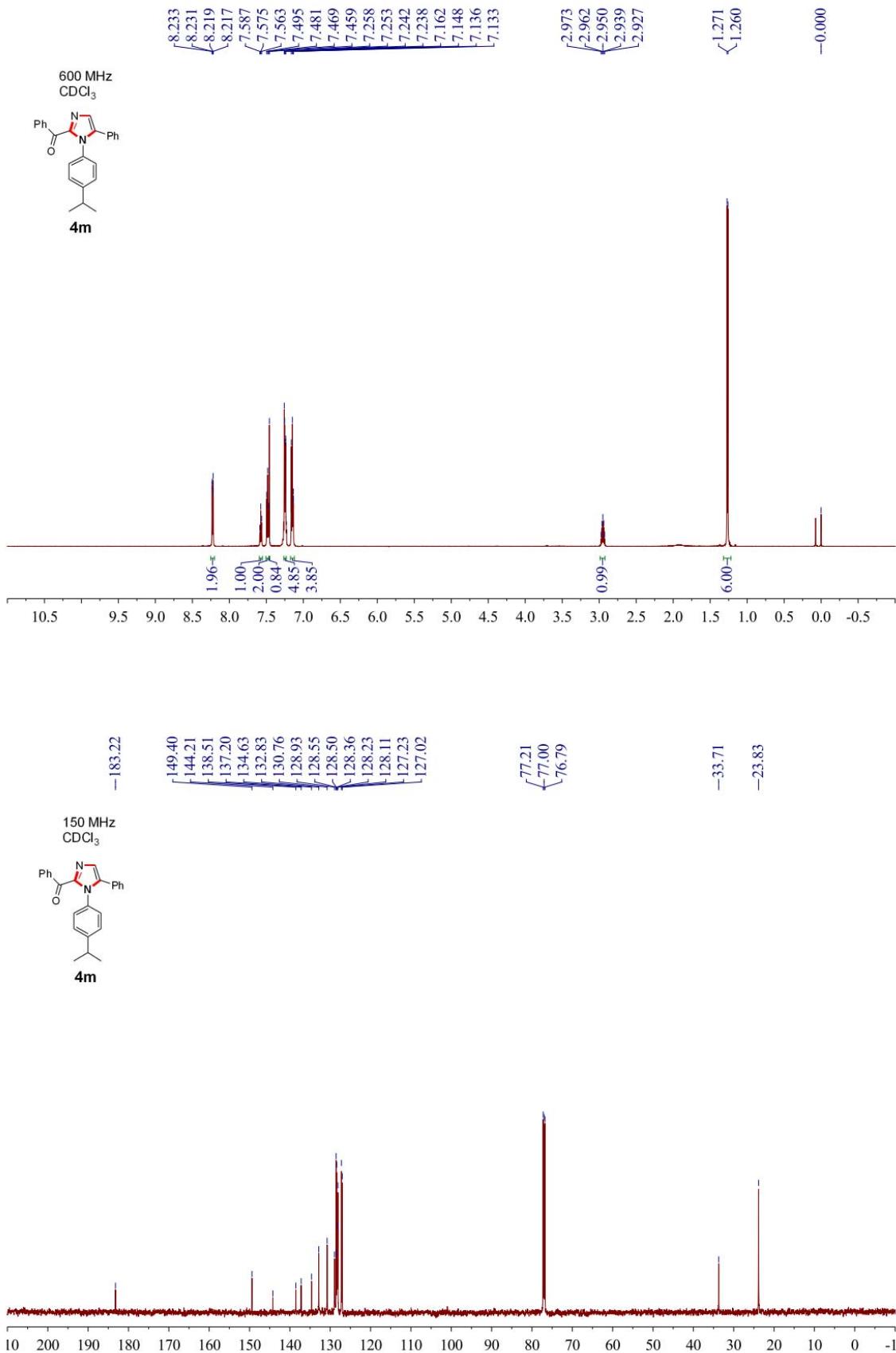


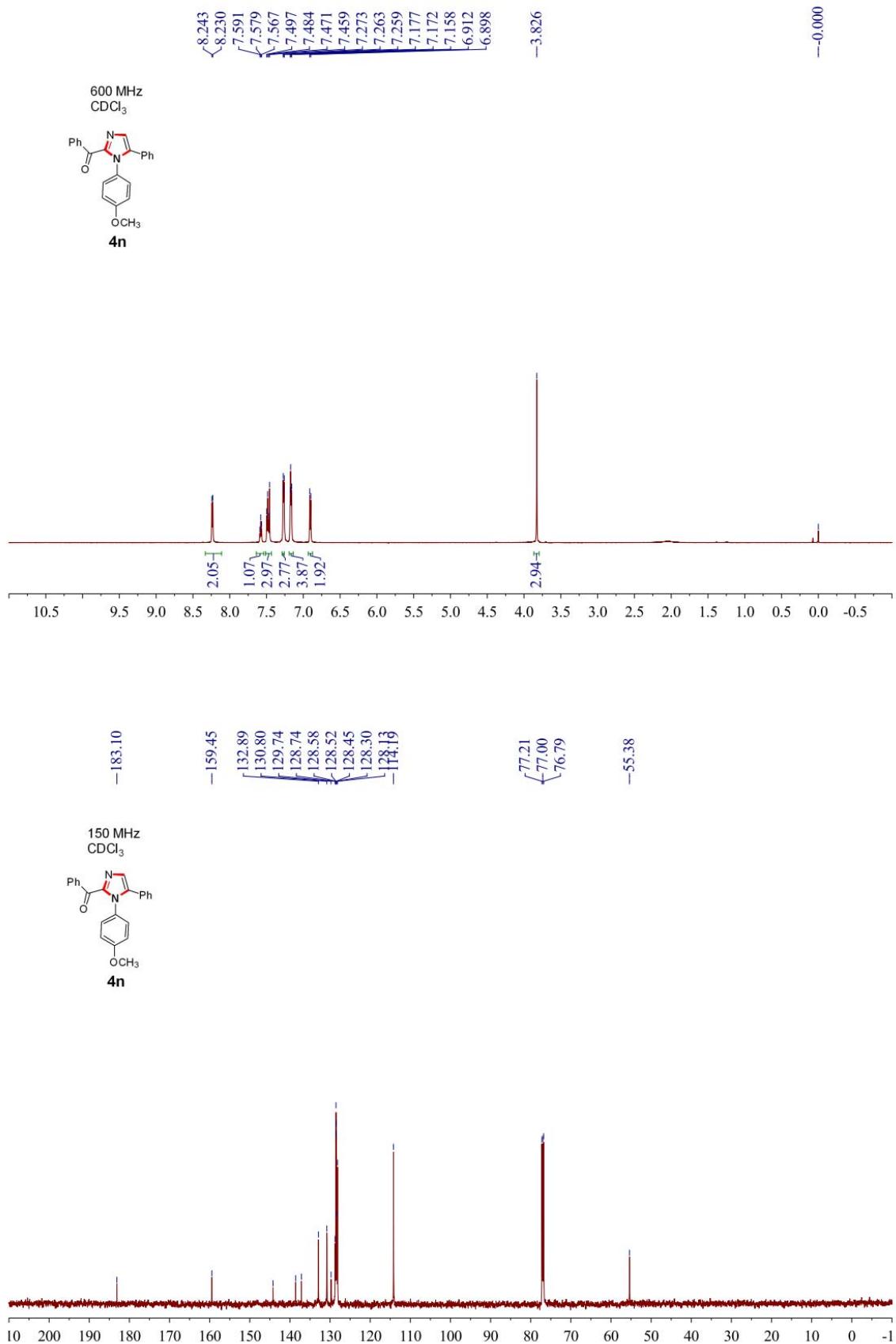


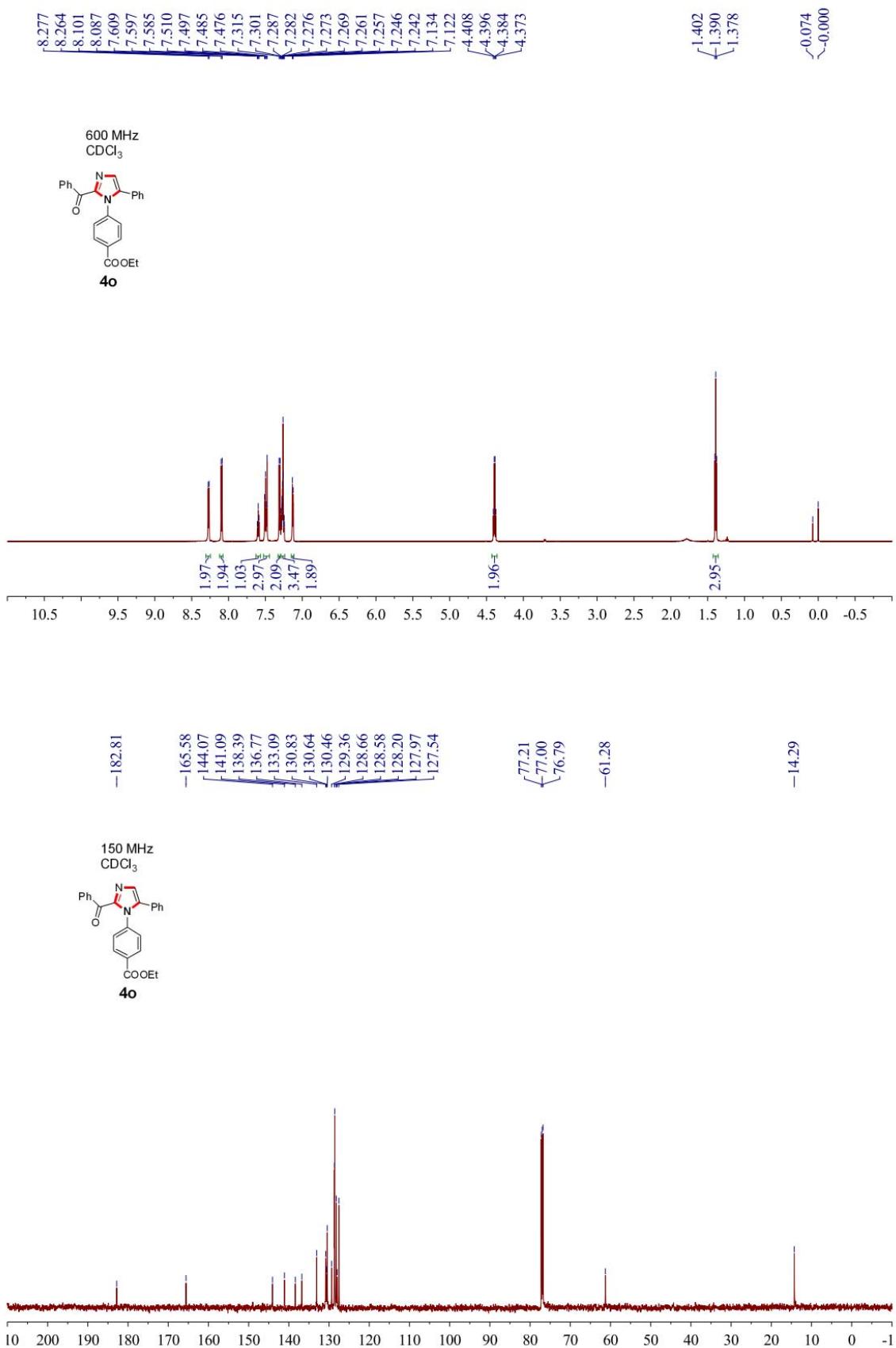


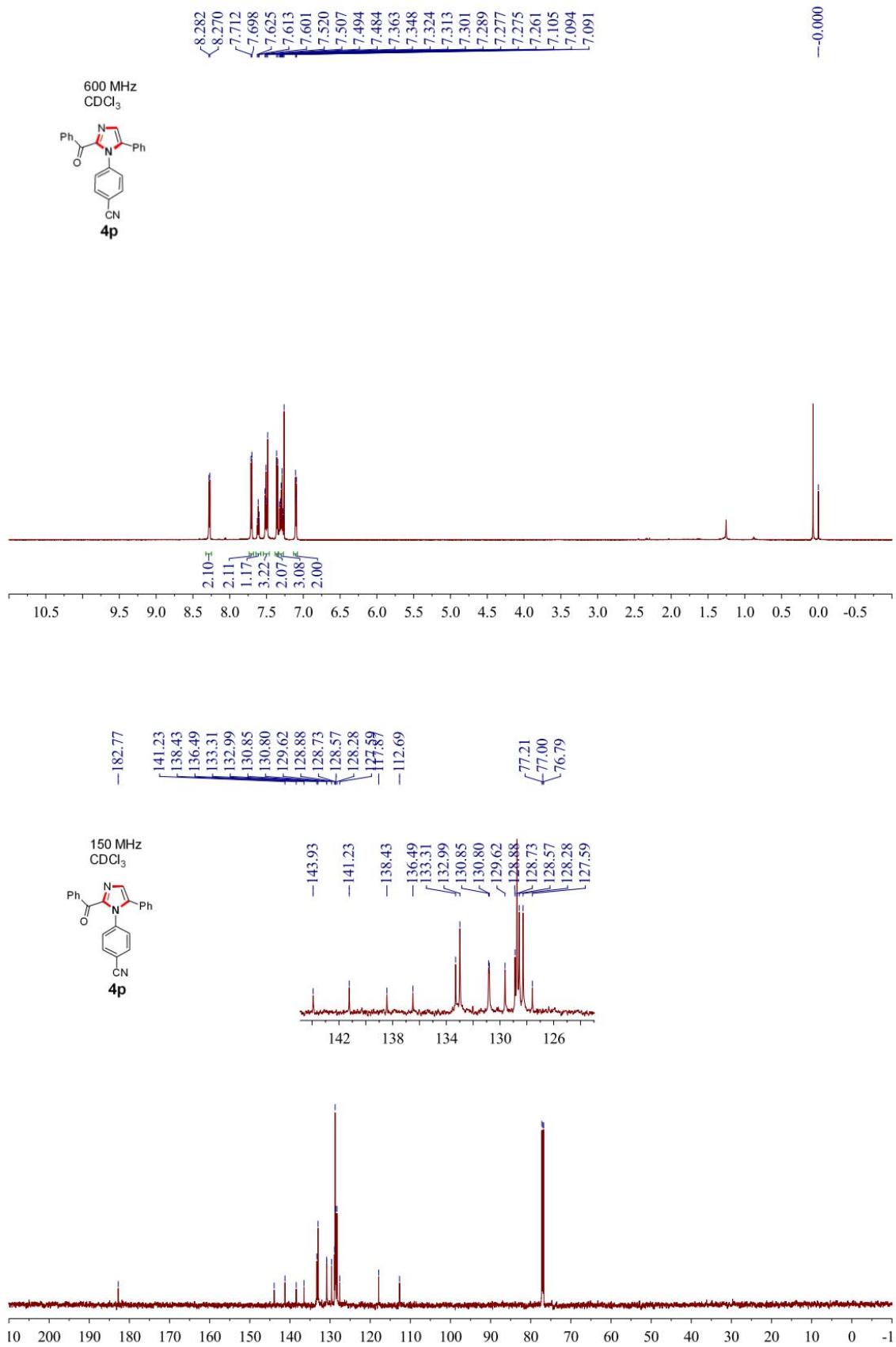


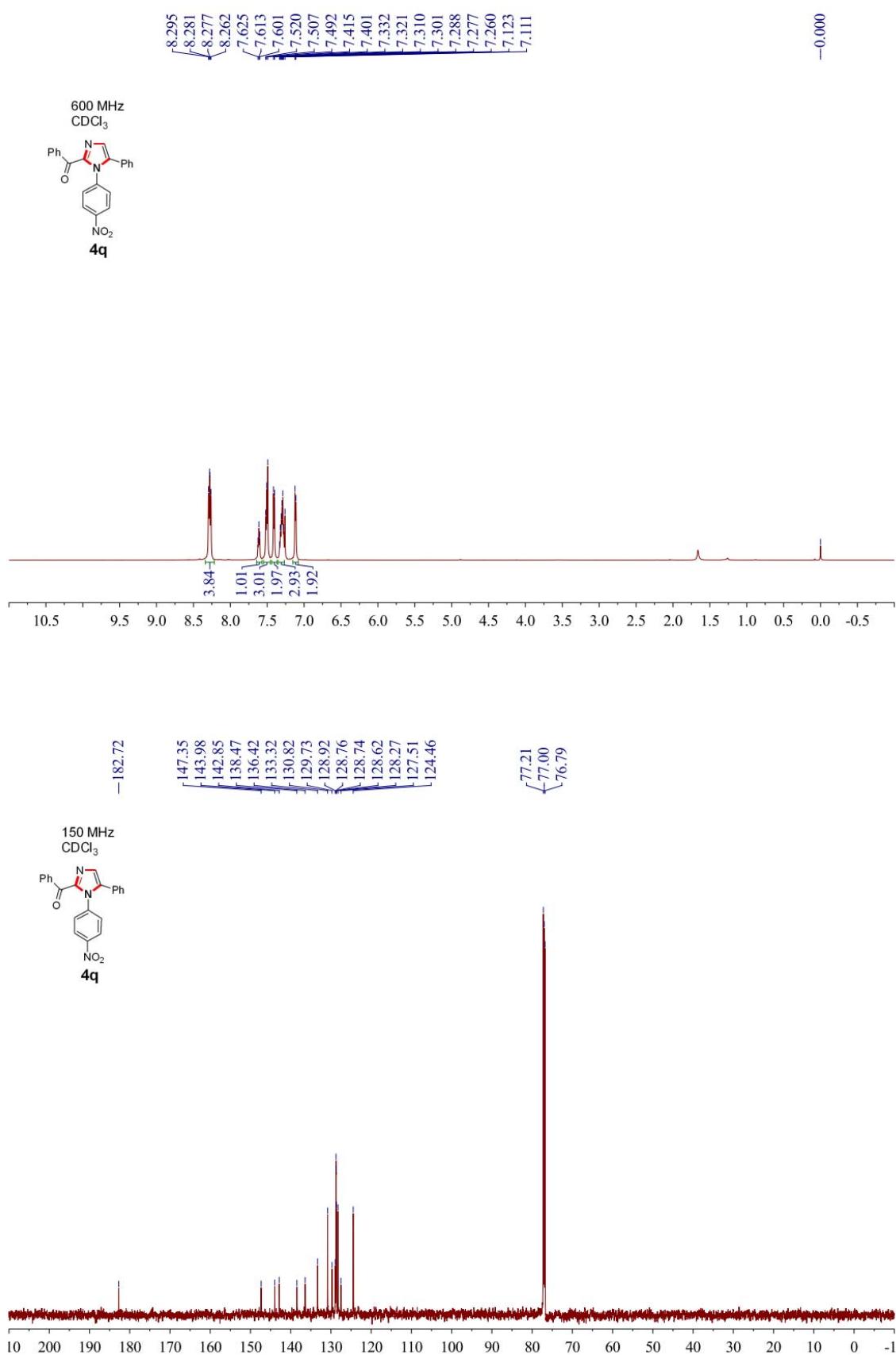




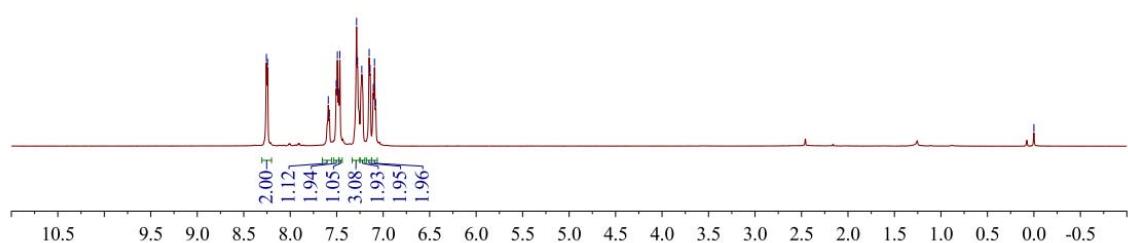
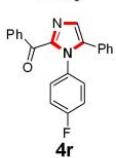




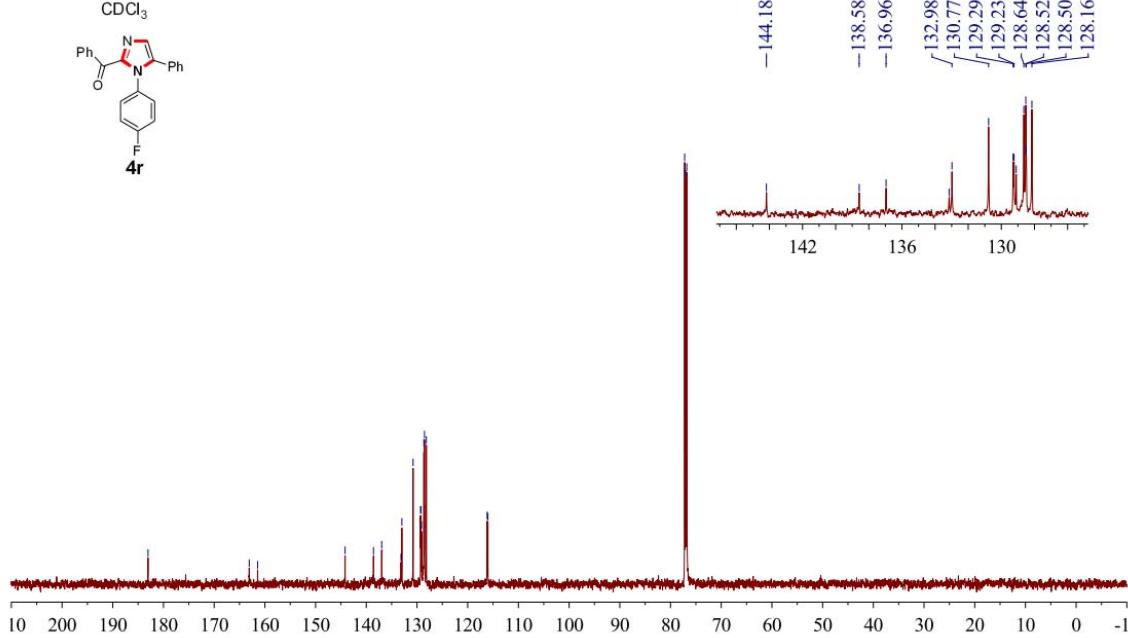
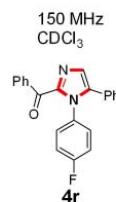


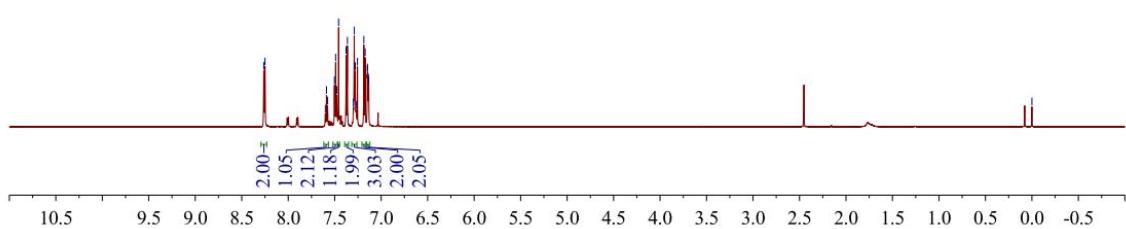
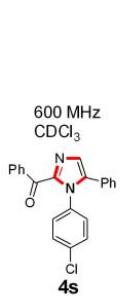


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 CDCl_3



-183.04



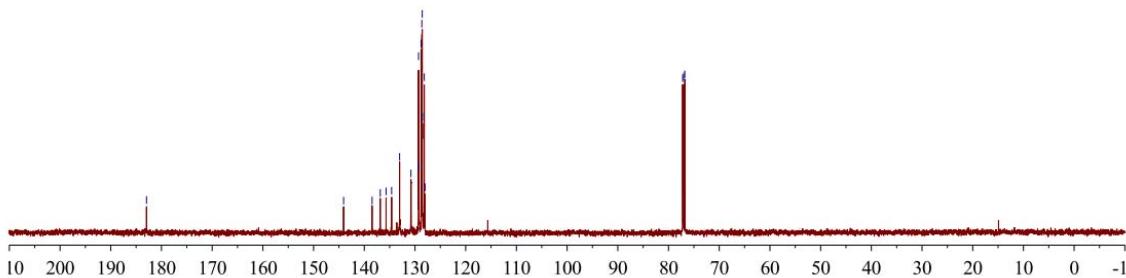
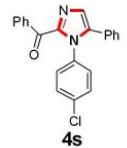


-182.95

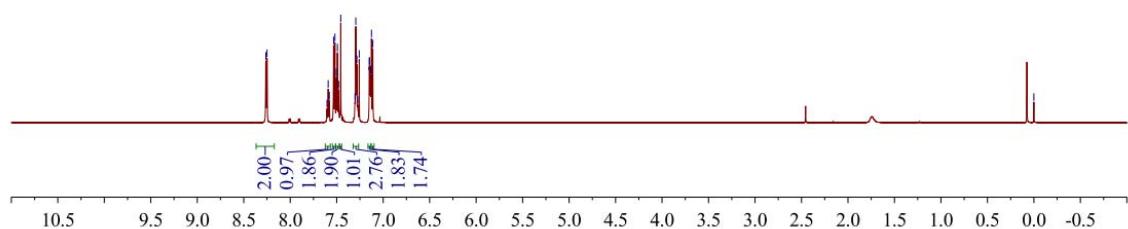
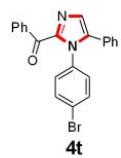
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77.21
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150 MHz
 CDCl_3



600 MHz
 CDCl_3



-182.95

144.04
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150 MHz
 CDCl_3

