

Supporting Information

Copper-Catalyzed Oxidative Coupling Reaction of α , β -Unsaturated Aldehydes with Amidines: Synthesis of 1, 2, 4-trisubstituted-1*H*-Imidazole-5-carbaldehydes

Yaxuan Li,^{ab} Yajie Fu,^{ab} Chaojie Ren,^{ab} Dong Tang,^{ab} Ping Wu,^{ab} Xu Meng^c and Baohua Chen^{*ab}

*E-mail: chbh@lzu.edu.cn

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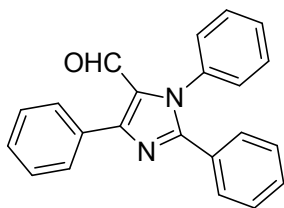
1. General Remarks

All of the reactions were carried out in oven-dried flask. Flash chromatography was carried out with Merck silica gel 60 (63-200 mesh). Analytical TLC was performed with Merck silica gel 60 F254 plates, and the products were visualized by UV detection. Unless otherwise noted, ^1H NMR (300 MHz) and ^{13}C NMR (75 MHz) spectra were recorded in CDCl_3 . Chemical shifts (δ) are reported in ppm using TMS as internal standard. Melting points were determined on a microscopic apparatus. Copies of ^1H NMR and ^{13}C NMR spectra are provided. Commercially available reagents were used without further purification.

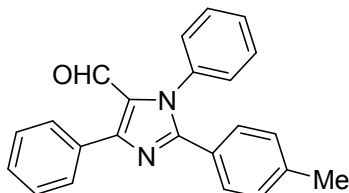
2. Reference

- (1) Hu, B.; Wang, Z.; Ai, N.; Zheng, J.; Liu, X.-H.; Shan, S.; Wang, Z., *Org. Lett.* **2011**, *13*, 6362-6365.
- (2) Zhu, Y.; Li, C.; Zhang, J.; She, M.; Sun, W.; Wan, K.; Wang, Y.; Yin, B.; Liu, P.; Li, J., *Org. Lett.* **2015**, *17*, 3872–3875.

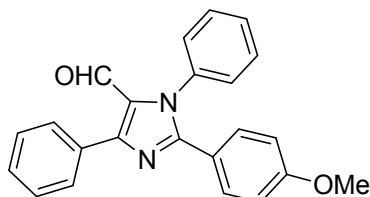
3. Spectral data of the compounds



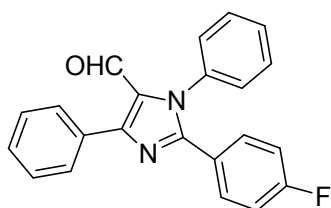
1, 2, 4-triphenyl-1H-imidazole-5-carbaldehyde (3aa)¹: yellow solid (48.6 mg, 75%); m. p. 162-164 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.82 (s, 1H), 7.94-7.86 (m, 2H), 7.54-7.41 (m, 8H), 7.36-7.21 (m, 5H). ¹³C NMR (75 MHz, CDCl₃) δ 179.5, 153.8, 151.4, 136.6, 132.2, 129.6, 129.4, 129.3, 129.2, 128.7, 128.6, 128.2, 127.8. HRMS (ESI⁺): calcd for C₂₂H₁₇N₂O (M+H)⁺: 325.1336; Found: 325.1332.



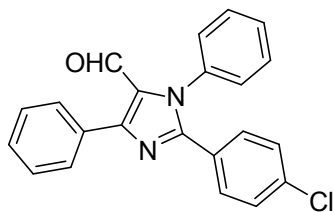
1, 4-diphenyl-2-(p-tolyl)-1H-imidazole-5-carbaldehyde (3ba): yellow crystal (54.1 mg, 80%); m. p. 115-117 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.79 (s, 1H), 7.94-7.84 (m, 2H), 7.52-7.40 (m, 6H), 7.32 (m, 4H), 7.07-7.01 (m, 2H), 2.28 (s, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 179.4, 153.8, 151.5, 139.8, 136.8, 132.3, 129.3, 129.2, 129.1, 129.0, 128.9, 128.5, 128.4, 127.8, 125.8, 21.2. HRMS (ESI⁺): calcd for C₂₃H₁₉N₂O (M+H)⁺: 339.1492; Found: 339.1497.



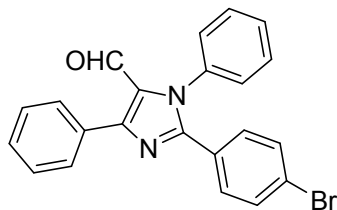
2-(4-methoxyphenyl)-1,4-diphenyl-1H-imidazole-5-carbaldehyde (3ca): yellow solid (58.1 mg, 82%); m. p. 118-120 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.78 (s, 1H), 7.93-7.85 (m, 2H), 7.53-7.37 (m, 8H), 7.35-7.28 (m, 2H), 6.78-6.72 (m, 2H), 3.74 (s, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 179.3, 160.6, 153.9, 151.4, 136.9, 132.4, 130.7, 129.4, 129.3, 129.2, 128.5, 128.4, 127.8, 121.1, 113.7, 55.2. HRMS (ESI⁺): calcd for C₂₃H₁₉N₂O₂ (M+H)⁺: 355.1441; Found: 355.1445.



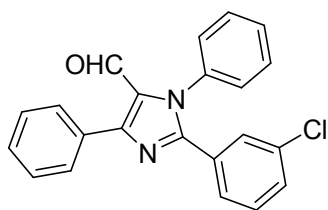
2-(4-fluorophenyl)-1,4-diphenyl-1H-imidazole-5-carbaldehyde (3da): light yellow solid (30.1 mg, 44%); m. p. 138-140 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.81 (s, 1H), 7.88 (dd, J = 7.9, 1.7 Hz, 2H), 7.55-7.41 (m, 8H), 7.34-7.28 (m, 2H), 6.98-6.90 (m, 2H). ¹³C NMR (75 MHz, CDCl₃) δ 179.5, 163.4 (J = 247.5 Hz), 153.8, 150.5, 136.5, 132.1, 131.3, 131.2, 129.4, 129.3, 129.2, 128.6, 128.5, 127.7, 124.9, 124.8, 115.6, 115.3. HRMS (ESI⁺): calcd for C₂₂H₁₆FN₂O (M+H)⁺: 343.1241; Found: 343.1246.



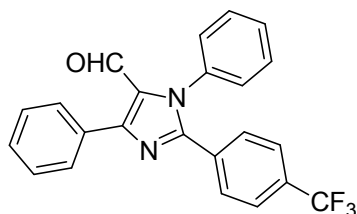
2-(4-chlorophenyl)-1,4-diphenyl-1H-imidazole-5-carbaldehyde (3ea): light yellow solid (44.4 mg, 62%); m. p. 150-152 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.81 (s, 1H), 7.92-7.84 (m, 2H), 7.54-7.43 (m, 6H), 7.42-7.39 (m, 1H), 7.39-7.37 (m, 1H), 7.34-7.28 (m, 2H), 7.24 (t, $J = 2.7$ Hz, 1H), 7.22-7.19 (m, 1H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.5, 153.8, 150.2, 136.5, 135.9, 132.1, 130.4, 129.4, 129.3, 128.6, 128.5, 127.7, 127.2. HRMS (ESI $^+$): calcd for $\text{C}_{22}\text{H}_{16}\text{ClN}_2\text{O}$ (M+H) $^+$: 359.0946; Found: 359.0943.



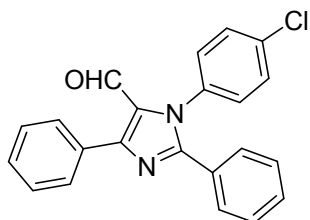
2-(4-bromophenyl)-1,4-diphenyl-1H-imidazole-5-carbaldehyde (3fa): yellow solid (44.3 mg, 55%); m. p. 131-133 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.81 (s, 1H), 7.91-7.84 (m, 2H), 7.54-7.44 (m, 6H), 7.41-7.36 (m, 2H), 7.35-7.28 (m, 4H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.6, 153.9, 150.3, 136.5, 131.6, 130.7, 129.5, 129.4, 128.7, 128.6, 127.8, 124.4, 120.2. HRMS (ESI $^+$): calcd for $\text{C}_{22}\text{H}_{16}\text{BrN}_2\text{O}$ (M+H) $^+$: 403.0441; Found: 403.0445.



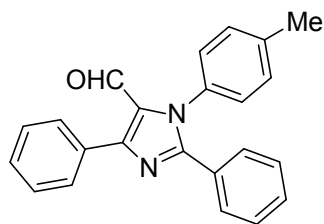
2-(3-chlorophenyl)-1,4-diphenyl-1H-imidazole-5-carbaldehyde (3ga): yellow solid (30.8 mg, 43%); m. p. 102-104 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.83 (s, 1H), 7.94-7.85 (m, 2H), 7.58 (t, $J = 1.9$ Hz, 1H), 7.56-7.45 (m, 6H), 7.36-7.27 (m, 3H), 7.23 (dt, $J = 7.9, 1.4$ Hz, 1H), 7.15 (t, $J = 7.8$ Hz, 1H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.6, 153.7, 149.8, 136.4, 134.4, 132.1, 130.5, 129.7, 129.6, 129.5, 129.4, 129.3, 128.7, 128.6, 127.7, 127.0. HRMS (ESI $^+$): calcd for $\text{C}_{22}\text{H}_{16}\text{ClN}_2\text{O}$ (M+H) $^+$: 359.0946; Found: 359.0942.



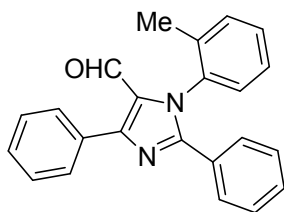
1,4-diphenyl-2-(4-(trifluoromethyl)phenyl)-1H-imidazole-5-carbaldehyde (3ha): yellow solid (29.8 mg, 38%); m. p. 128-130 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.84 (s, 1H), 7.89 (dd, $J = 7.7, 1.8$ Hz, 2H), 7.62-7.47 (m, 10H), 7.33 (dd, $J = 7.6, 1.8$ Hz, 2H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.7, 151.8 ($J = 307.5$ Hz), 136.3, 132.2, 132.0, 129.7, 129.6, 129.5, 129.4, 128.9, 128.7, 127.7, 125.2, 125.1. HRMS (ESI $^+$): calcd for $\text{C}_{23}\text{H}_{16}\text{F}_3\text{N}_2\text{O}$ (M+H) $^+$: 393.1209; Found: 393.1207.



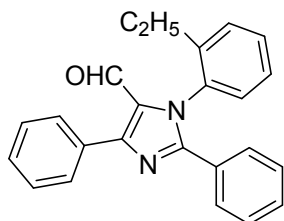
1-(4-chlorophenyl)-2, 4-diphenyl-1H-imidazole-5-carbaldehyde (3ia): yellow solid (35.8 mg, 50%); m. p. 130-132 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.82 (s, 1H), 7.88-7.80 (m, 2H), 7.53-7.37 (m, 7H), 7.36-7.19 (m, 5H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.5, 154.4, 151.6, 135.2, 135.1, 132.0, 129.8, 129.4, 129.3, 129.2, 129.1, 128.6, 128.3, 128.2. calcd for $\text{C}_{22}\text{H}_{16}\text{ClN}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 359.0946; Found: 359.0944.



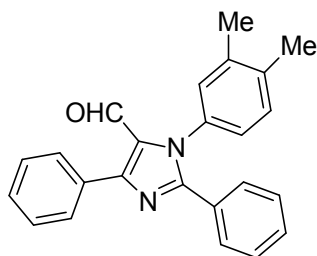
2, 4-diphenyl-1-(p-tolyl)-1H-imidazole-5-carbaldehyde (3ja): yellow crystal (54.8 mg, 81%); m. p. 136-138 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.50 (s, 1H), 7.60 (dd, $J = 7.8, 1.6$ Hz, 2H), 7.23-7.13 (m, 5H), 7.05-6.85 (m, 7H), 2.12 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.6, 153.7, 151.4, 139.3, 134.0, 132.4, 130.0, 129.5, 129.4, 129.2, 128.9, 128.5, 128.2, 127.5, 21.3. HRMS (ESI^+): calcd for $\text{C}_{23}\text{H}_{19}\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 339.1492; Found: 339.1496.



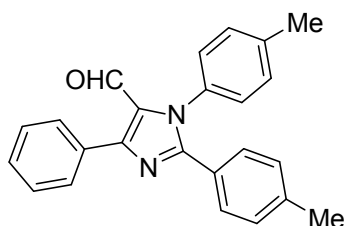
2, 4-diphenyl-1-(o-tolyl)-1H-imidazole-5-carbaldehyde (3ka): white solid (41.9 mg, 62%); m. p. 113-115 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.81 (s, 1H), 7.93 (dd, $J = 7.8, 1.6$ Hz, 2H), 7.56-7.37 (m, 6H), 7.36-7.20 (m, 6H), 2.04 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.5, 153.8, 150.9, 136.1, 135.5, 132.3, 131.1, 129.7, 129.6, 129.4, 129.3, 128.9, 128.7, 128.6, 128.3, 128.2, 128.0, 127.0, 17.5. HRMS (ESI^+): calcd for $\text{C}_{23}\text{H}_{19}\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 339.1492; Found: 339.1495.



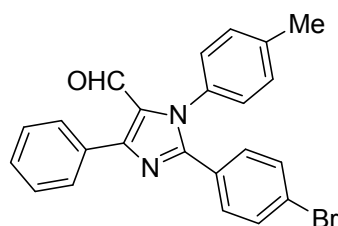
1-(2-ethylphenyl)-2, 4-diphenyl-1H-imidazole-5-carbaldehyde (3la): yellow solid (40.1 mg, 57%); m. p. 110-112 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.79 (s, 1H), 7.95 (dd, $J = 7.9, 1.7$ Hz, 2H), 7.55-7.44 (m, 6H), 7.41-7.28 (m, 4H), 7.28-7.21 (m, 2H), 2.43-2.20 (m, 2H), 1.02 (t, $J = 7.6$ Hz, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.4, 153.5, 151.0, 140.8, 135.5, 132.3, 129.9, 129.7, 129.3, 129.2, 128.8, 128.7, 128.5, 128.3, 128.1, 126.9, 23.4, 13.3. HRMS (ESI^+): calcd for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}$ ($\text{M}+\text{H}$) $^+$: 353.1649; Found: 353.1645.



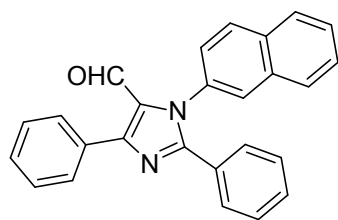
1-(3,4-dimethylphenyl)-2,4-diphenyl-1H-imidazole-5-carbaldehyde (3ma): yellow solid (57.7 mg, 82%); m. p. 138-140 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.77 (s, 1H), 7.96-7.88 (m, 2H), 7.53-7.42 (m, 5H), 7.34-7.16 (m, 4H), 7.10-7.00 (m, 2H), 2.32 (s, 3H), 2.26 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.6, 153.3, 151.2, 138.0, 137.9, 134.1, 132.4, 130.4, 129.5, 129.3, 129.1, 129.0, 128.7, 128.5, 128.4, 128.2, 125.0, 19.8, 19.6. HRMS (ESI $^+$): calcd for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}$ (M+H) $^+$: 353.1649; Found: 353.1652.



4-phenyl-1,2-di-p-tolyl-1H-imidazole-5-carbaldehyde (3na): yellow solid (62 mg, 88%); m. p. 135-137 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.78 (s, 1H), 7.89 (dd, J = 7.9, 1.6 Hz, 2H), 7.52-7.42 (m, 3H), 7.37 (d, J = 8.3 Hz, 2H), 7.27-7.15 (m, 4H), 7.05 (d, J = 8.0 Hz, 2H), 2.42 (s, 3H), 2.29 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.4, 153.7, 151.5, 139.7, 139.2, 134.1, 132.4, 129.9, 129.3, 129.0, 128.9, 128.5, 127.4, 125.9, 21.3. HRMS (ESI $^+$): calcd for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}$ (M+H) $^+$: 353.1649; Found: 353.1651.

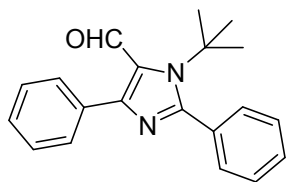


2-(4-bromophenyl)-4-phenyl-1-(p-tolyl)-1H-imidazole-5-carbaldehyde (3oa): yellow solid (50.7 mg, 61%); m. p. 145-147 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.79 (s, 1H), 7.87 (dd, J = 7.8, 1.7 Hz, 2H), 7.54-7.43 (m, 3H), 7.42-7.31 (m, 4H), 7.26 (d, J = 8.9 Hz, 2H), 7.18 (d, J = 8.3 Hz, 2H), 2.43 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.5, 153.6, 150.2, 139.6, 133.8, 132.1, 131.5, 130.6, 130.1, 129.3, 129.3, 128.7, 128.6, 127.8, 127.4, 124.2, 21.3. HRMS (ESI $^+$): calcd for $\text{C}_{23}\text{H}_{18}\text{BrN}_2\text{O}$ (M+H) $^+$: 417.0597; Found: 417.0593.

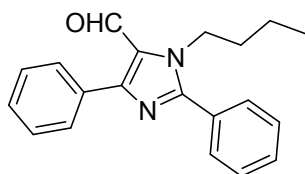


1-(naphthalen-2-yl)-2,4-diphenyl-1H-imidazole-5-carbaldehyde (3pa): brown solid (37.4 mg, 50%); m. p. 136-138 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.84 (s, 1H), 7.94 (t, J = 8.3 Hz, 4H), 7.78 (d, J = 10.6 Hz, 2H), 7.61-7.43 (m, 8H), 7.31-7.15 (m, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.6, 153.9, 151.7,

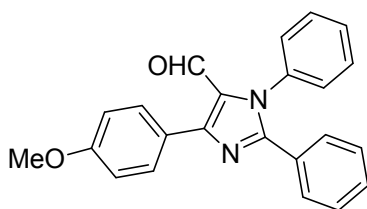
134.1, 133.0, 132.4, 129.7, 129.5, 129.4, 129.3, 129.2, 128.9, 128.8, 128.6, 128.3, 128.2, 128.0, 127.2, 127.0, 126.6, 125.5. HRMS (ESI⁺): calcd for C₂₆H₁₉N₂O (M+H)⁺: 375.1492; Found: 375.1490.



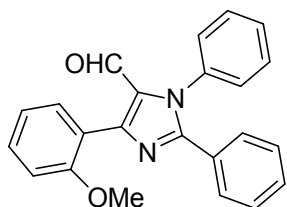
1-(tert-butyl)-2,4-diphenyl-1H-imidazole-5-carbaldehyde (3qa): white solid (18.8 mg, 31%); m. p. 126-128 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.70 (s, 1H), 7.70-7.64 (m, 2H), 7.53-7.48 (m, 2H), 7.48-7.39 (m, 6H), 1.60 (s, 9H). ¹³C NMR (75 MHz, CDCl₃) δ 180.7, 159.4, 154.7, 134.5, 132.8, 130.2, 129.5, 129.3, 129.1, 128.3, 128.1, 61.1, 31.6. HRMS (ESI⁺): calcd for C₂₀H₂₁N₂O (M+H)⁺: 305.1649; Found: 305.1652.



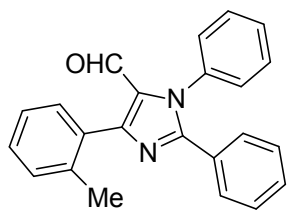
1-butyl-2,4-diphenyl-1H-imidazole-5-carbaldehyde (3ra): yellow solid (17.0 mg, 28%); m. p. 66-68 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.90 (s, 1H), 7.70 (ddd, J = 20.6, 7.0, 2.2 Hz, 4H), 7.58-7.40 (m, 6H), 4.45-4.32 (m, 2H), 1.76 (dt, J = 15.2, 7.5 Hz, 2H), 1.31-1.23 (m, 2H), 0.86 (t, J = 7.4 Hz, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 180.7, 155.6, 152.9, 132.7, 132.5, 129.9, 129.5, 129.4, 129.0, 128.7, 128.6, 126.9, 46.4, 33.2, 19.6, 13.5. HRMS (ESI⁺): calcd for C₂₀H₂₁N₂O (M+H)⁺: 305.1649; Found: 305.1655.



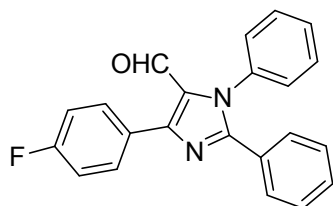
4-(4-methoxyphenyl)-1,2-diphenyl-1H-imidazole-5-carbaldehyde (3ab): light yellow solid (53.1 mg, 75%); m. p. 128-130 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.77 (s, 1H), 7.93-7.84 (m, 2H), 7.51-7.39 (m, 5H), 7.35-7.20 (m, 5H), 7.06-6.99 (m, 2H), 3.86 (s, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 179.4, 160.5, 153.5, 151.2, 136.6, 130.7, 129.5, 129.3, 129.2, 128.8, 128.2, 127.8, 124.8, 114.0, 55.3. HRMS (ESI⁺): calcd for C₂₃H₁₉N₂O₂ (M+H)⁺: 355.1441; Found: 355.1443.



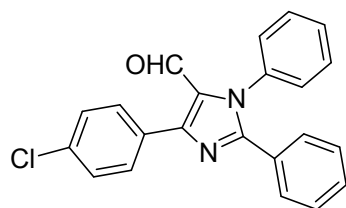
4-(2-methoxyphenyl)-1,2-diphenyl-1H-imidazole-5-carbaldehyde (3ac): light yellow solid (61.6 mg, 87%); m. p. 163-165 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.69 (s, 1H), 7.69 (dd, J = 7.5, 1.7 Hz, 1H), 7.51-7.37 (m, 6H), 7.37-7.16 (m, 5H), 7.10 (t, J = 7.3 Hz, 1H), 7.01 (d, J = 8.3 Hz, 1H), 3.83 (s, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 180.1, 156.7, 151.5, 150.2, 136.9, 129.3, 129.2, 129.1, 129.0, 128.1, 127.7, 121.5, 120.9, 111.0, 55.5. HRMS (ESI⁺): calcd for C₂₃H₁₉N₂O₂ (M+H)⁺: 355.1441; Found: 355.1445.



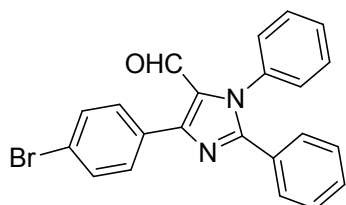
1, 2-diphenyl-4-(*o*-tolyl)-1*H*-imidazole-5-carbaldehyde (3ad): yellow solid (51.4 mg, 76%); m. p. 152-154 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.54 (s, 1H), 7.51-7.43 (m, 6H), 7.38-7.21 (m, 8H), 2.49 (s, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 179.3, 155.0, 151.0, 137.6, 136.6, 131.4, 131.2, 130.6, 129.6, 129.2, 129.1, 129.0, 128.7, 128.2, 127.7, 125.5, 20.4. HRMS (ESI⁺): calcd for C₂₃H₁₉N₂O (M+H)⁺: 339.1492; Found: 339.1490.



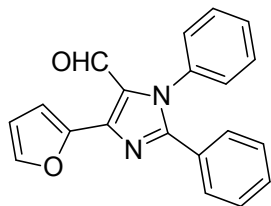
4-(4-fluorophenyl)-1, 2-diphenyl-1*H*-imidazole-5-carbaldehyde (3ae): yellow solid (44.5 mg, 65%); m. p. 151-152 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.74 (s, 1H), 8.00-7.92 (m, 2H), 7.51-7.42 (m, 5H), 7.26 (dddd, J = 17.4, 15.3, 7.0, 2.9 Hz, 7H). ¹³C NMR (75 MHz, CDCl₃) δ 179.3, 163.5 (J=247.5 Hz), 152.2, 151.3, 136.4, 131.3, 131.2, 129.7, 129.4, 129.2, 128.7, 128.5, 128.3, 127.9, 115.7, 115.4. HRMS (ESI⁺): calcd for C₂₂H₁₆FN₂O (M+H)⁺: 343.1241; Found: 343.1245.



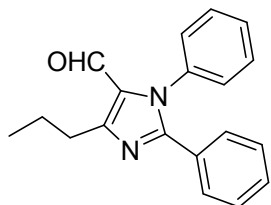
4-(4-chlorophenyl)-1, 2-diphenyl-1*H*-imidazole-5-carbaldehyde (3af): yellow solid (40.8 mg, 57%); m. p. 159-161 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.75 (s, 1H), 7.93 (d, J = 8.5 Hz, 2H), 7.52-7.41 (m, 7H), 7.36-7.21 (m, 5H). ¹³C NMR (75 MHz, CDCl₃) δ 179.2, 151.7, 151.3, 136.3, 135.4, 130.8, 130.6, 129.7, 129.5, 129.2, 128.7, 128.6, 128.5, 128.3, 127.9. HRMS (ESI⁺): calcd for C₂₂H₁₆ClN₂O (M+H)⁺: 359.0946; Found: 359.0948.



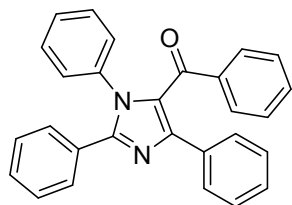
4-(4-bromophenyl)-1, 2-diphenyl-1*H*-imidazole-5-carbaldehyde (3ag): yellow solid (50.8 mg, 63%); m. p. 172-174 °C; ¹H NMR (300 MHz, CDCl₃) δ 9.75 (s, 1H), 7.90-7.82 (m, 2H), 7.66-7.60 (m, 2H), 7.52-7.42 (m, 5H), 7.37-7.22 (m, 5H). ¹³C NMR (75 MHz, CDCl₃) δ 179.2, 151.8, 151.4, 136.4, 131.7, 131.3, 130.8, 129.8, 129.5, 129.2, 128.7, 128.6, 128.3, 127.9, 123.7, 110.1. HRMS (ESI⁺): calcd for C₂₂H₁₆BrN₂O (M+H)⁺: 403.0441; Found: 403.0446.



4-(furan-2-yl)-1,2-diphenyl-1H-imidazole-5-carbaldehyde (3ai): yellow solid (22.6 mg, 36%); m. p. 130-132 °C; ^1H NMR (300 MHz, CDCl_3) δ 10.15 (s, 1H), 7.60 (dd, $J = 1.8, 0.7$ Hz, 1H), 7.44 (ddt, $J = 7.0, 3.8, 2.5$ Hz, 5H), 7.34-7.21 (m, 6H), 6.58 (dd, $J = 3.5, 1.8$ Hz, 1H). ^{13}C NMR (75 MHz, CDCl_3) δ 179.7, 151.9, 148.3, 144.0, 142.7, 136.5, 129.7, 129.4, 129.3, 129.2, 128.5, 128.2, 128.0, 127.9, 111.8, 111.6. HRMS (ESI $^+$): calcd for $\text{C}_{20}\text{H}_{15}\text{N}_2\text{O}_2$ (M+H) $^+$: 315.1128; Found: 315.1132.

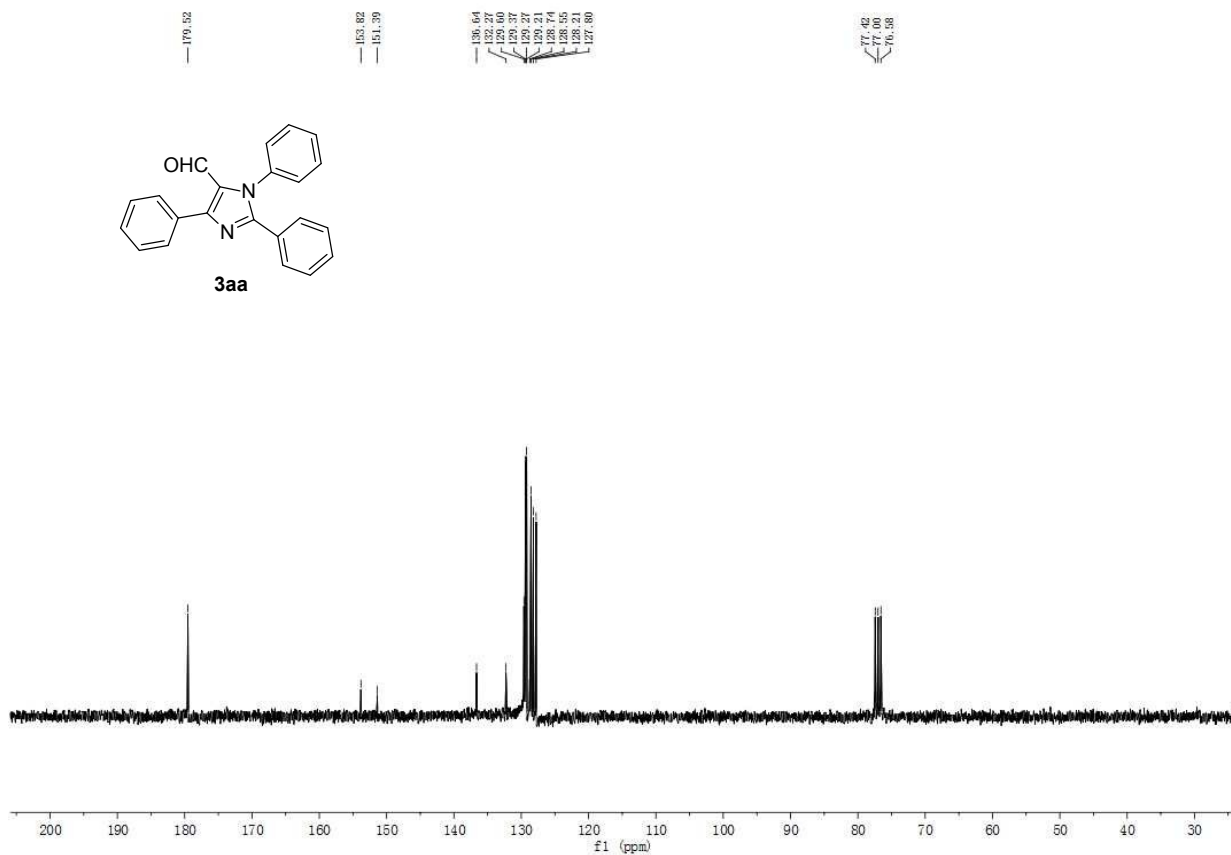
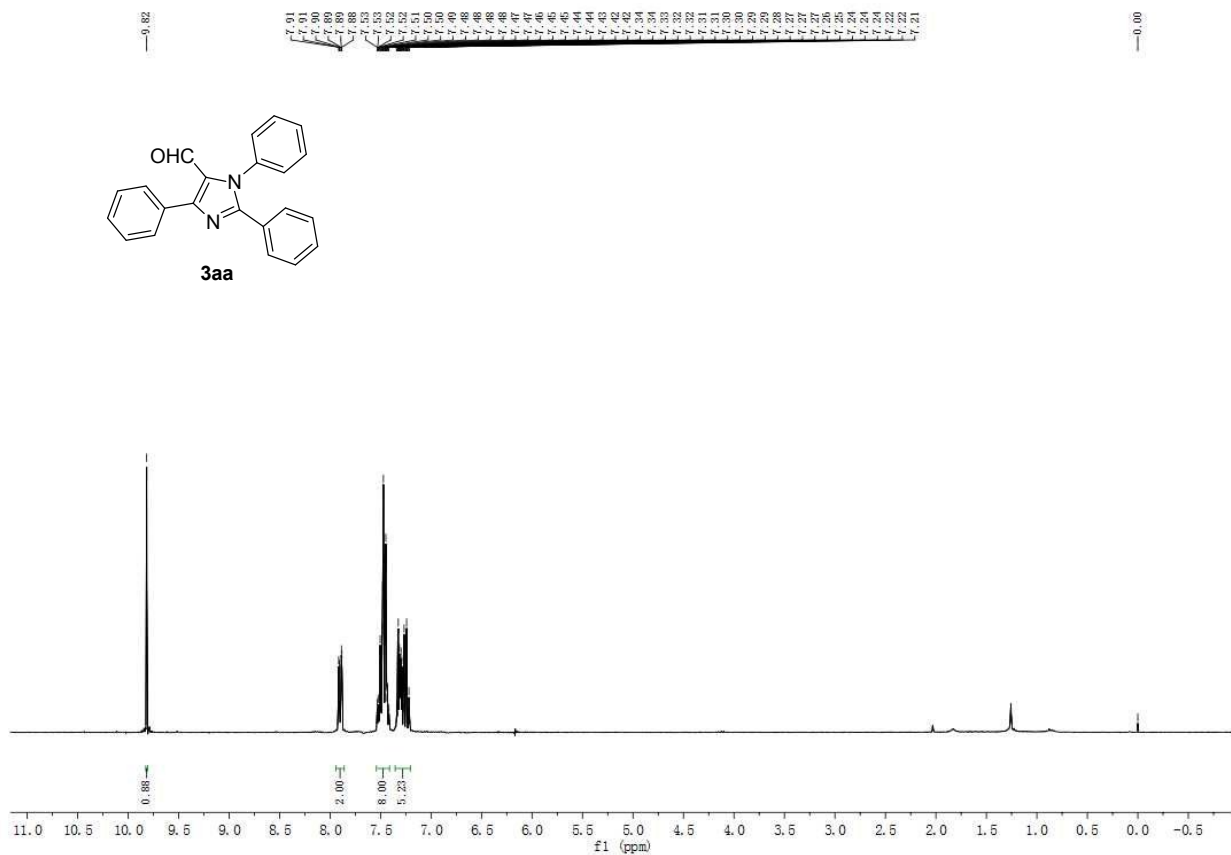


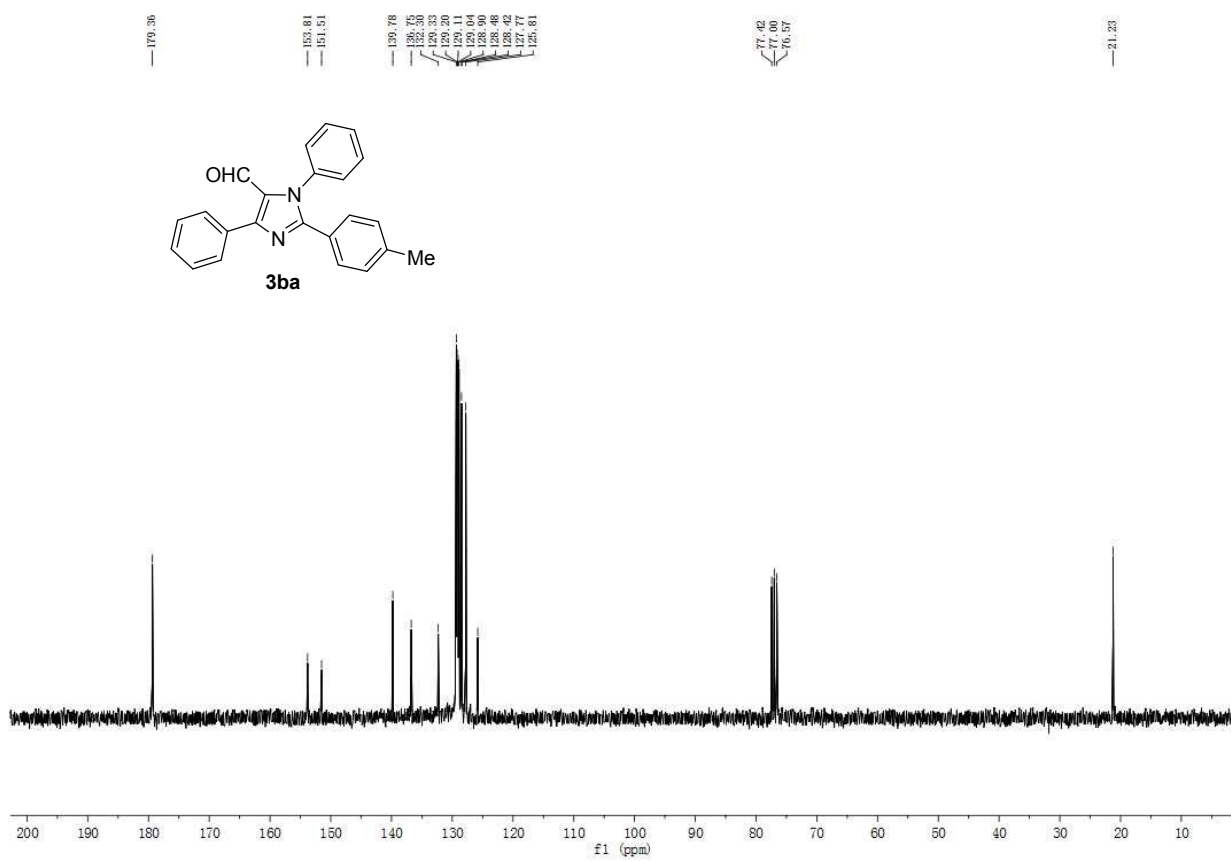
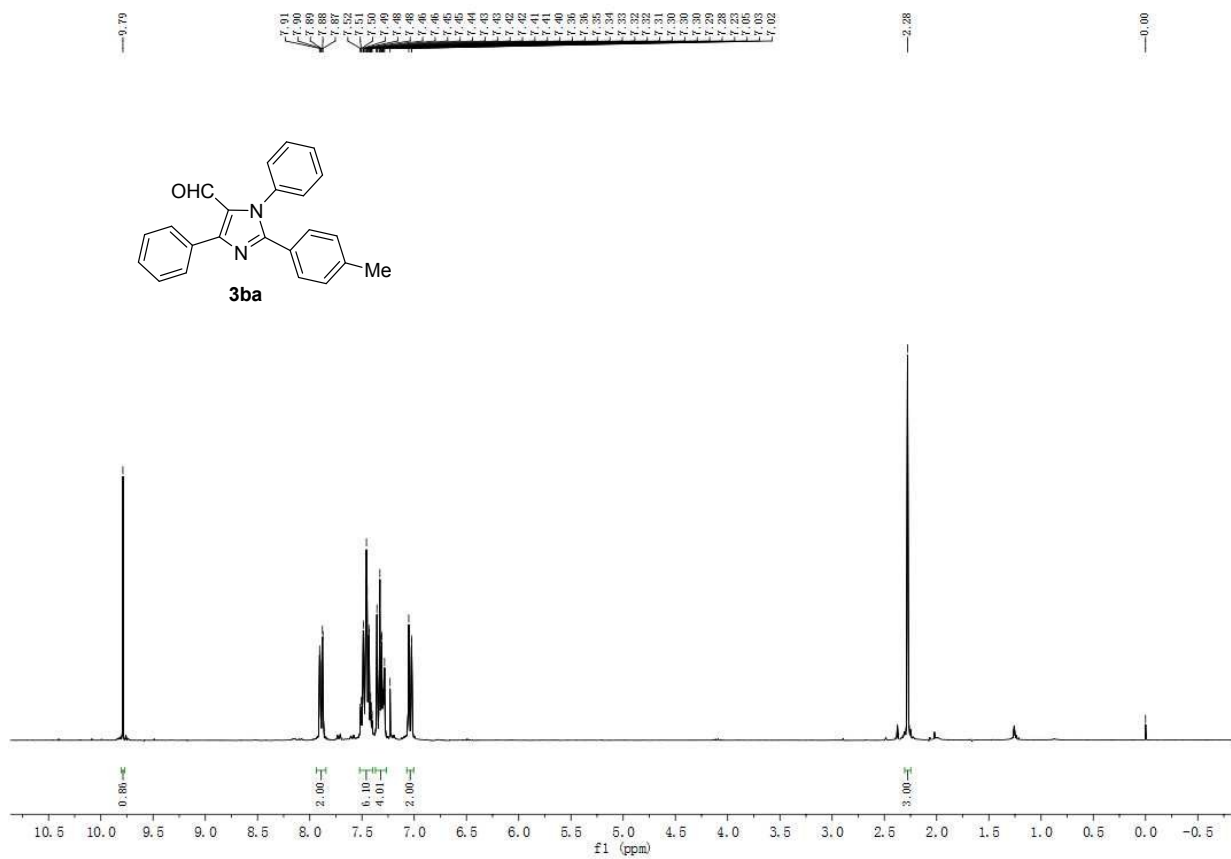
1,2-diphenyl-4-propyl-1H-imidazole-5-carbaldehyde (3aj): light yellow solid (19.7 mg, 34%); m. p. 82-84 °C; ^1H NMR (300 MHz, CDCl_3) δ 9.65 (s, 1H), 7.51-7.36 (m, 5H), 7.33-7.19 (m, 5H), 2.98 (dd, $J = 8.6, 6.8$ Hz, 2H), 1.93-1.79 (m, 2H), 1.07 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 178.6, 155.5, 150.5, 136.2, 129.4, 129.3, 129.0, 128.9, 128.2, 127.9, 30.1, 23.0, 14.0. HRMS (ESI $^+$): calcd for $\text{C}_{19}\text{H}_{19}\text{N}_2\text{O}$ (M+H) $^+$: 291.1492; Found: 291.1496.

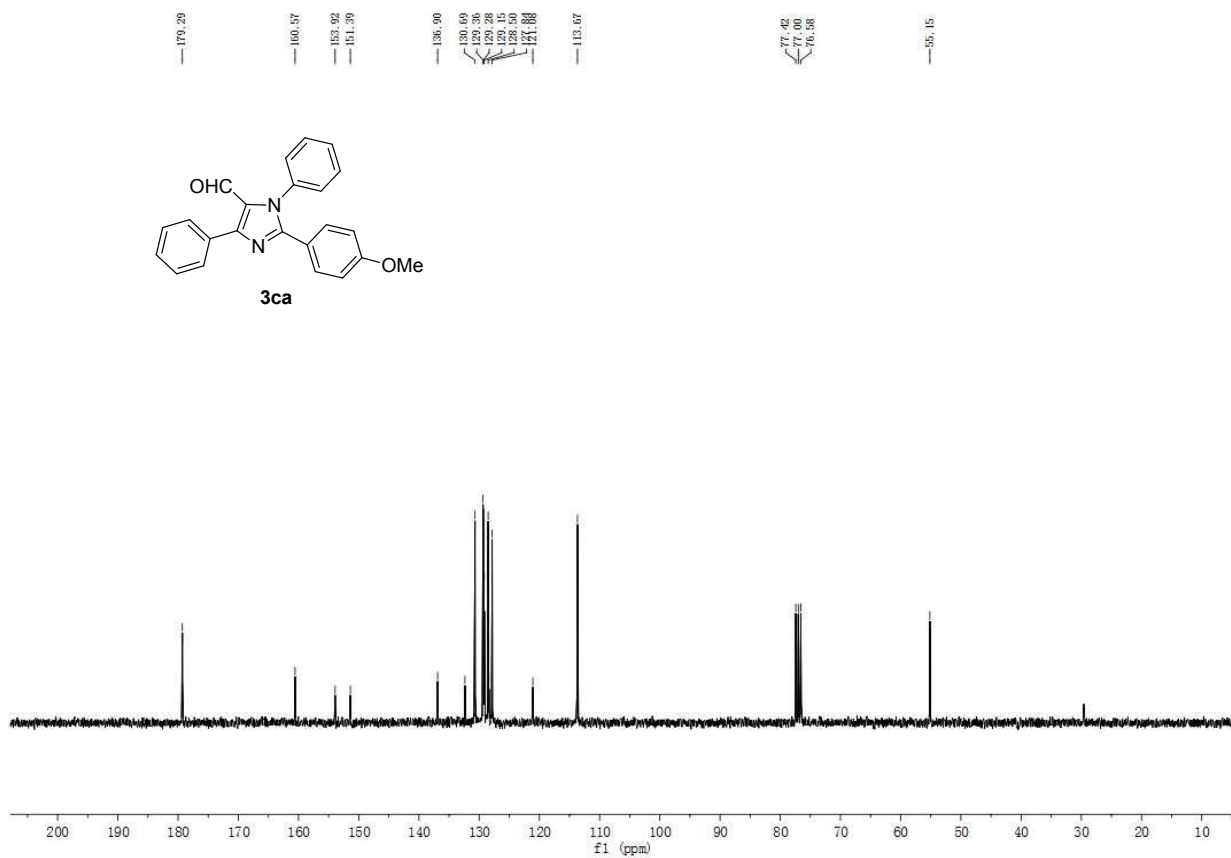
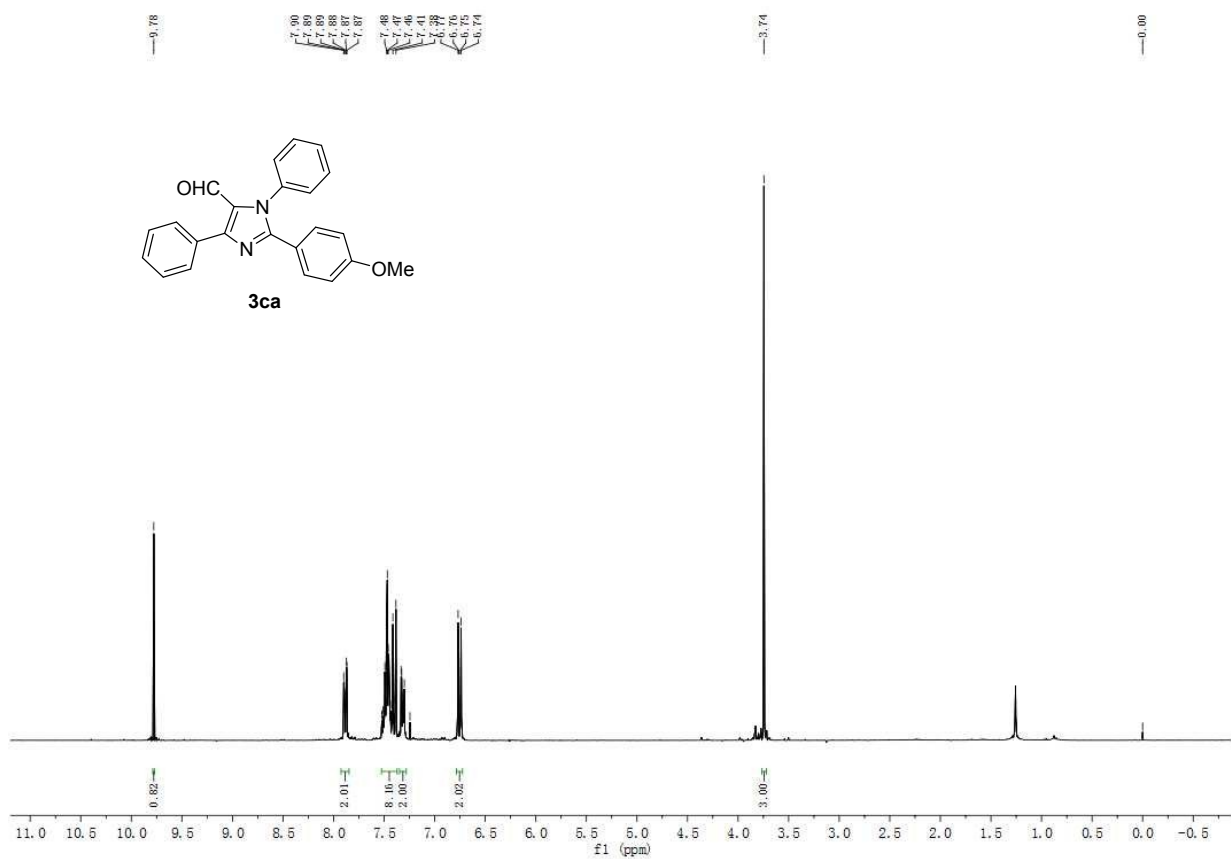


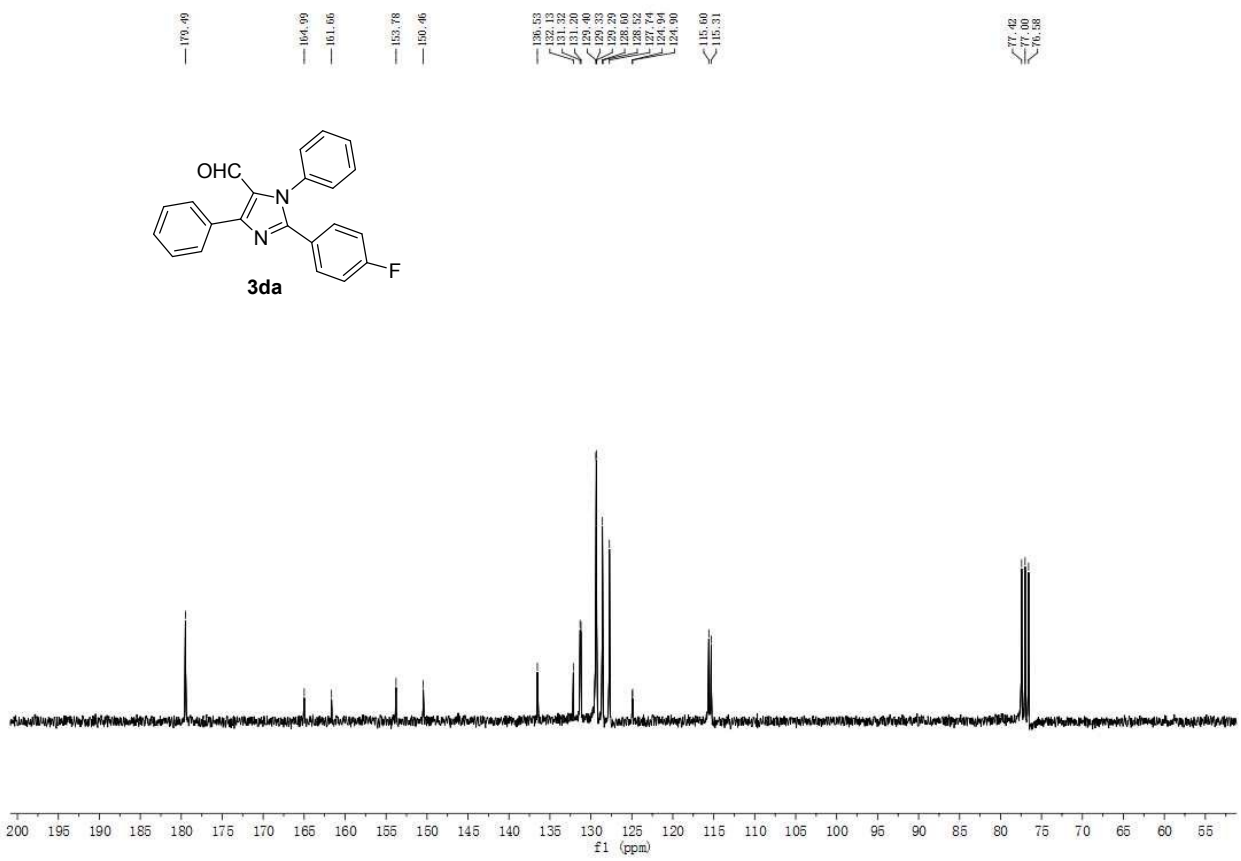
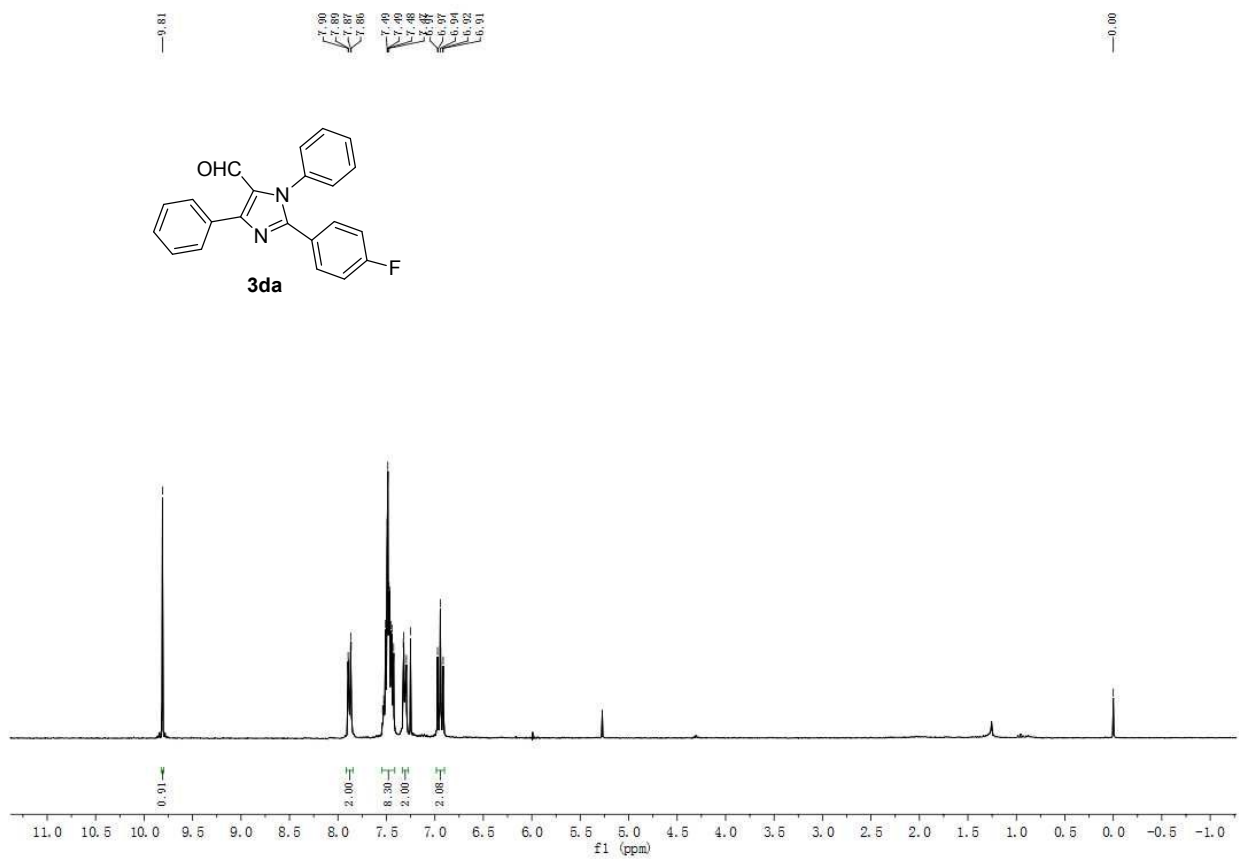
phenyl(1,2,4-triphenyl-1H-imidazol-5-yl)methanone (3ak)²: yellow solid (56.0 mg, 70%); m. p. 194-196 °C; ^1H NMR (300 MHz, CDCl_3) δ 7.74-7.65 (m, 2H), 7.53-7.43 (m, 4H), 7.39-7.09 (m, 14H). ^{13}C NMR (75 MHz, CDCl_3) δ 187.6, 149.6, 146.5, 137.6, 136.9, 133.3, 132.9, 129.8, 129.4, 129.1, 129.0, 128.9, 128.8, 128.7, 128.4, 128.1, 128.0, 127.9, 127.7, 127.5. HRMS (ESI $^+$): calcd for $\text{C}_{28}\text{H}_{21}\text{N}_2\text{O}$ (M+H) $^+$: 401.1649; Found: 401.1654.

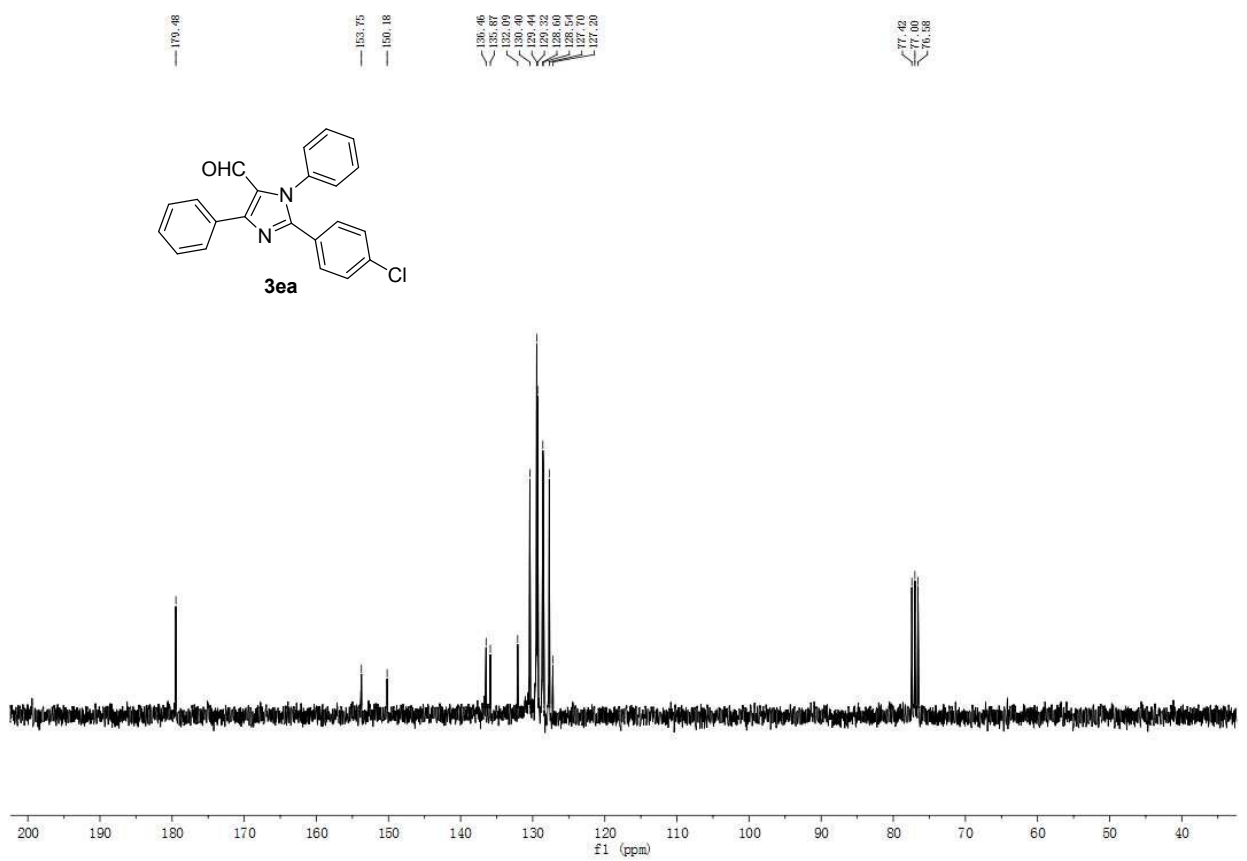
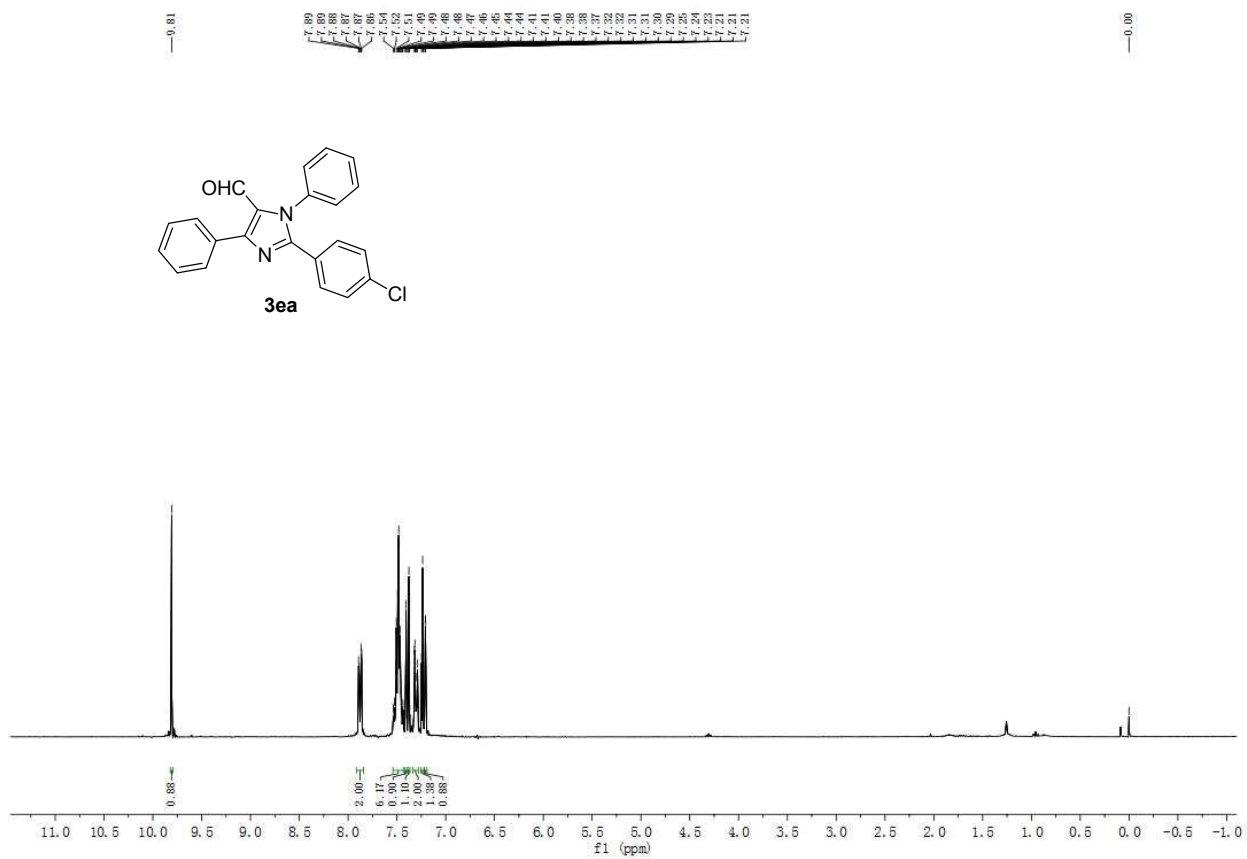
4. ¹H and ¹³C NMR spectra

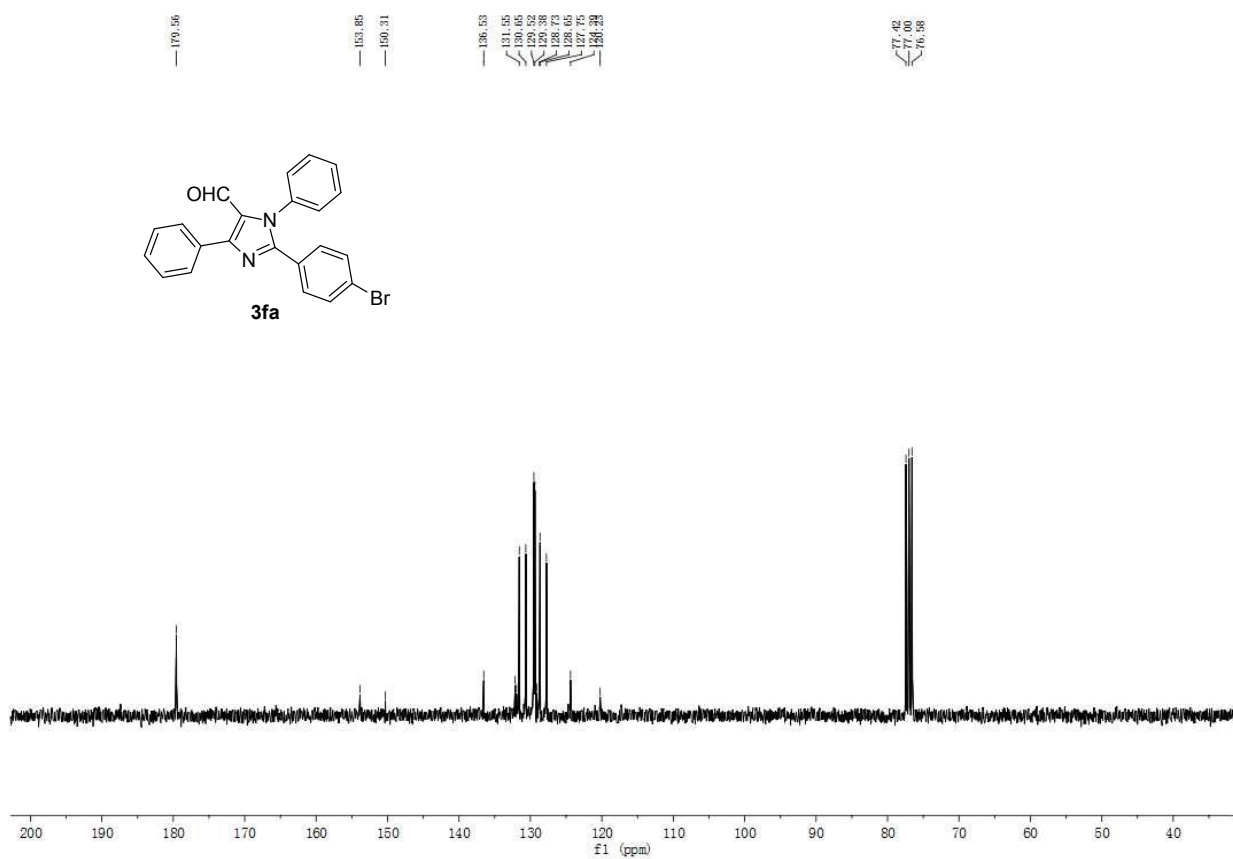
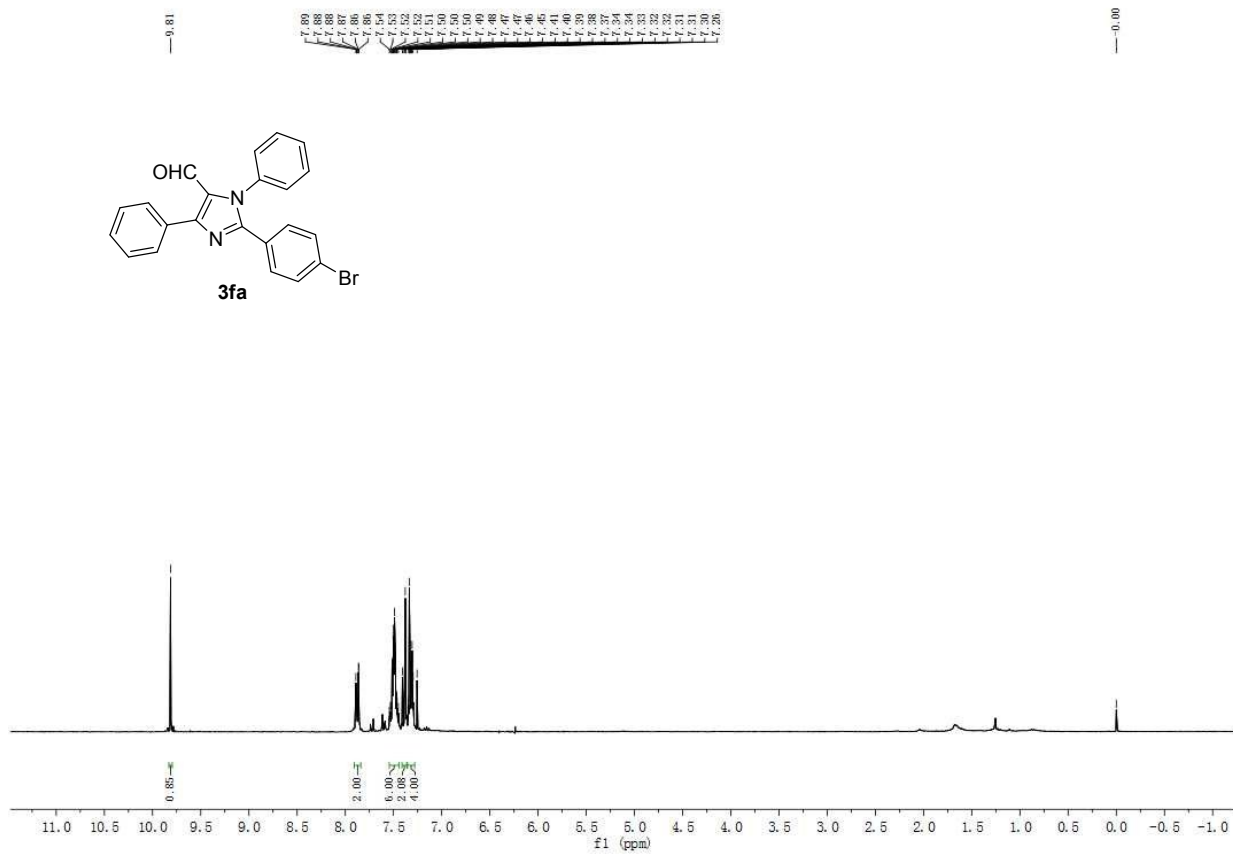


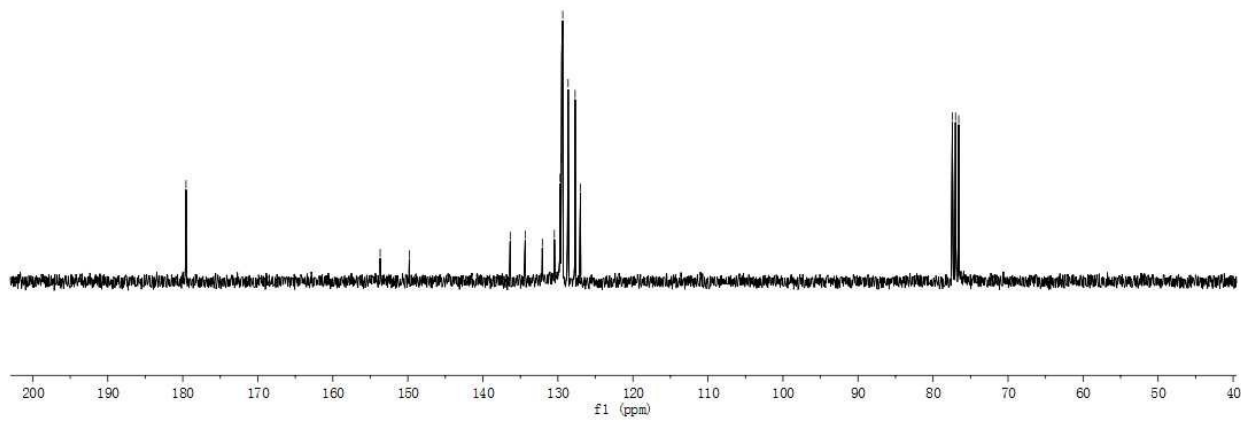
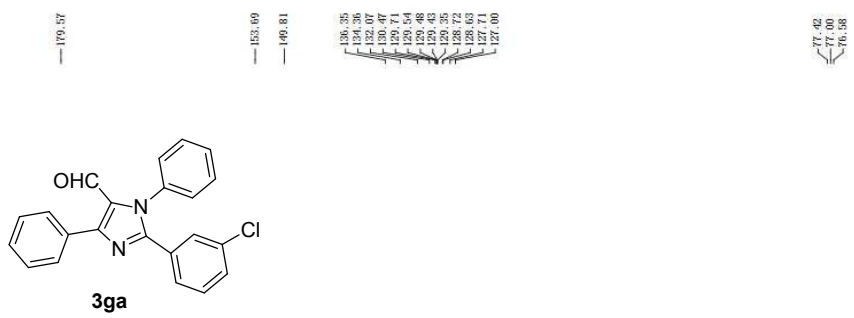
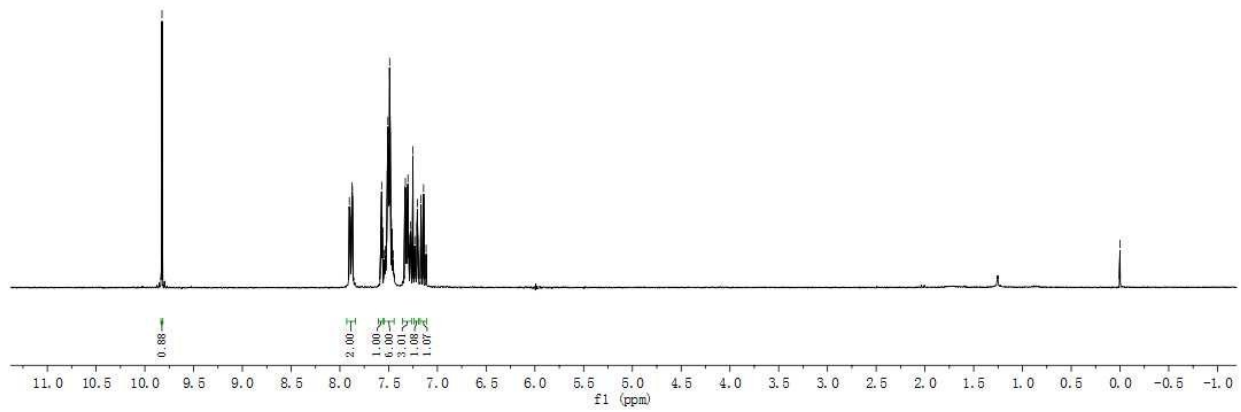
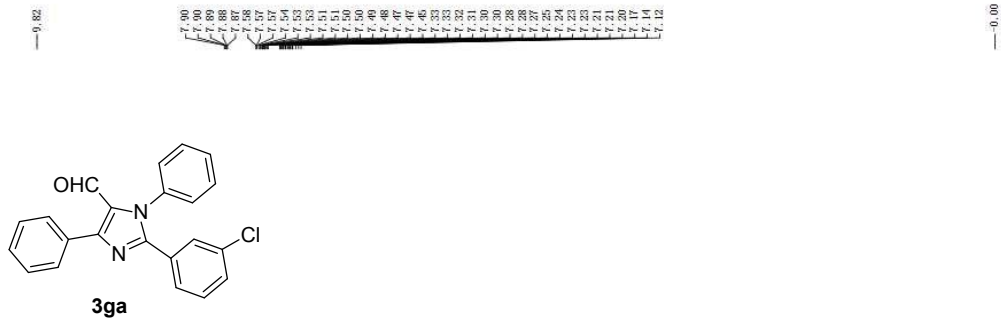


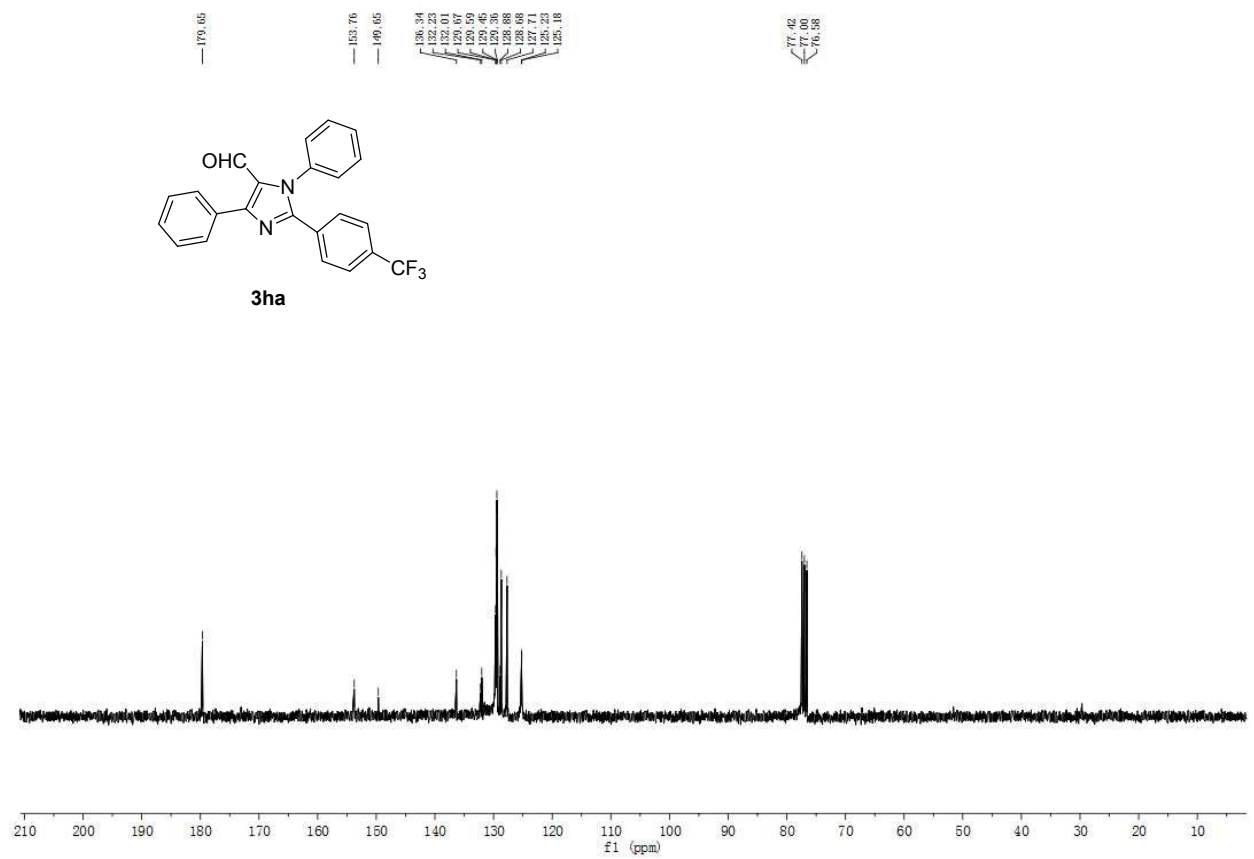
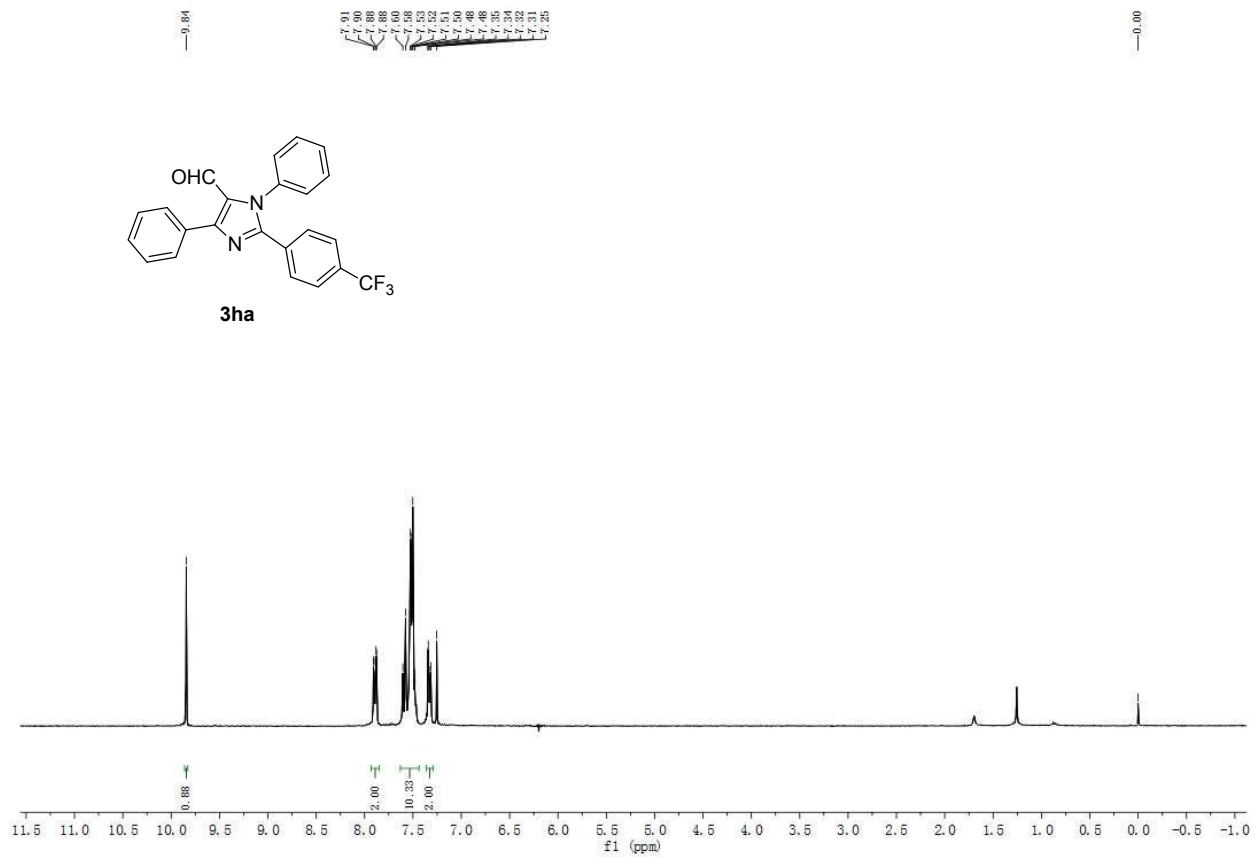


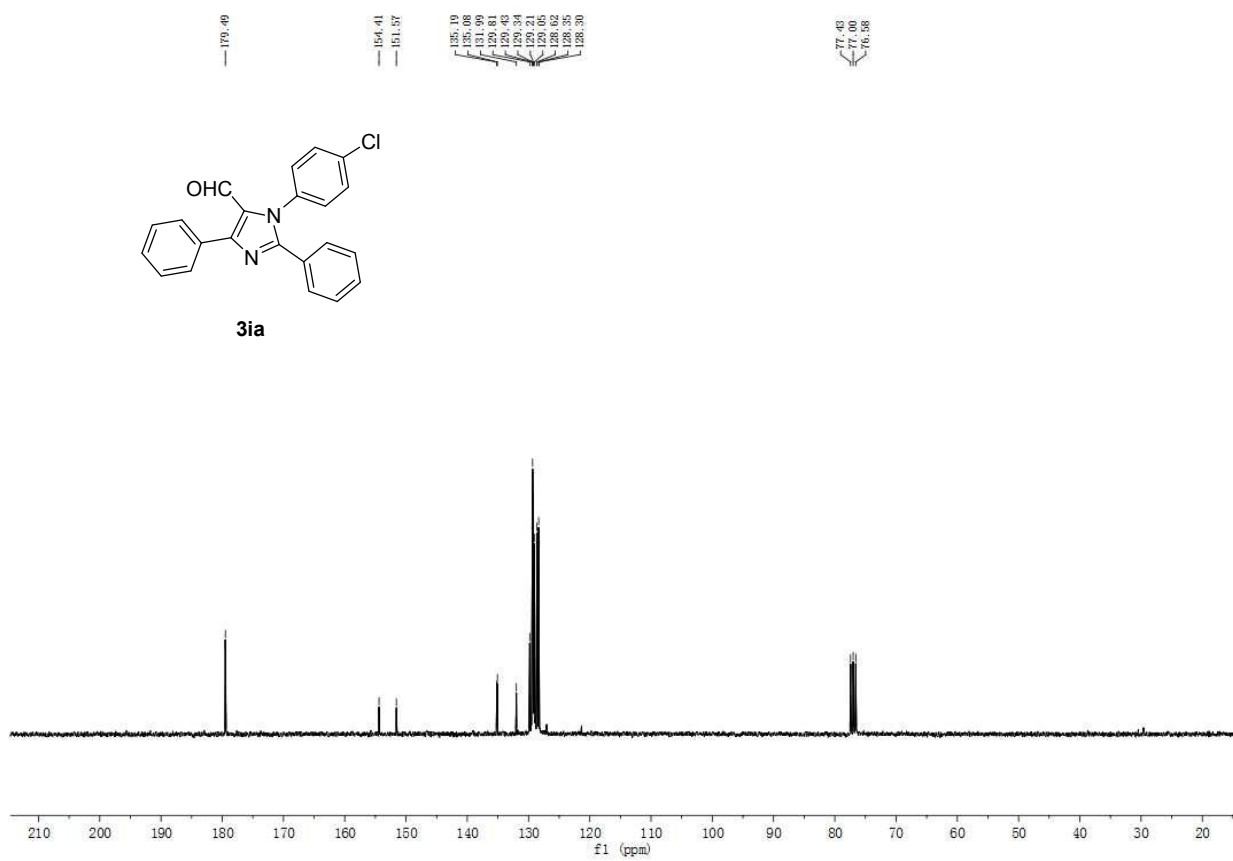
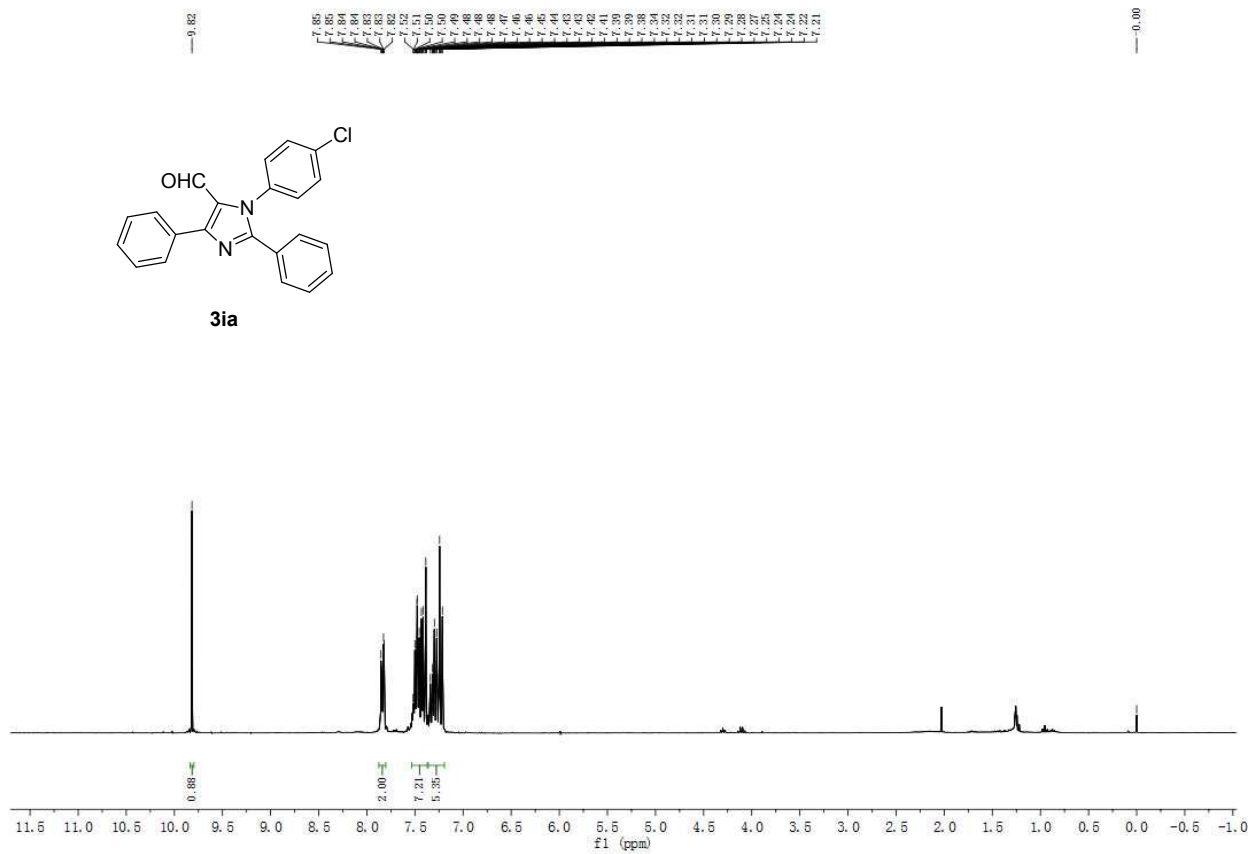


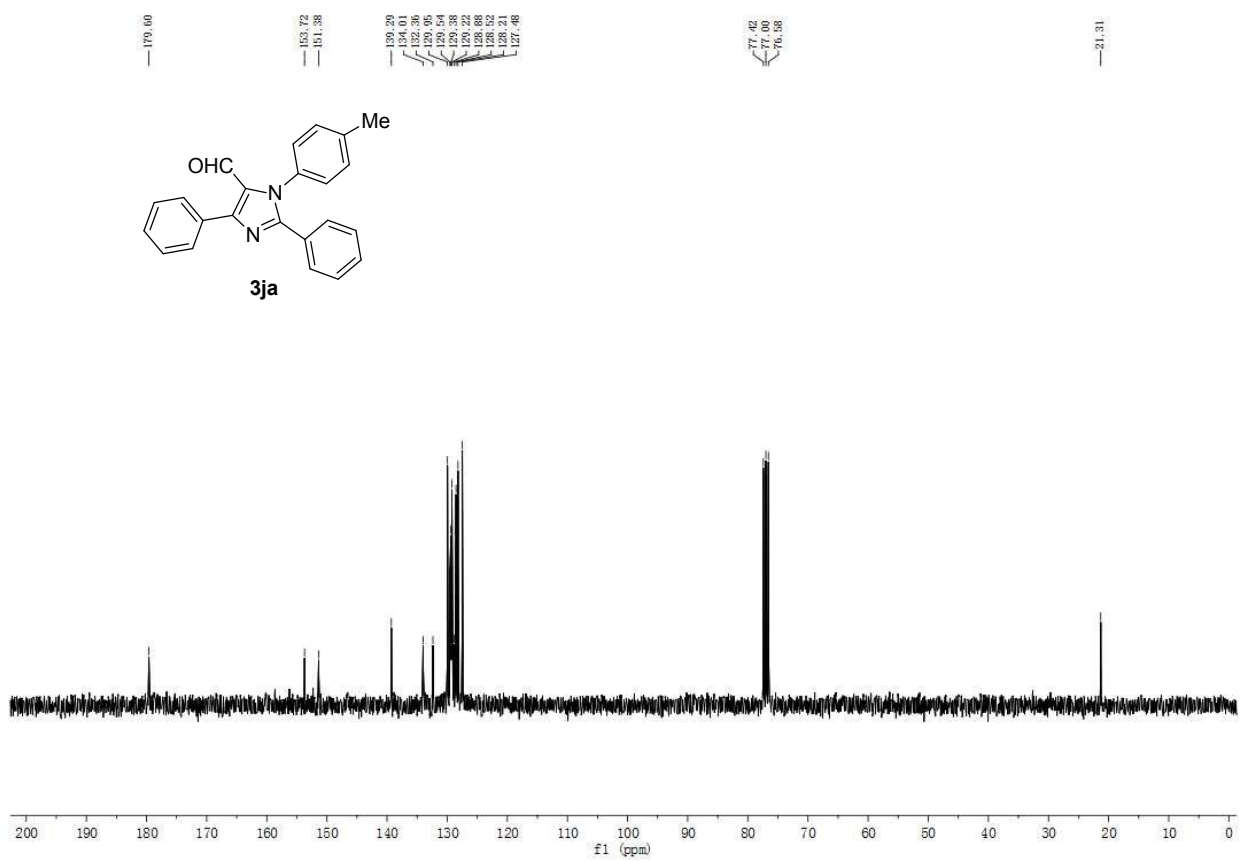
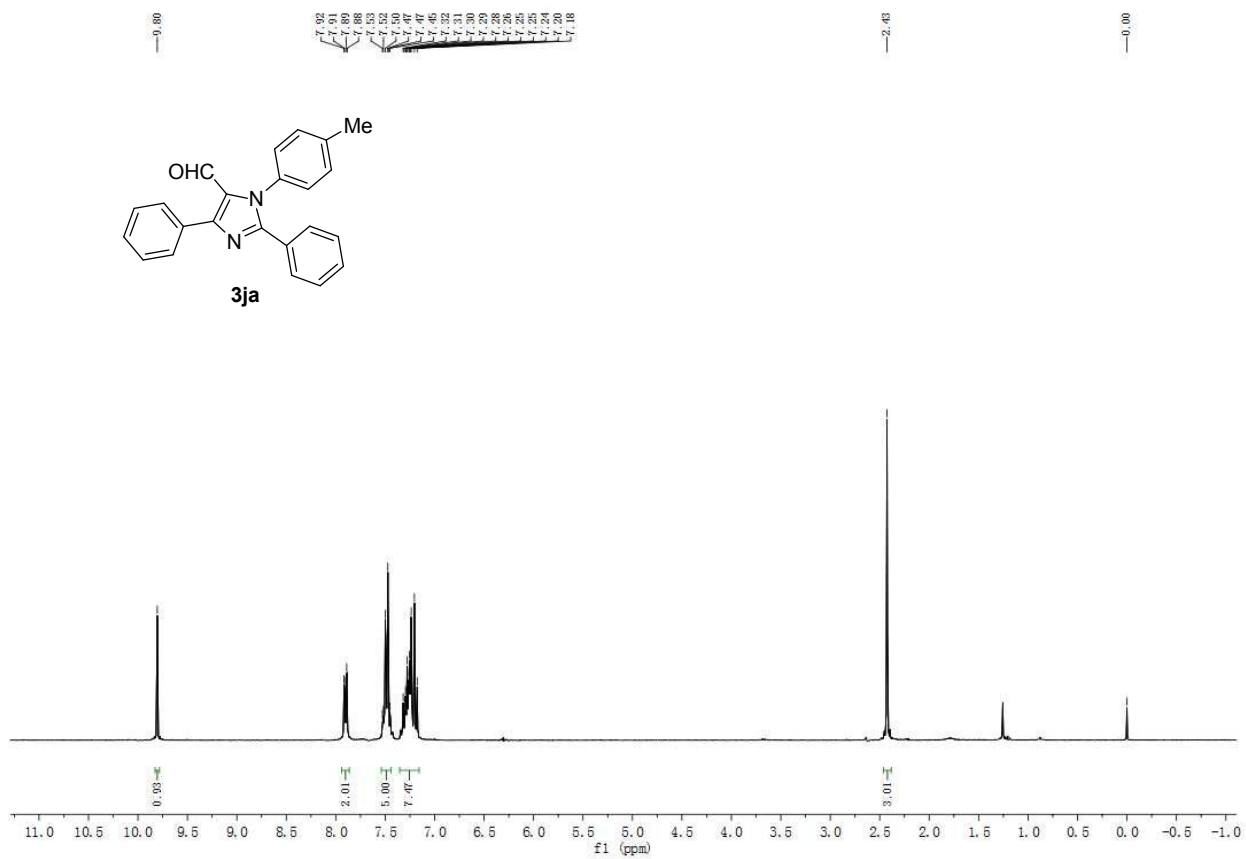


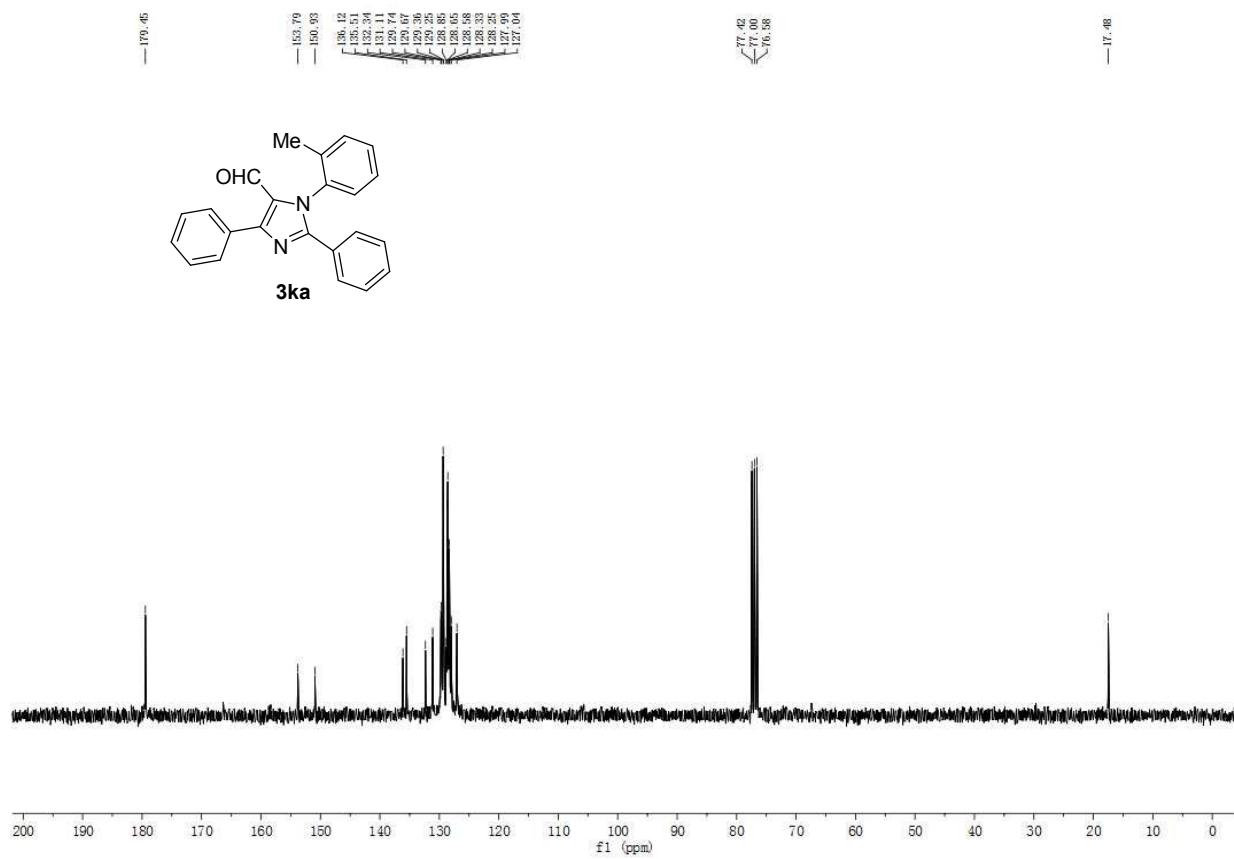
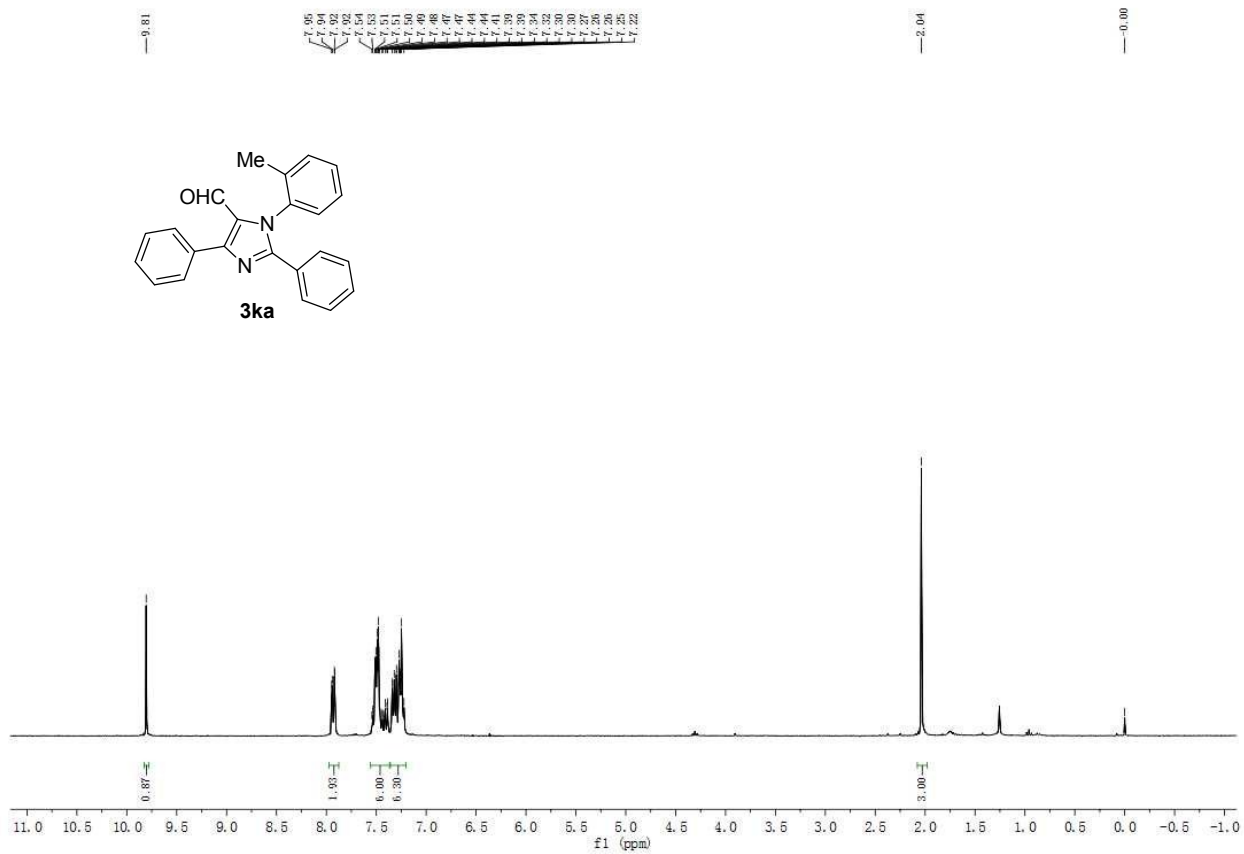


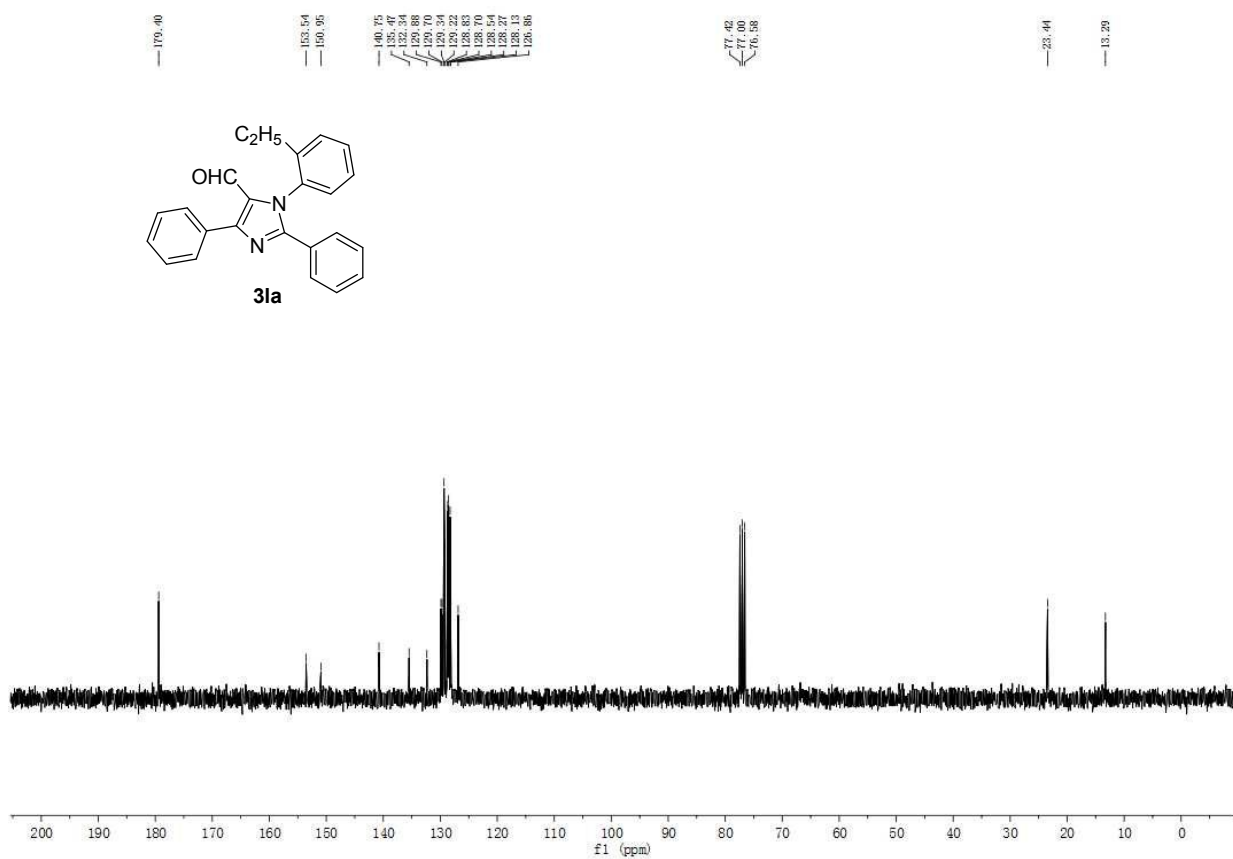
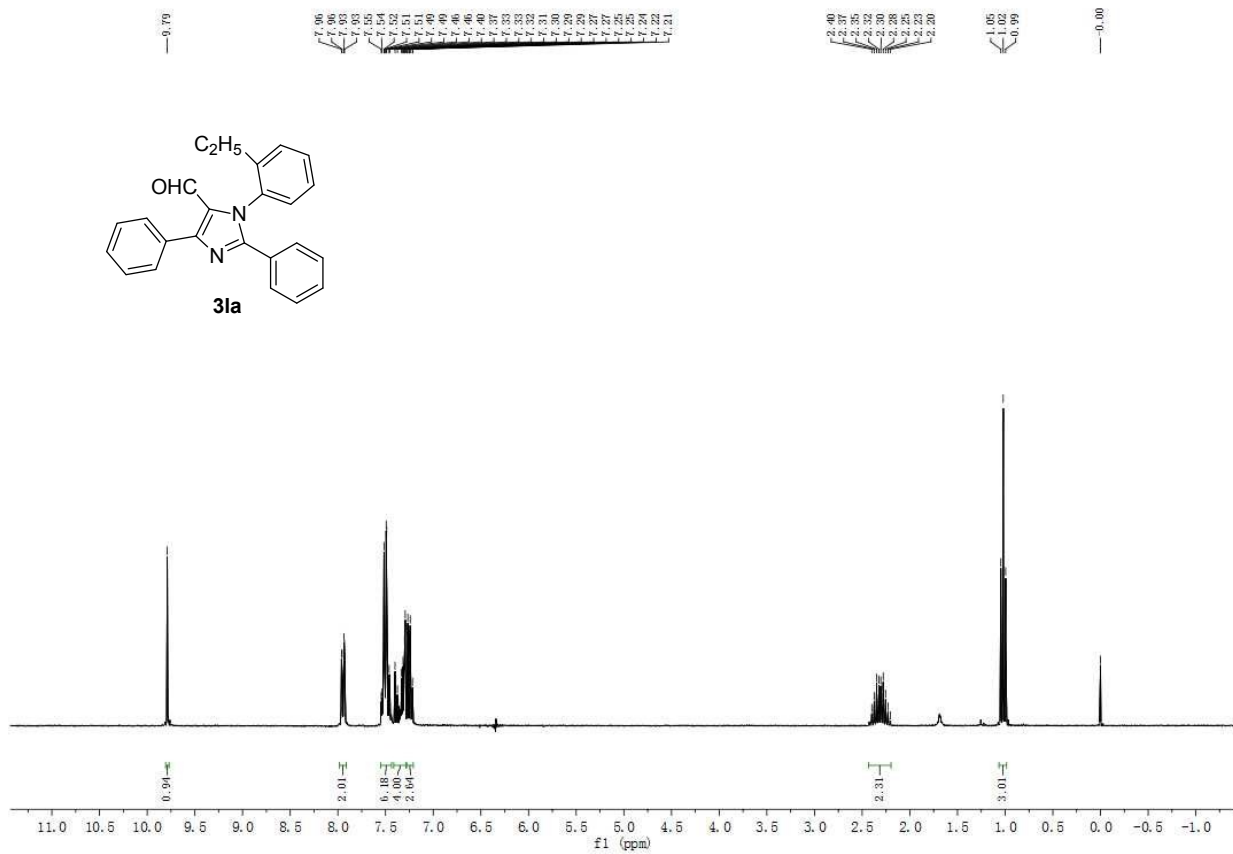


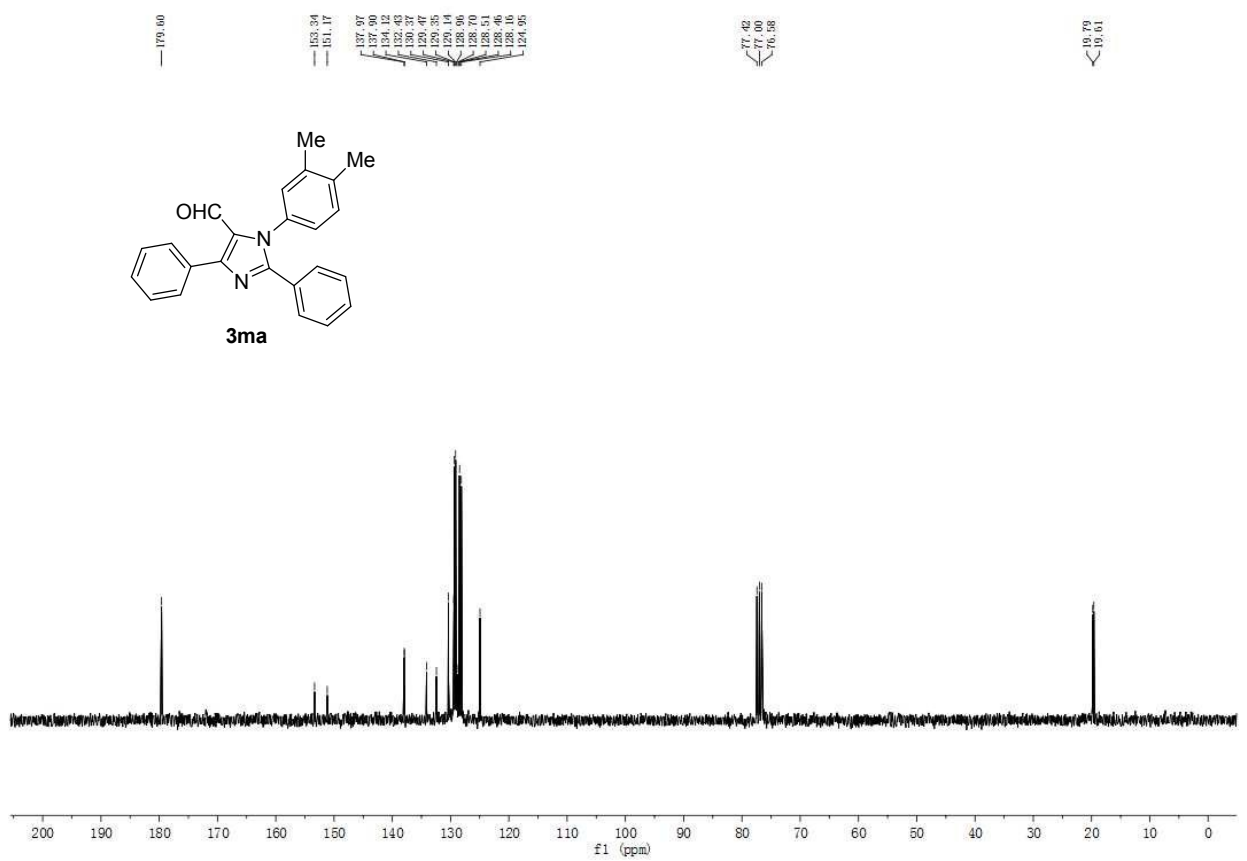
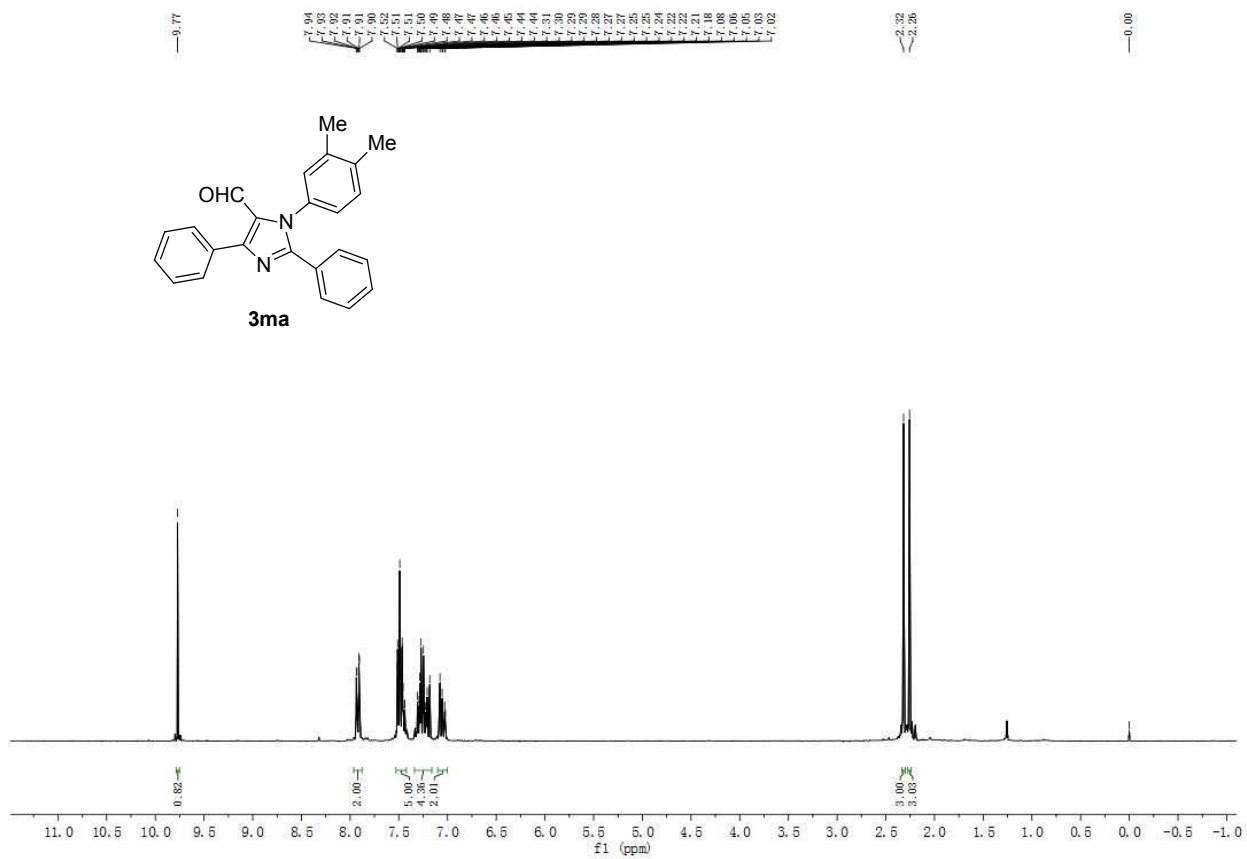


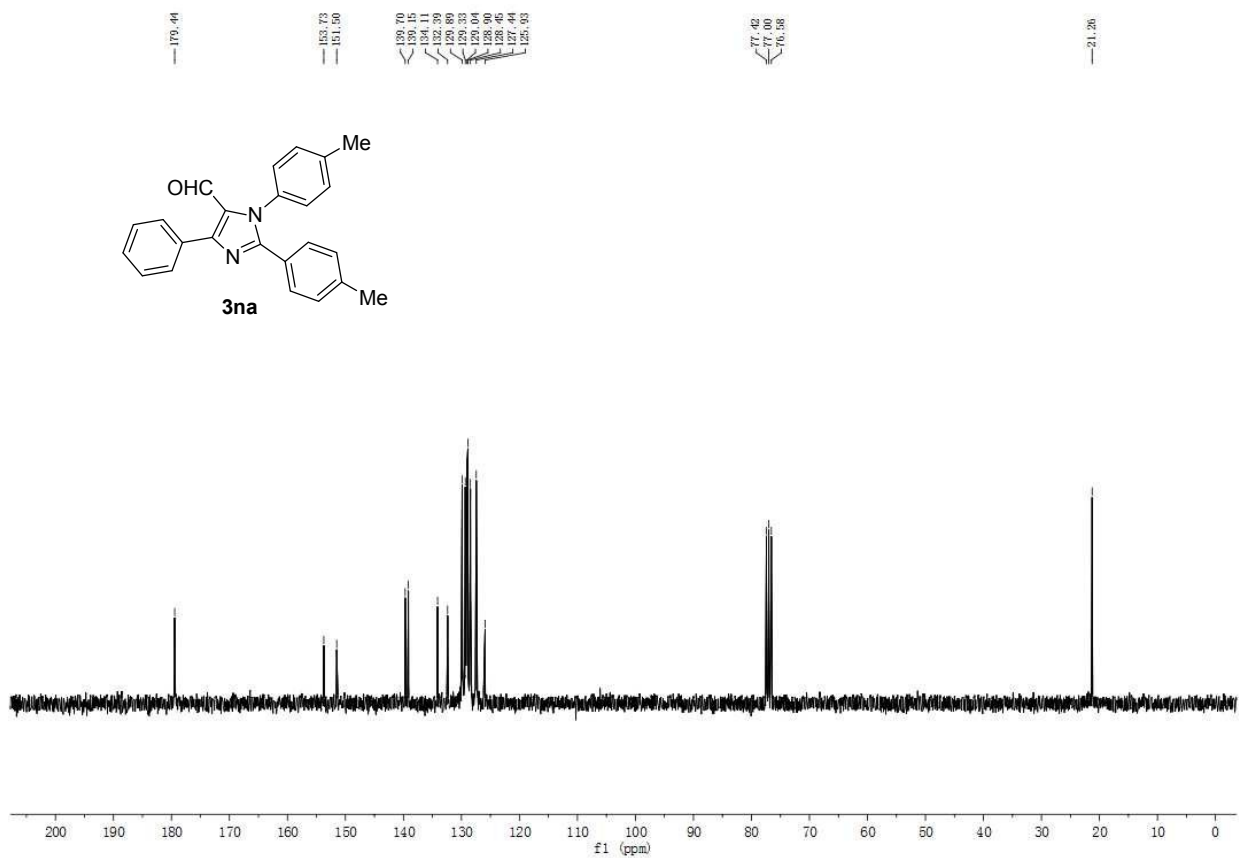
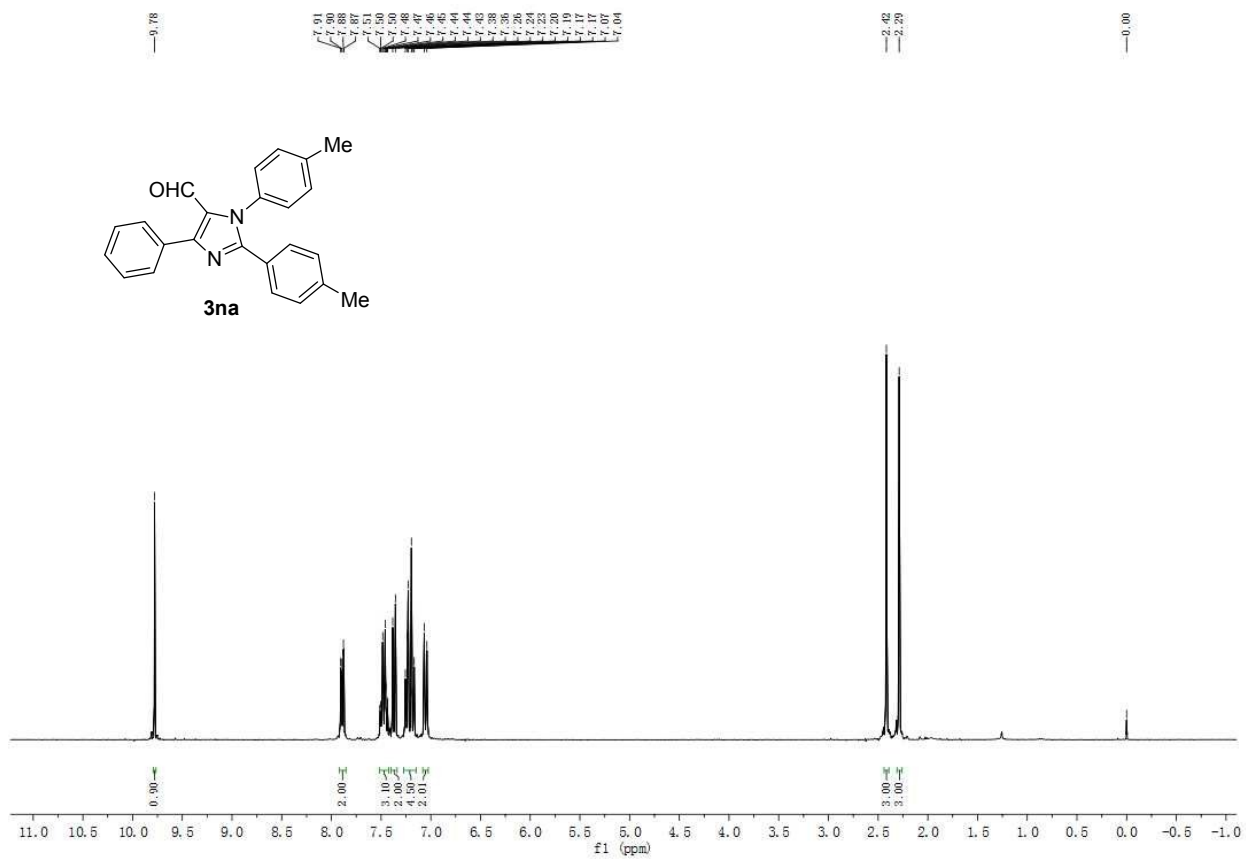


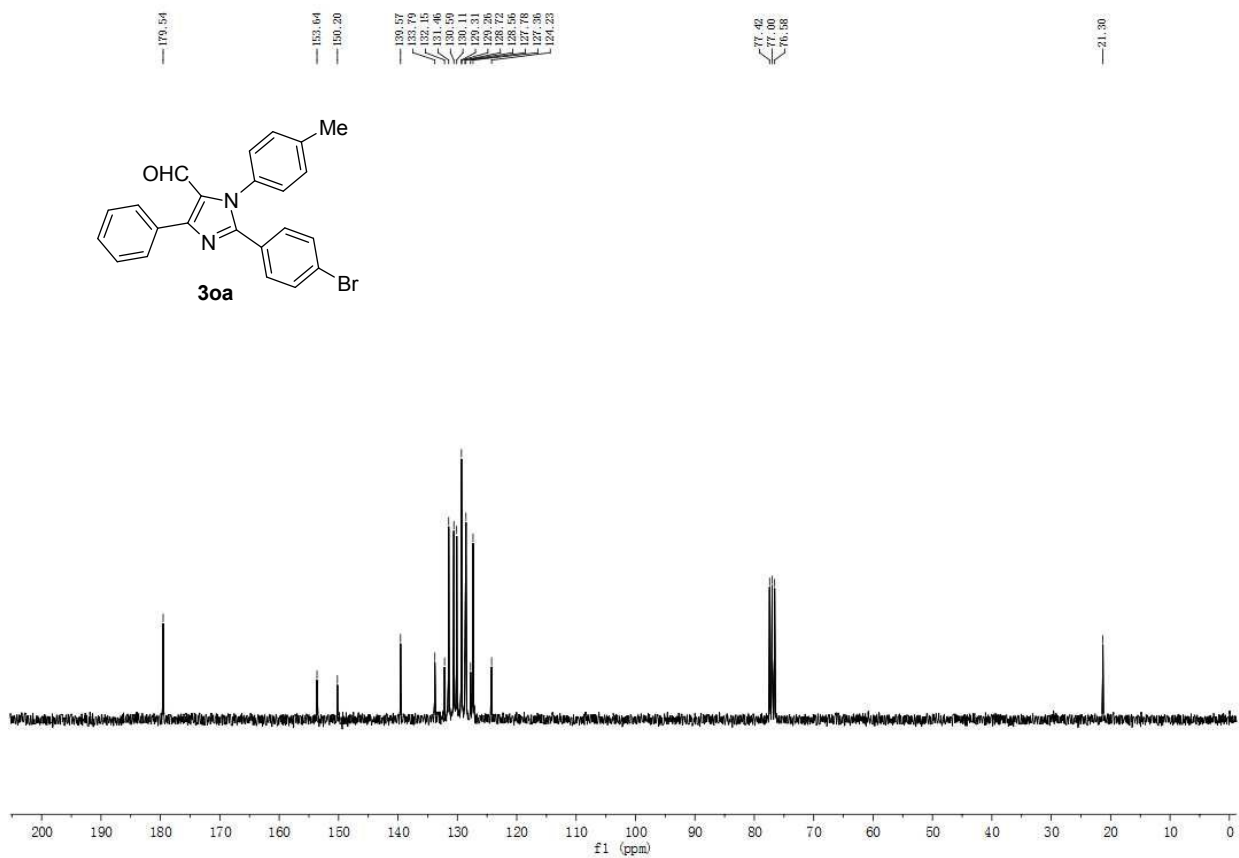
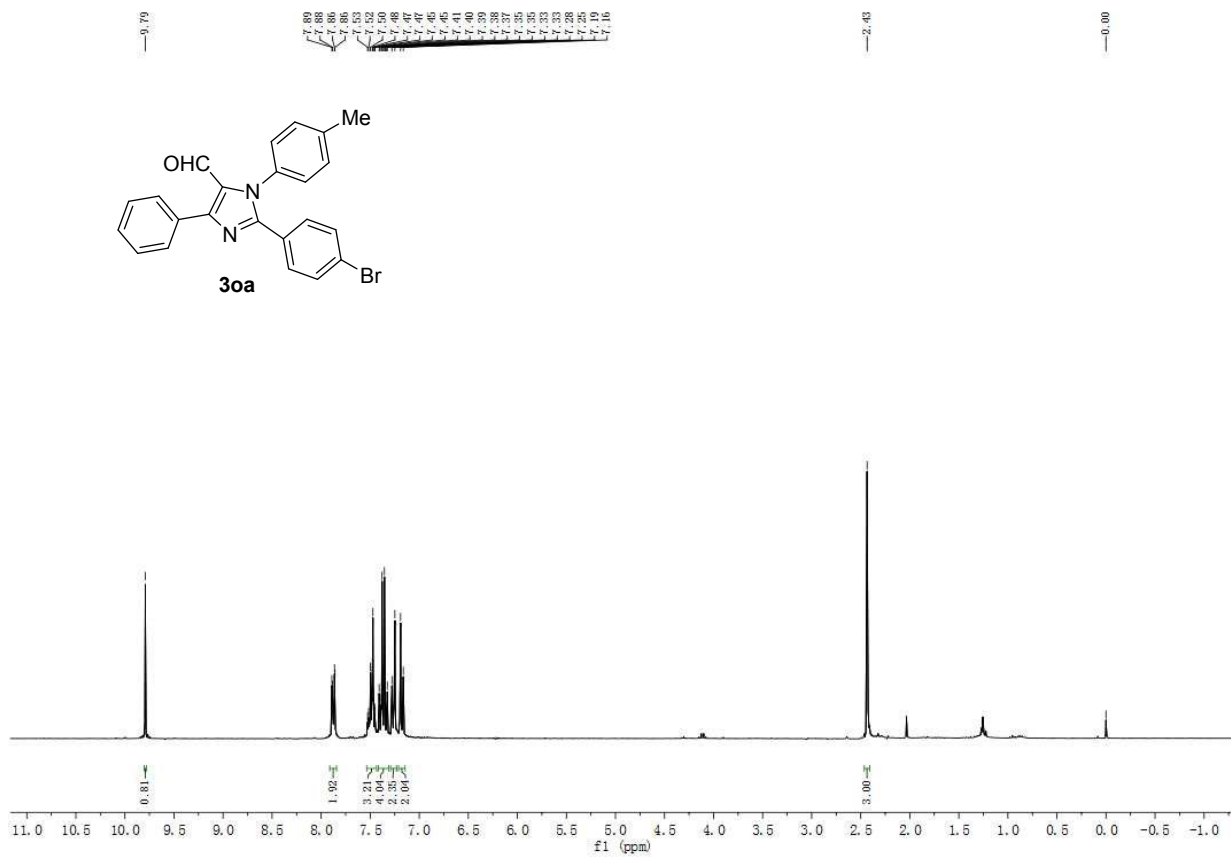




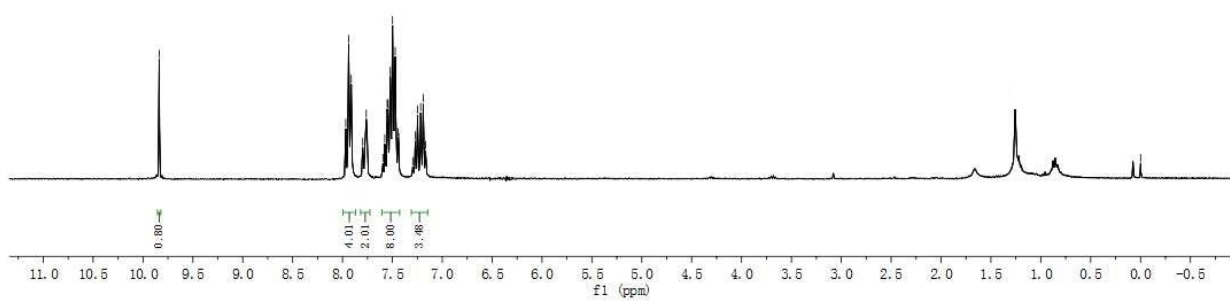
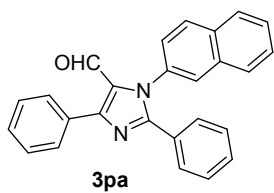




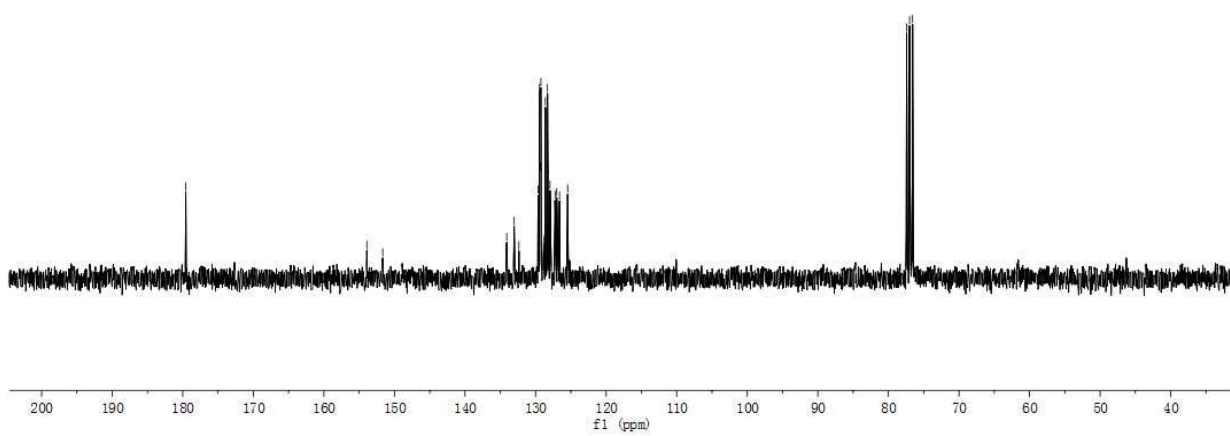
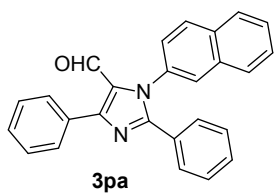


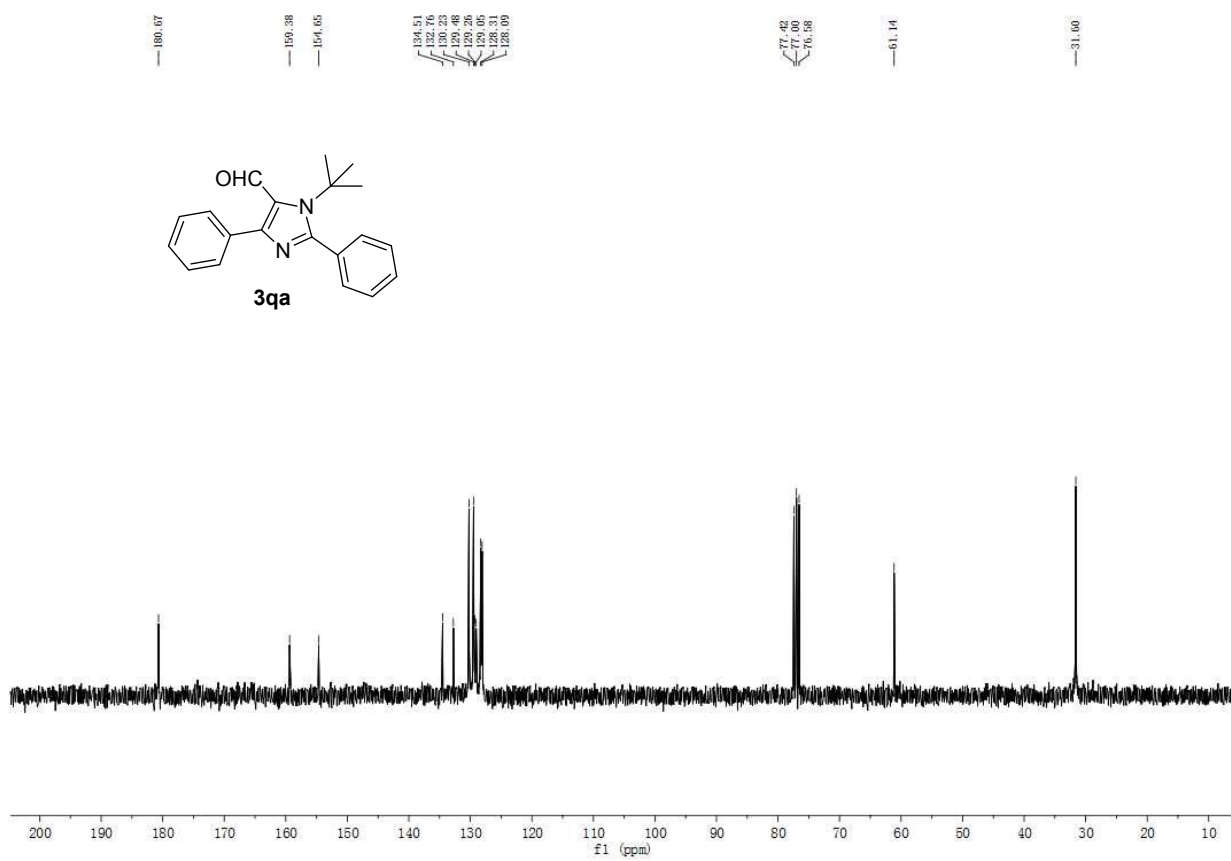
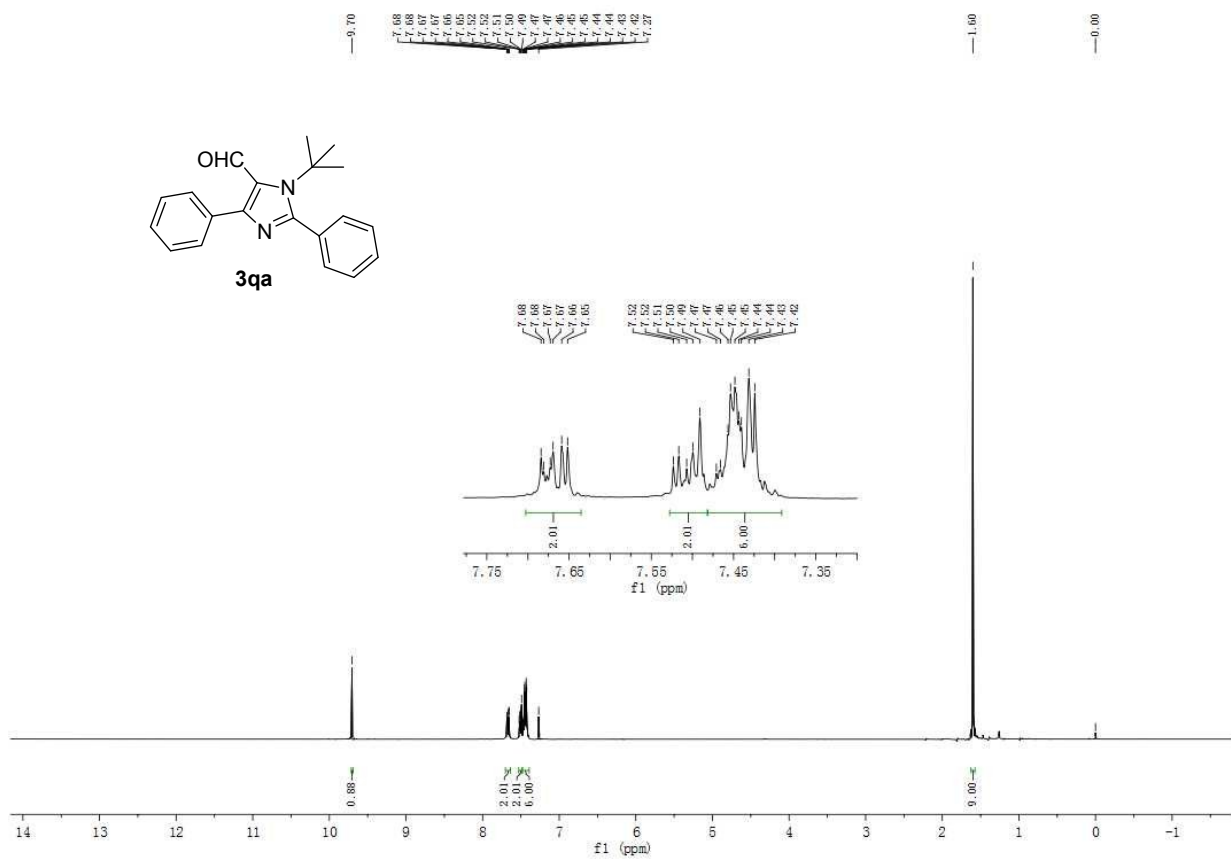


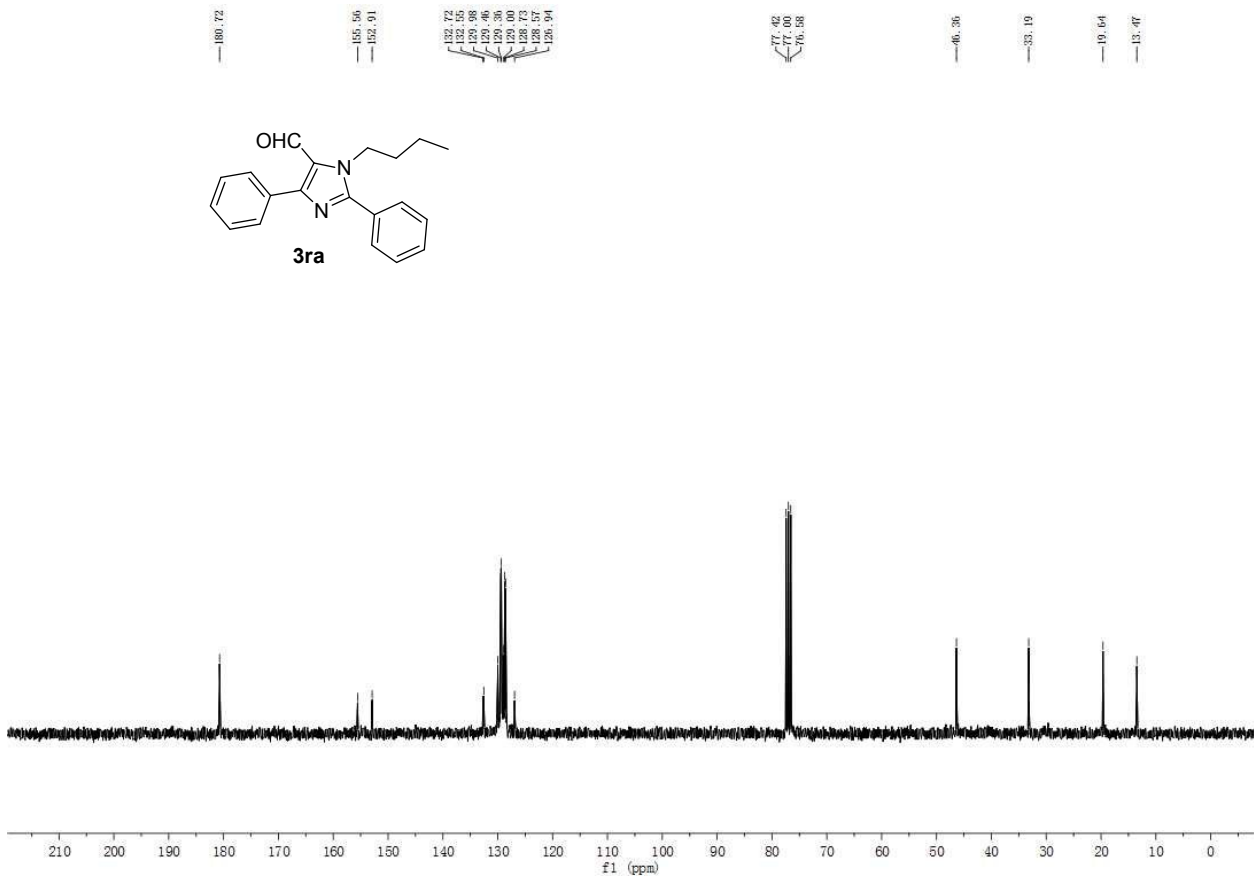
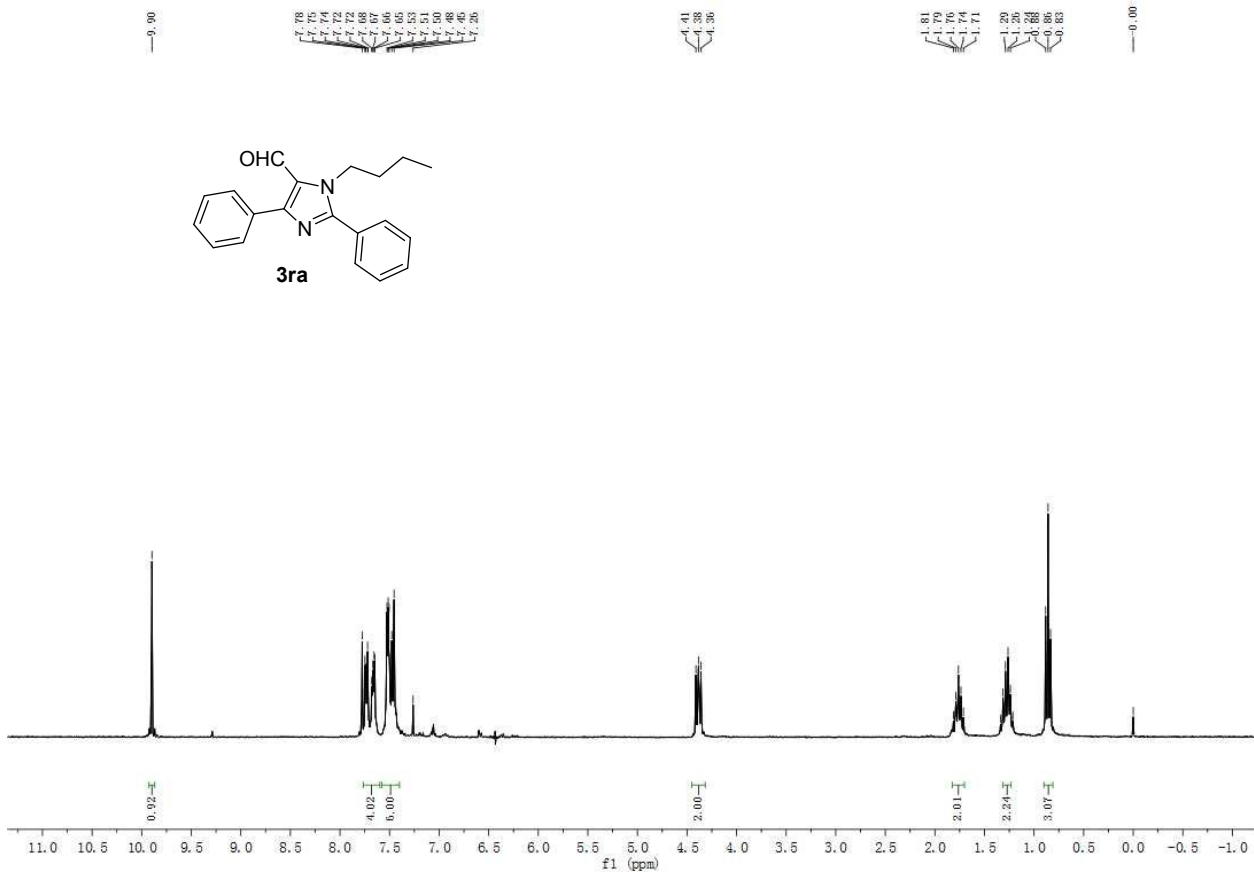
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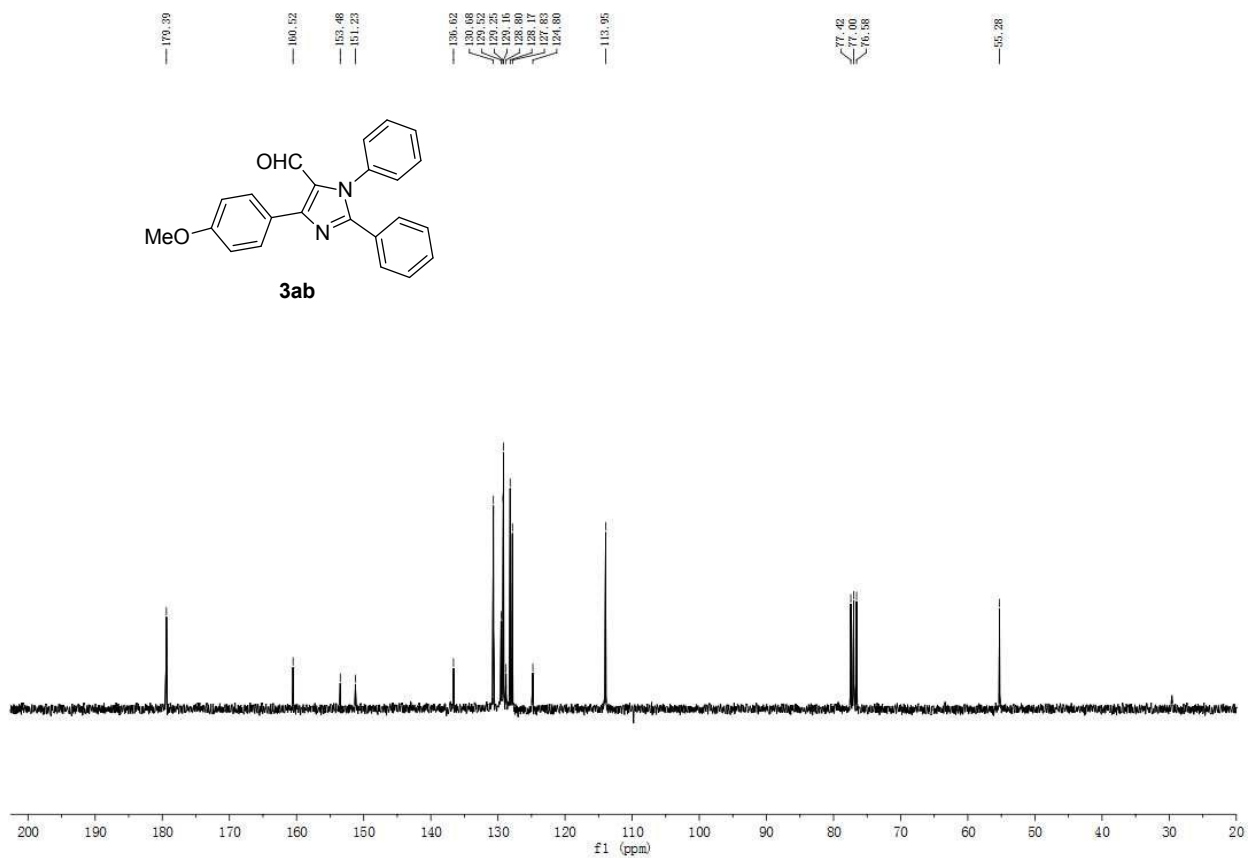
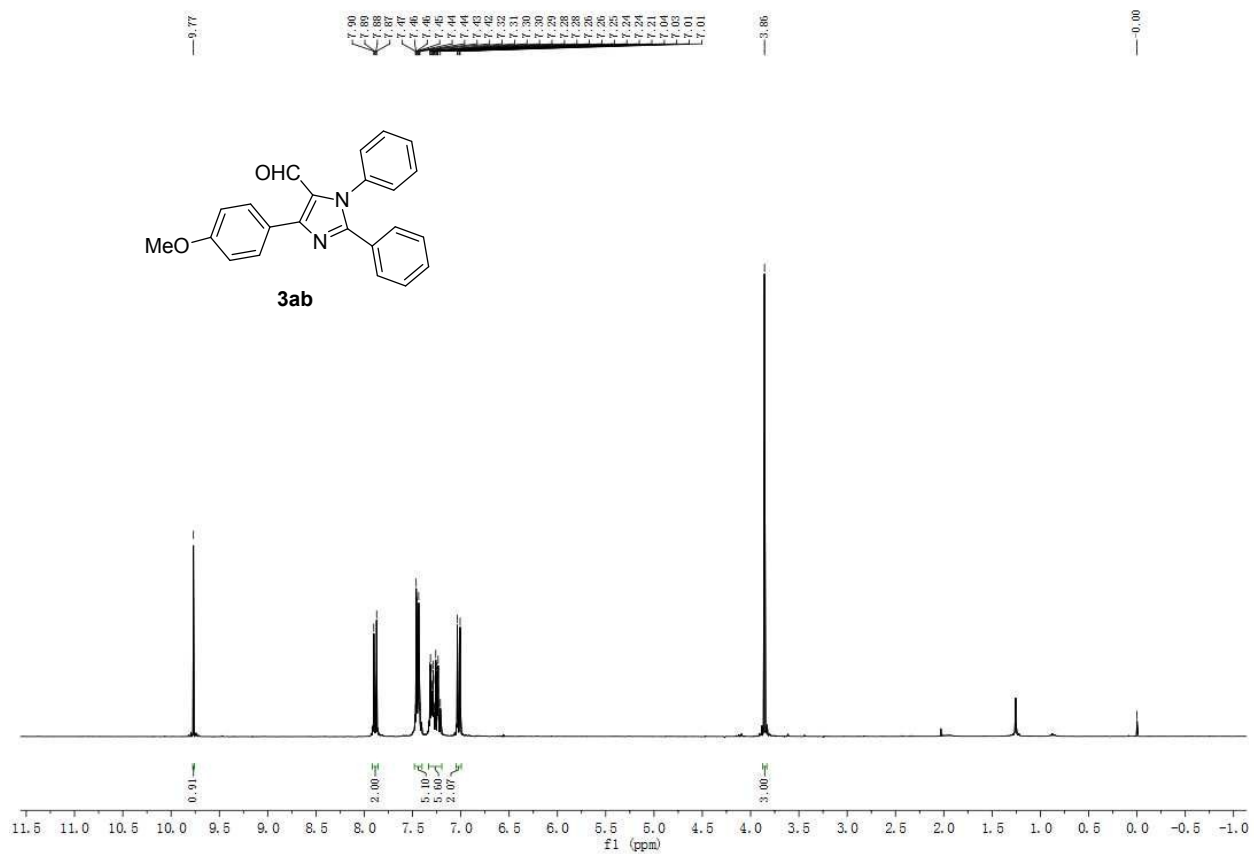


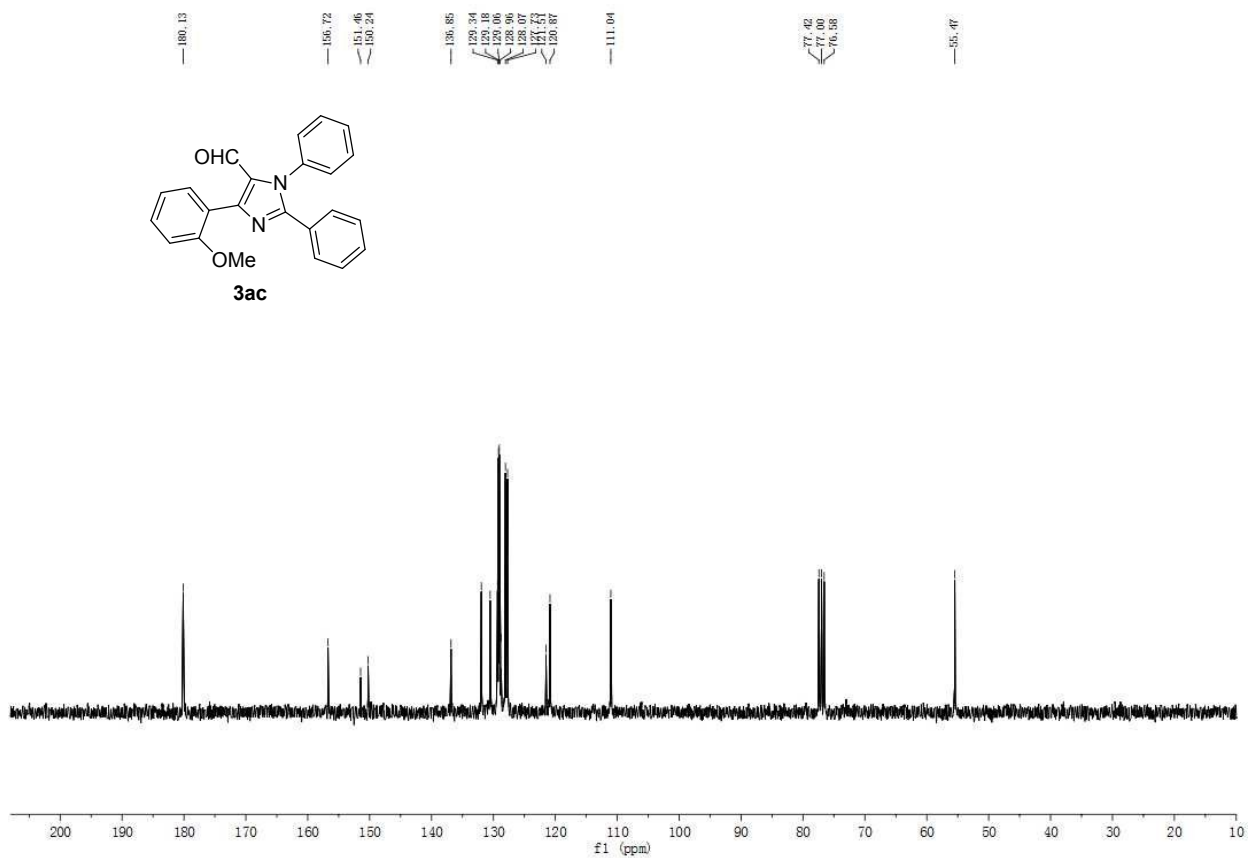
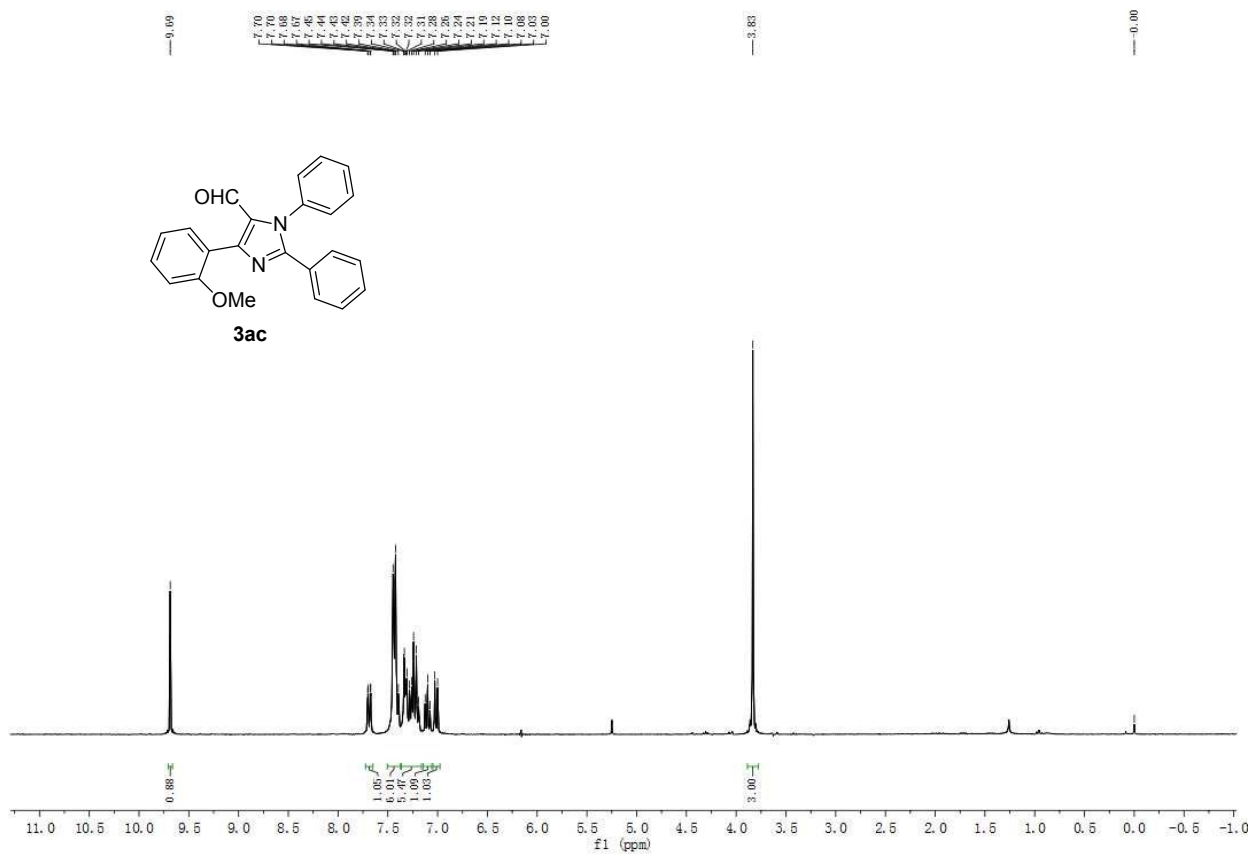
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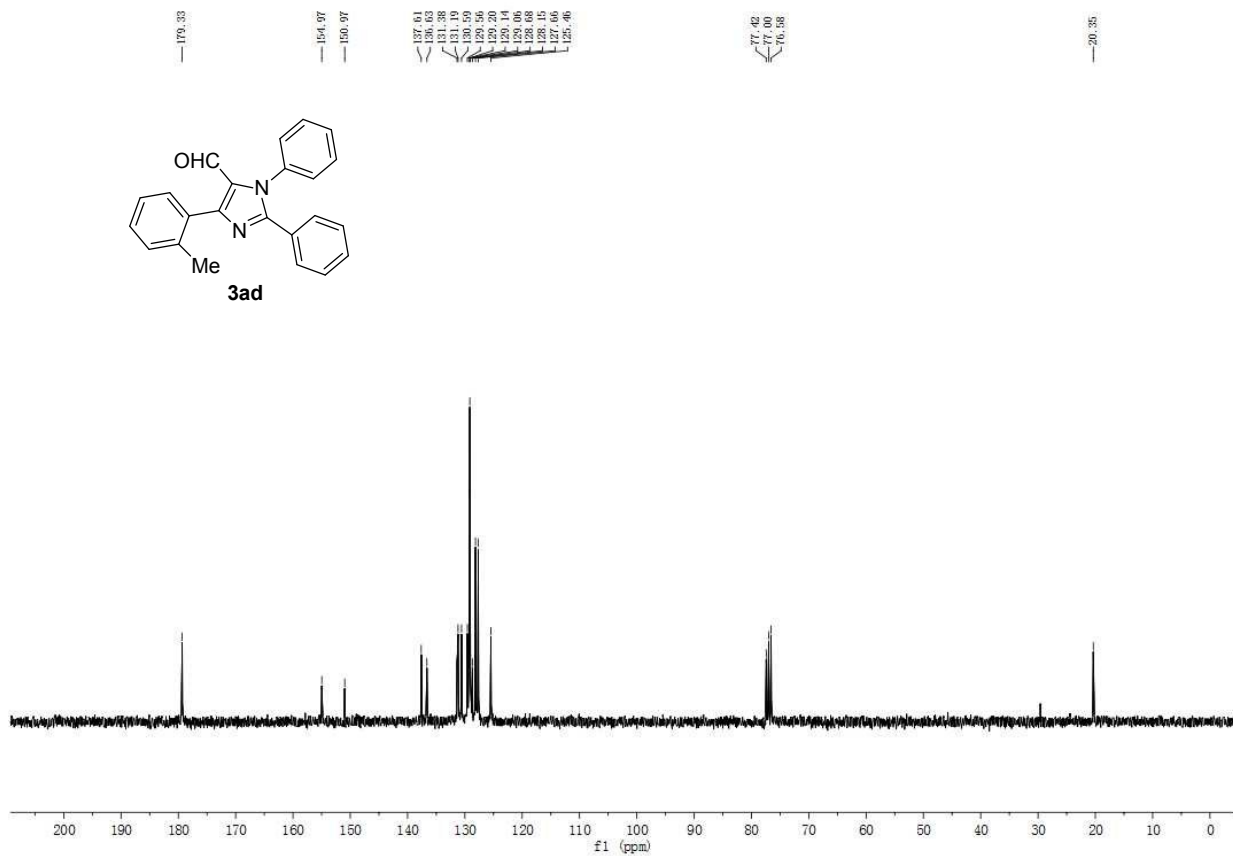
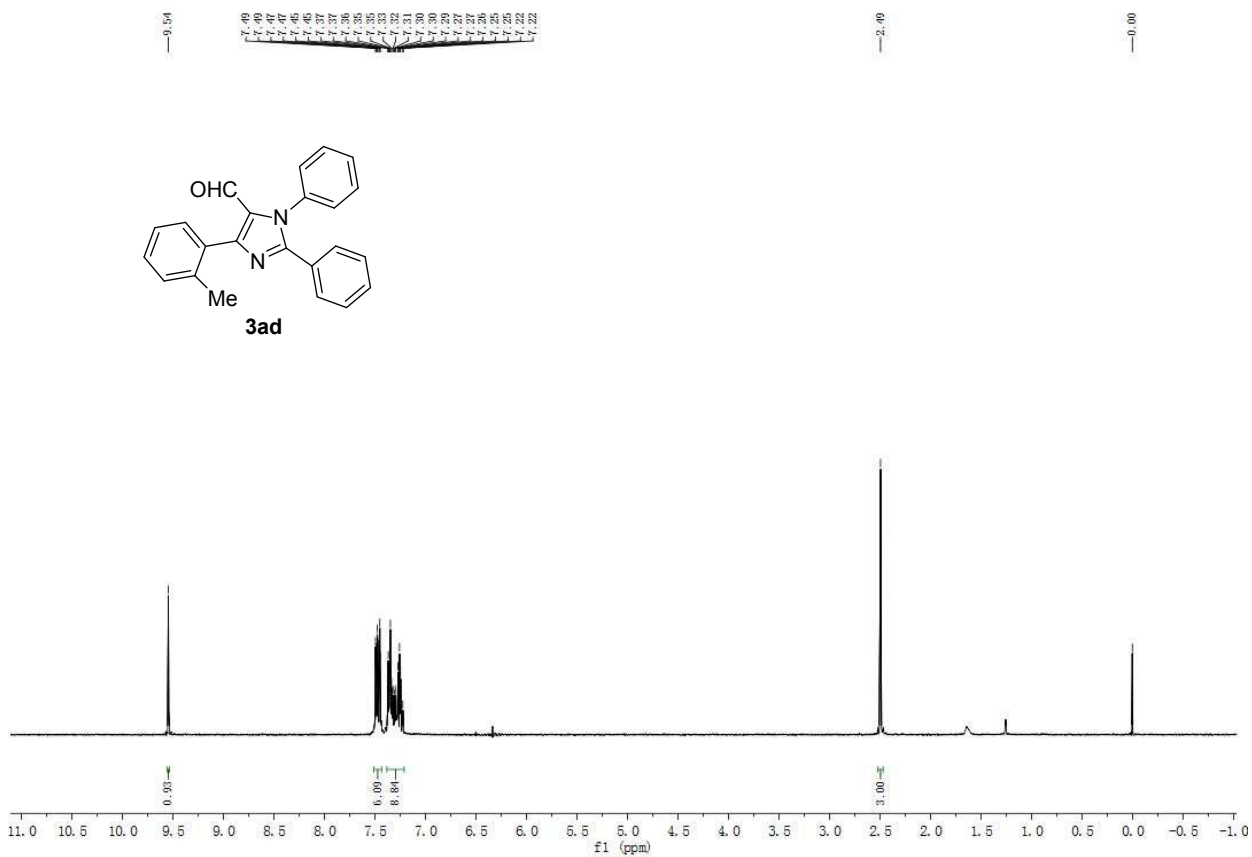


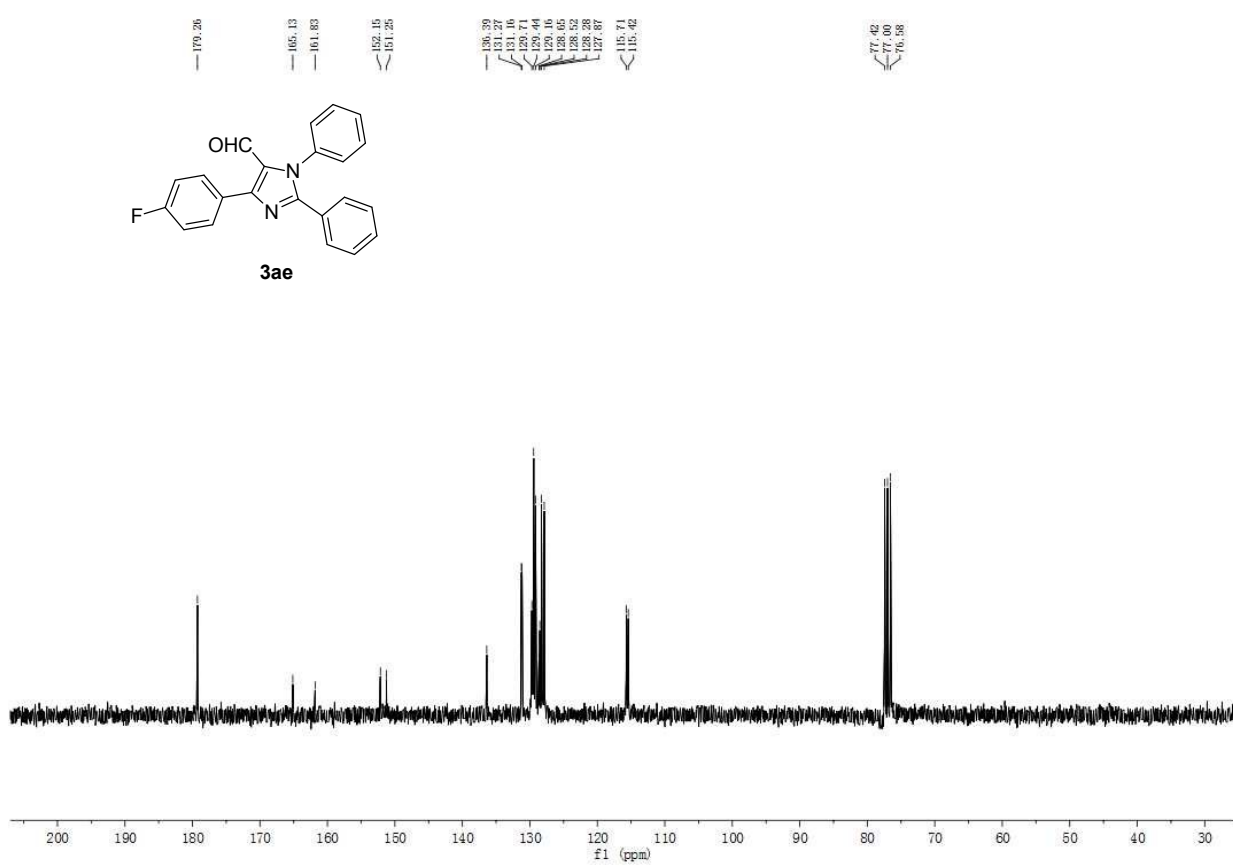
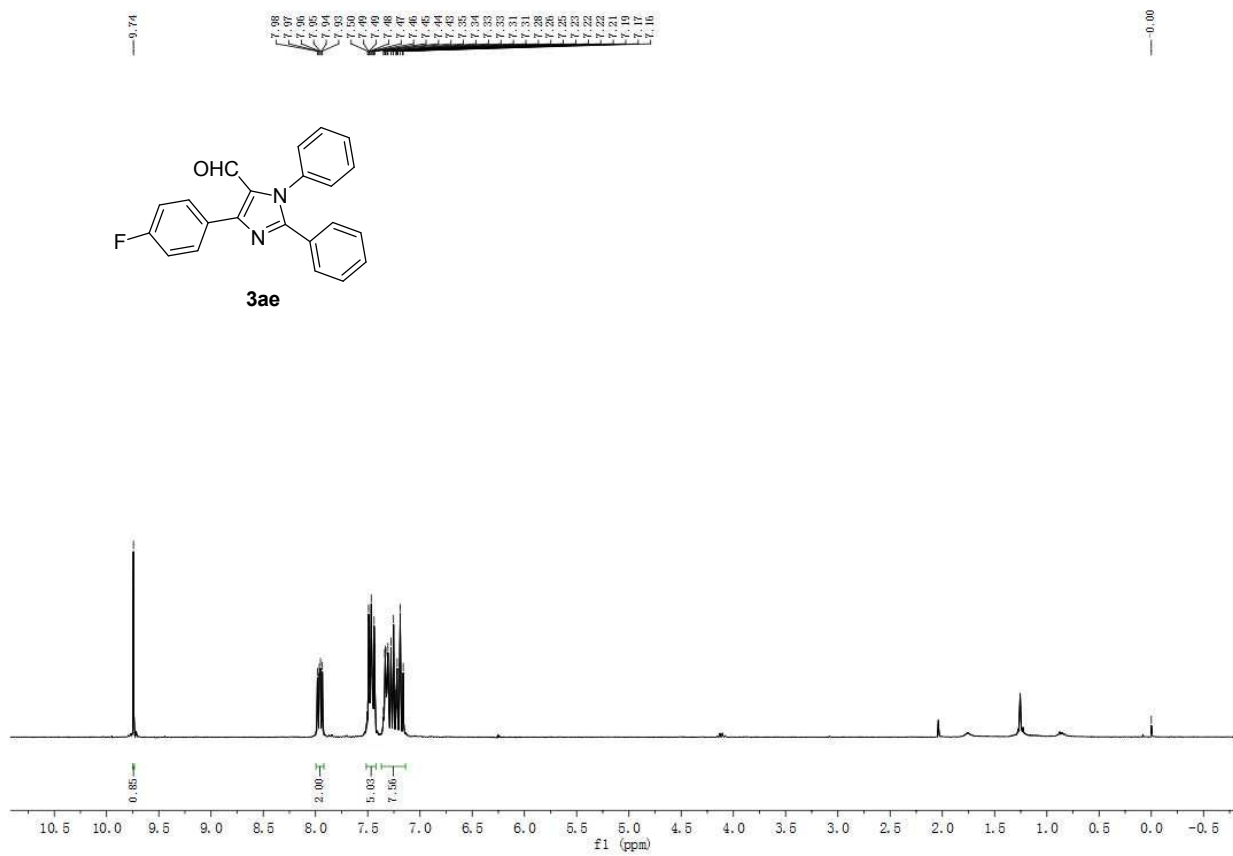


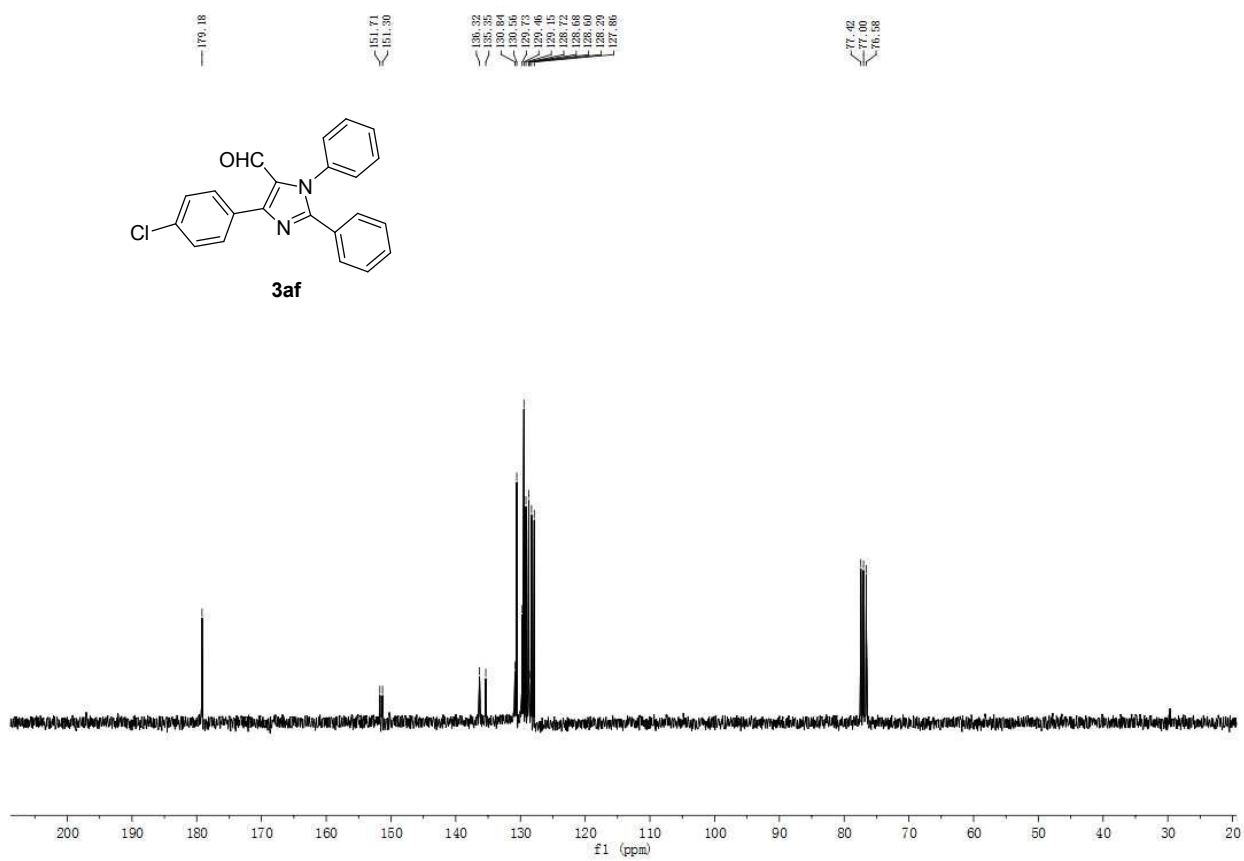
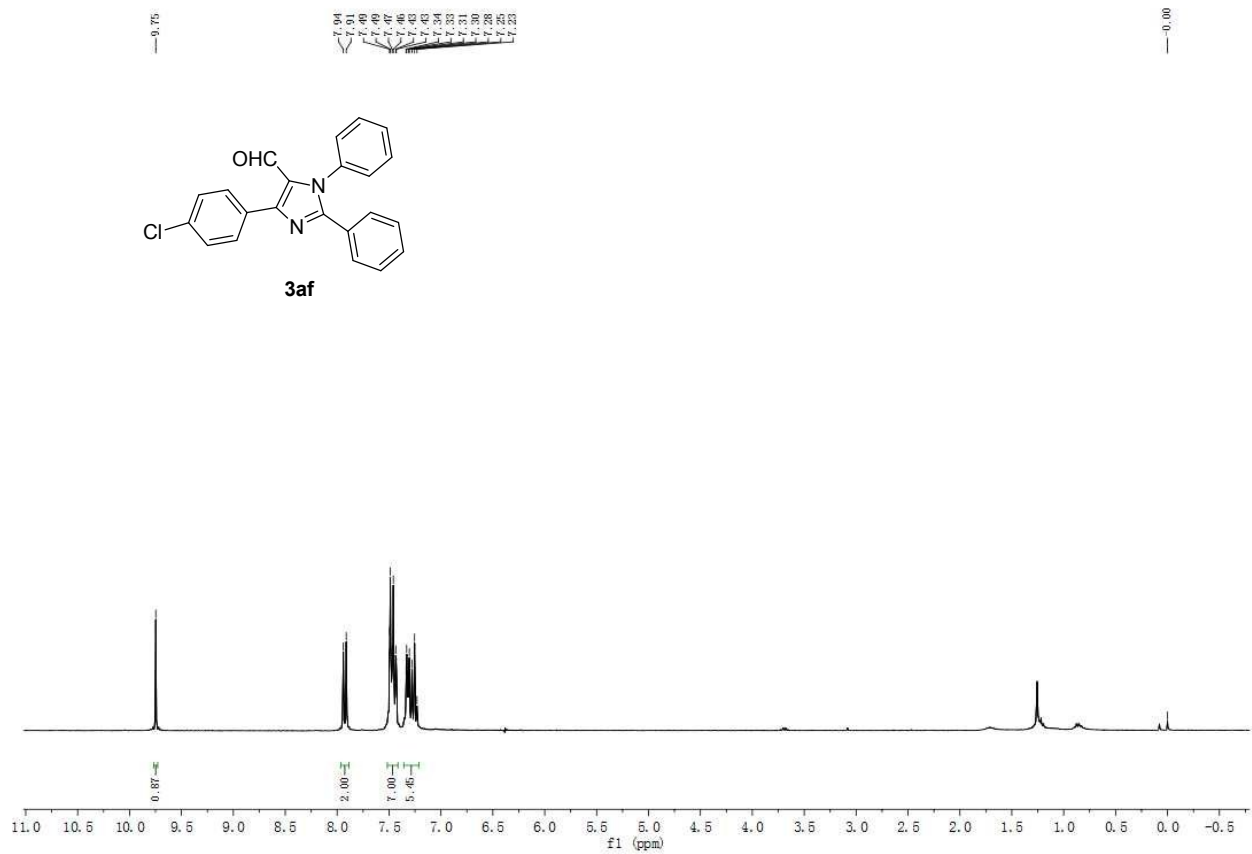


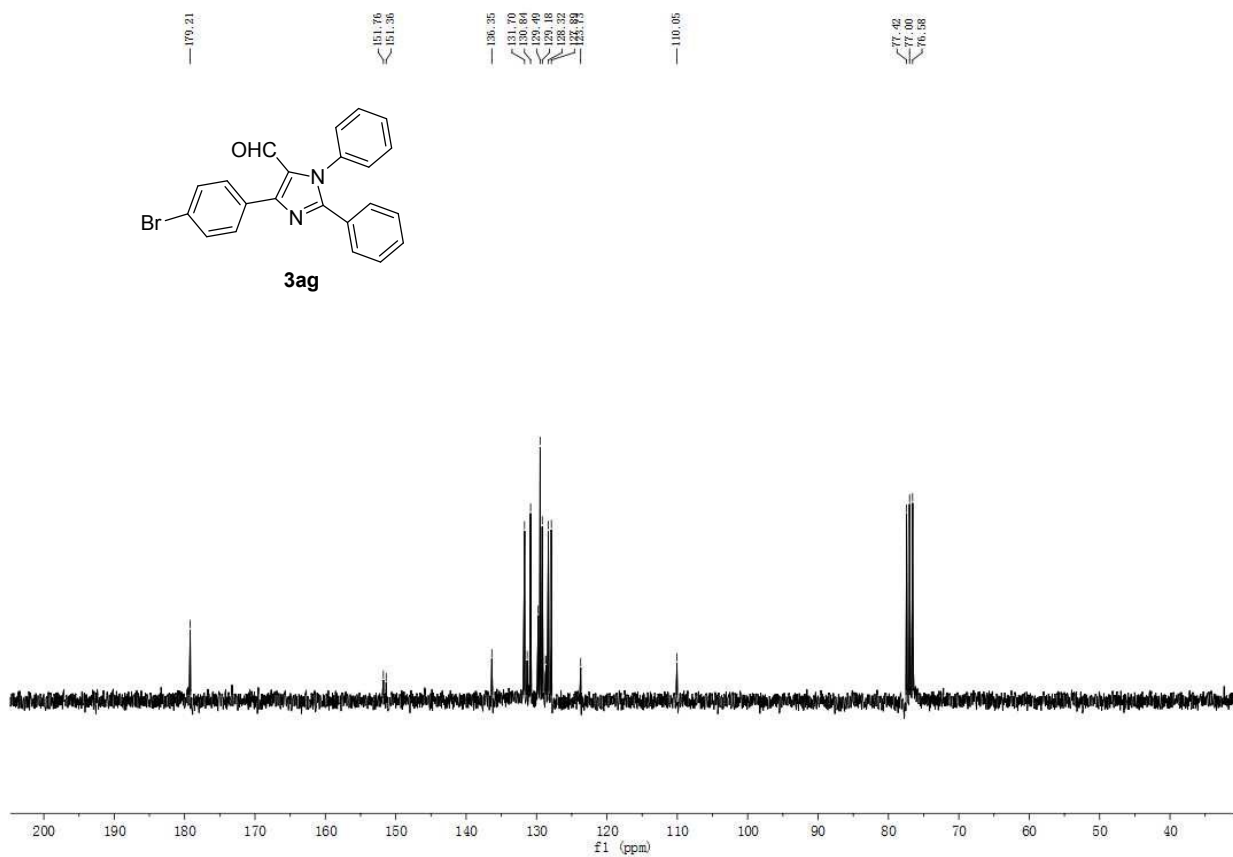
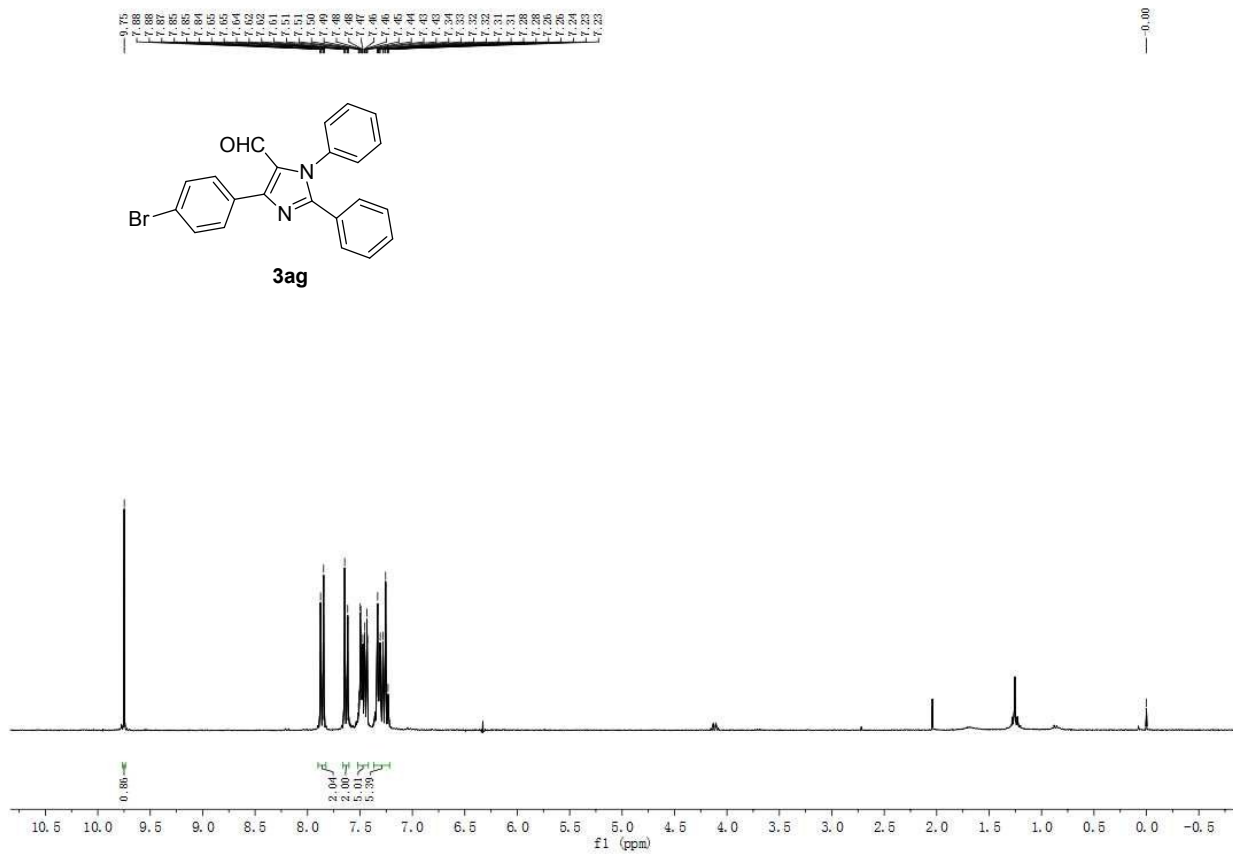


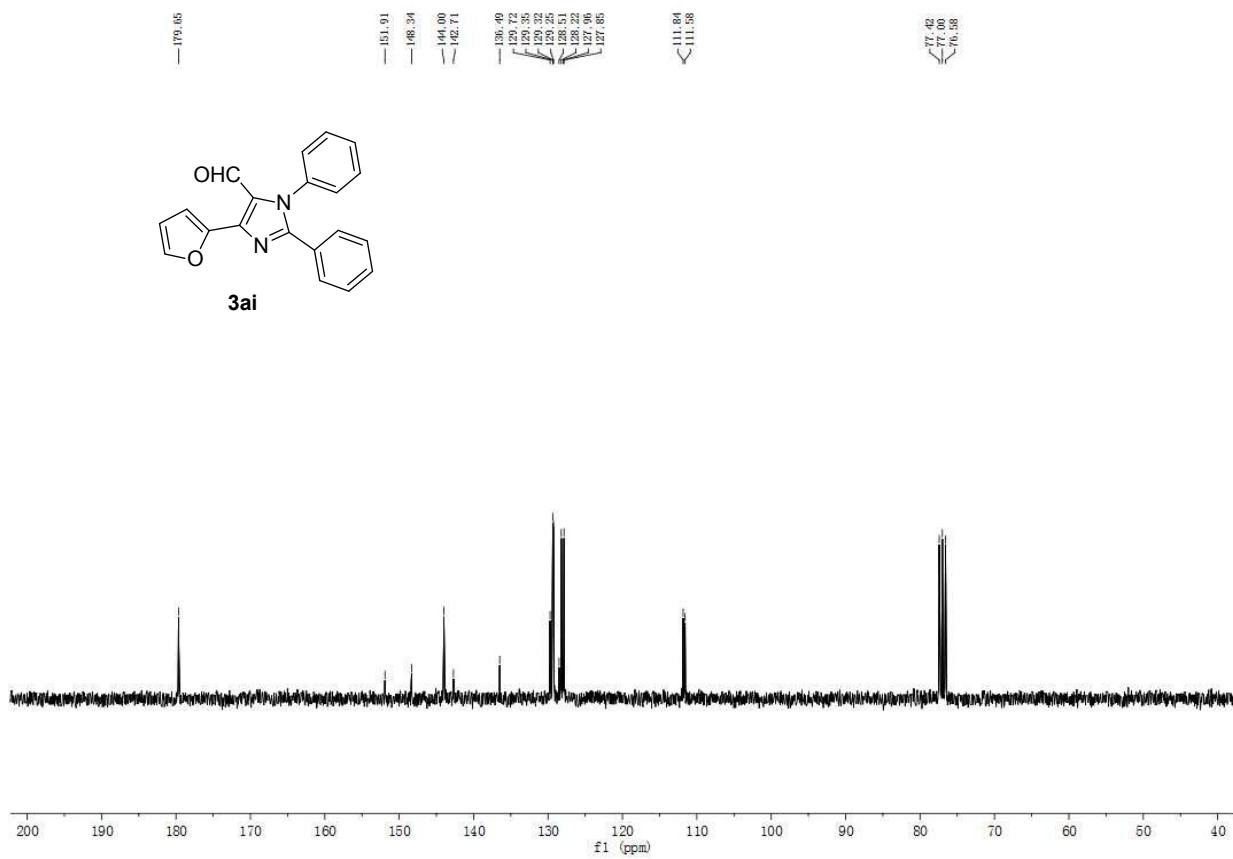
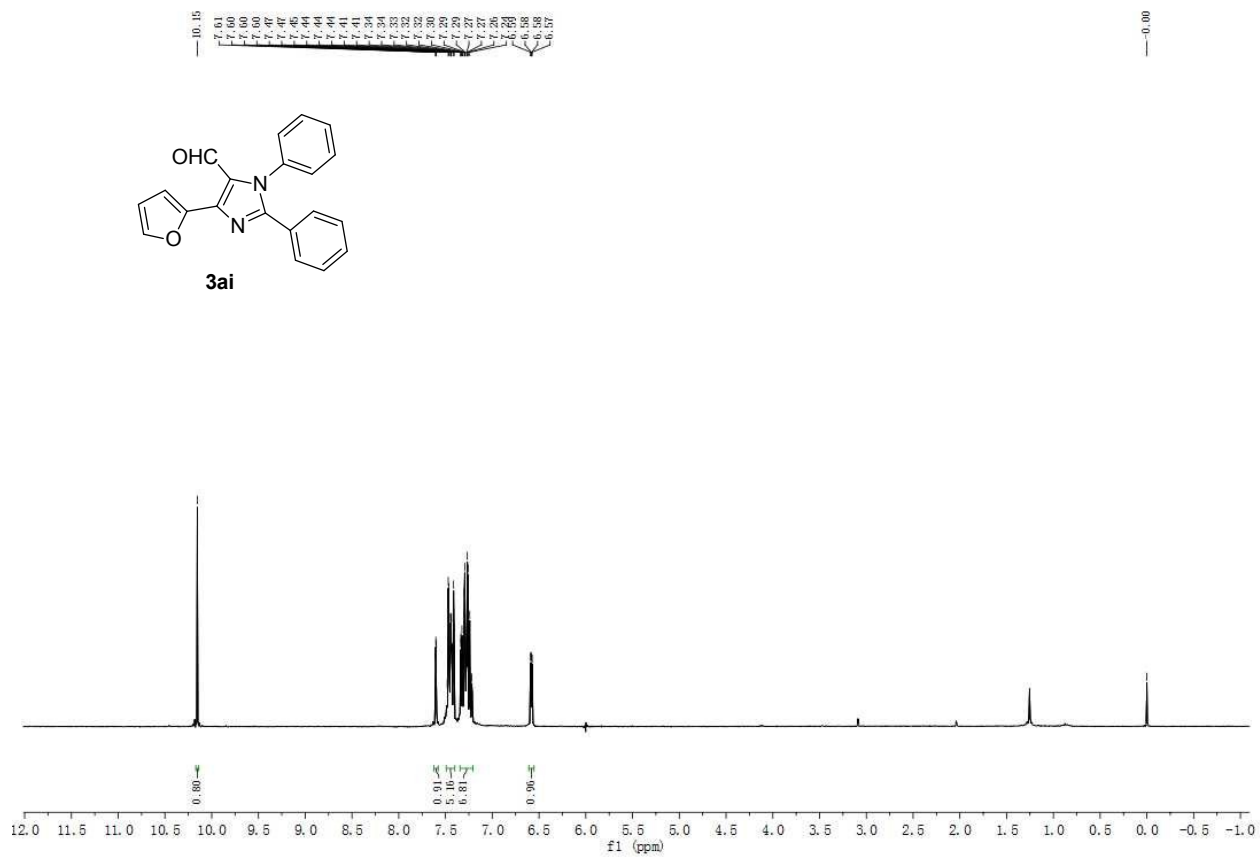


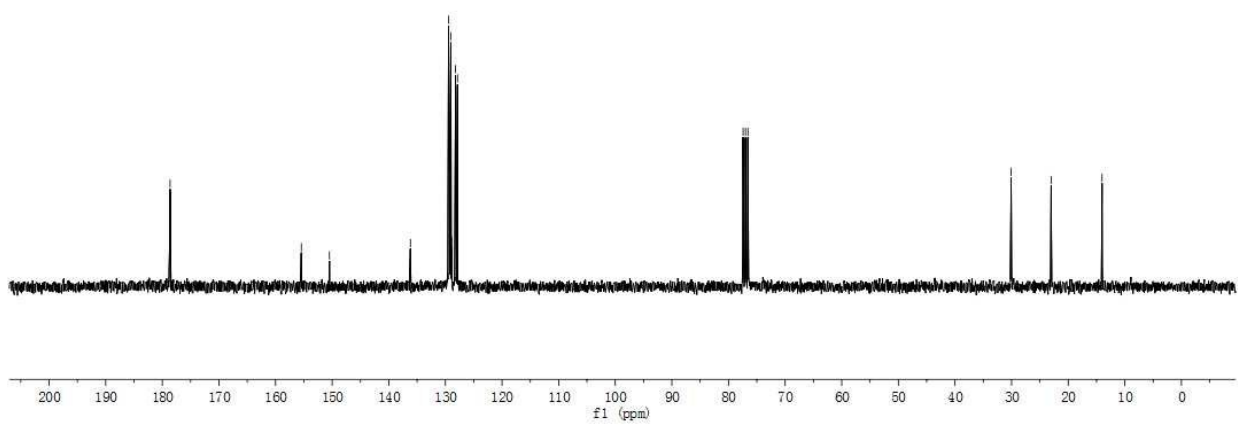
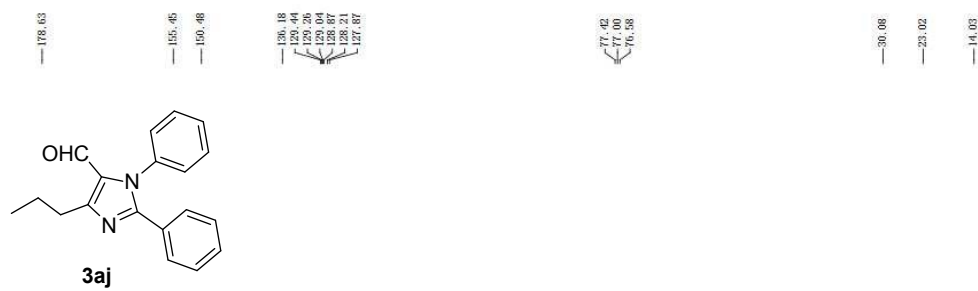
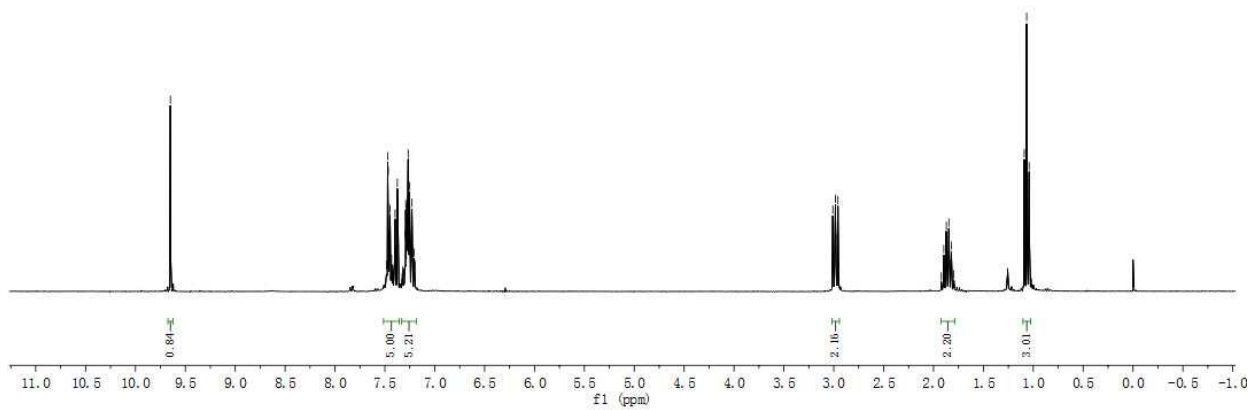
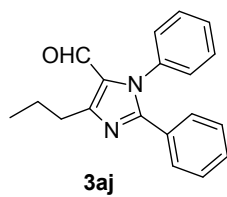






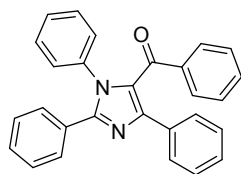




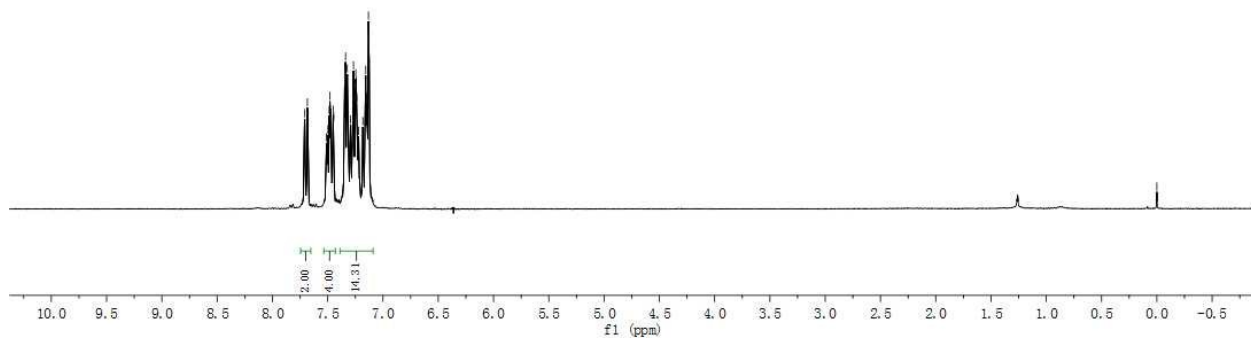


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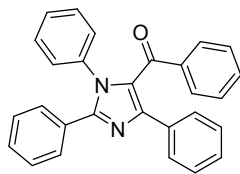
3ak



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3ak

