Supporting Information

Heterogeneous Recyclable Nano-Palladium Catalyzed Amidation of Esters Using Formamides as Amine Sources

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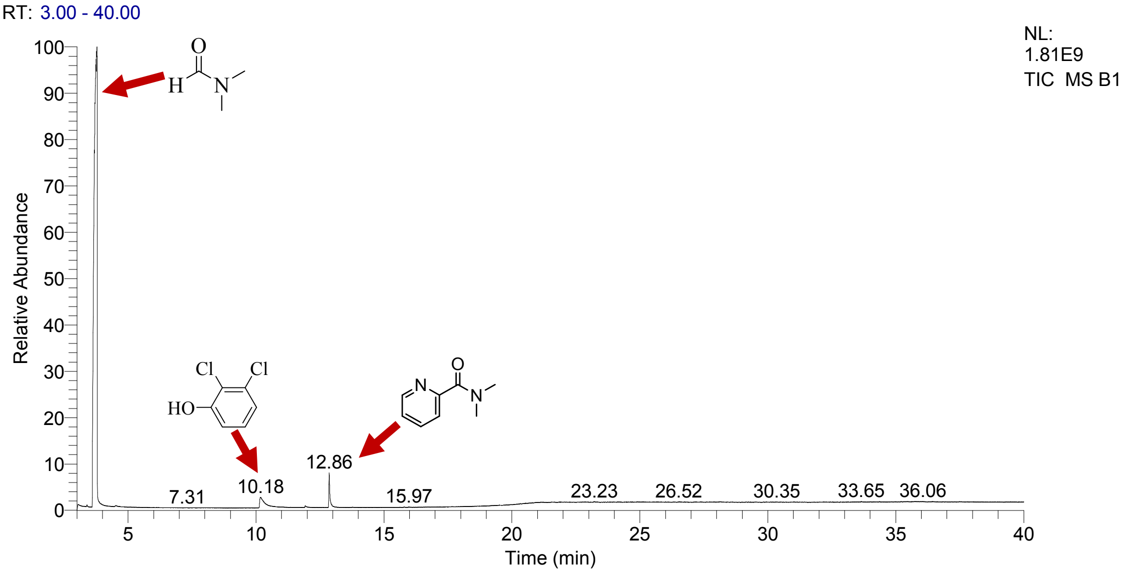
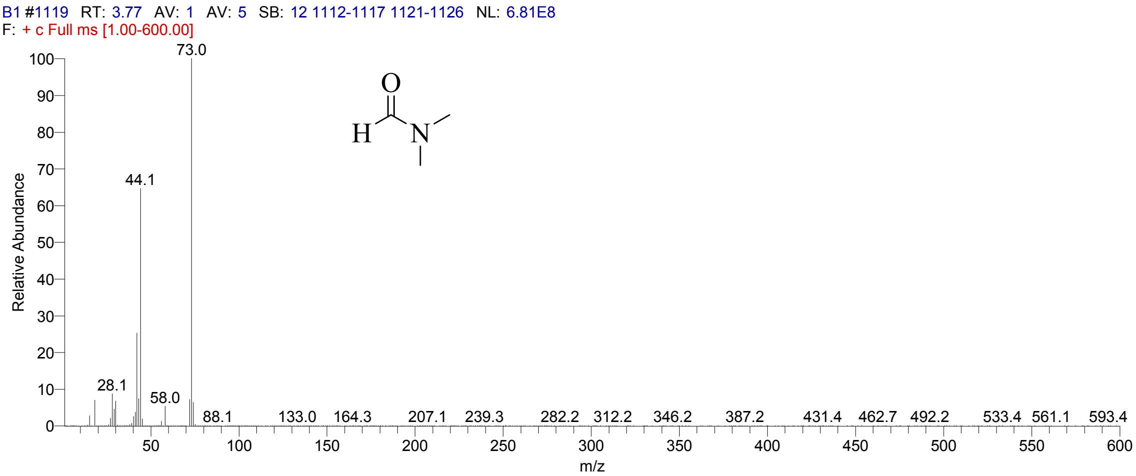
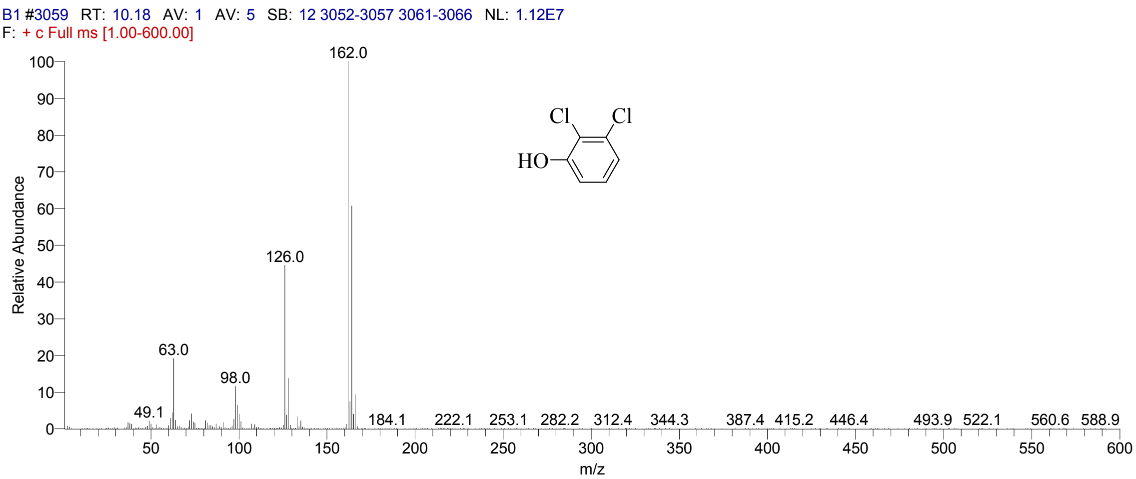
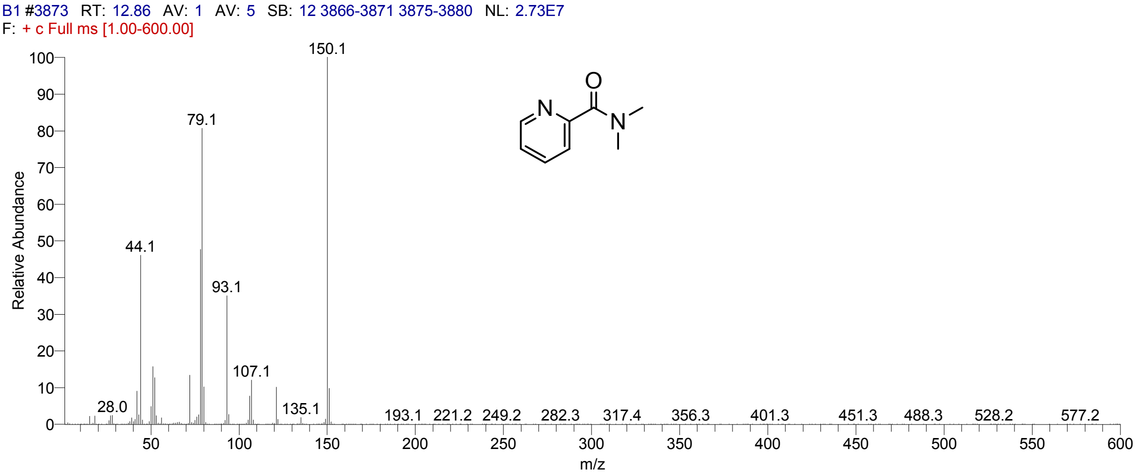
1. GCMS Analysis of Reaction of 1a with DMF 2a









2. Characterization Data for the Products

N, N-dimethylpicolinamide **3aa.** [1] Yield: 90% (27.0 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.60 (s, 1H), 7.82 (td, J = 7.7, 1.6 Hz, 1H), 7.64 (d, J = 7.6 Hz, 1H), 7.40 – 7.33 (m, 1H), 3.15 (s, 3H), 3.08 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 168.9, 154.2, 148.1, 137.3, 124.5, 123.7, 39.0, 35.8.

N, N-dimethylpyrazine-2-carboxamide **3ja.** [2] Yield: 87% (26.3 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.95 (d, J = 1.3 Hz, 1H), 8.64 (d, J = 2.5 Hz, 1H), 8.55 (dd, J = 2.4, 1.6 Hz, 1H), 3.17 (s, 3H), 3.13 (s, 3H).

N, N-dimethylfuran-2-carboxamide **3ka.** [3] Yield: 90% (25.0 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.49 (d, J = 0.9 Hz, 1H), 7.01 (d, J = 3.4 Hz, 1H), 6.47 (dd, J = 3.4, 1.7 Hz, 1H), 3.29 (s, 3H), 3.10 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.5, 147.9, 143.9, 116.4, 111.2, 38.4, 36.6.

N, N-dimethylthiophene-2-carboxamide **3la.** [4] Yield: 91% (28.2 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.42 (dd, J = 5.0, 1.0 Hz, 1H), 7.34 (dd, J = 3.7, 1.0 Hz, 1H), 7.02 (dd, J = 5.0, 3.7 Hz, 1H), 3.16 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 164.5, 137.8, 129.2, 128.8, 126.7, 39.5, 36.6.

2-(*1H*-indol-2-yl)-*N,N*-dimethylacetamide **3ma.**[5] Yield: 83% (33.5 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.64 (d, J = 7.9 Hz, 1H), 7.35 (d, J = 8.1 Hz, 1H), 7.20 (t, J = 7.1 Hz, 1H), 7.13 (d, J = 7.1 Hz, 1H), 7.11 – 7.08 (m, 1H), 3.83 (s, 2H), 3.03 (s, 3H), 2.98 (s, 3H).

N, N-dimethylbenzamide **3na.** [6] Yield: 85% (25.3 mg).^{1}H NMR (500 MHz, $CDCl_3$) δ 7.54 – 7.32 (m, 5H), 3.10 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 136.1, 129.6, 128.3, 127.0, 39.6, 35.4.

4-cyano-N, N-dimethylbenzamide **3oa.** [6] Yield: 92% (32.0 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.81 – 7.67 (m, 2H), 7.63 – 7.46 (m, 2H), 3.13 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.6, 140.6, 132.4, 127.8, 118.1, 113.4, 39.4, 35.4.

4-bromo-N, N-dimethylbenzamide **3pa.** [6] Yield: 88% (39.9 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.63 – 7.45 (m, 2H), 7.31 – 7.27 (m, 2H), 3.09 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.6, 135.1, 131.6, 128.8, 123.8, 39.6, 35.4.

N, N-dimethyl-4-(trifluoromethyl)benzamide **3qa.**[4] Yield: 87% (37.8 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.67 (d, J = 8.1 Hz, 2H), 7.52 (d, J = 8.1 Hz, 2H), 3.13 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.2, 139.8, 131.5 (q, $J_{C\text{-}F}$ = 32.6 Hz), 127.4, 125.5 (q, $J_{C\text{-}F}$ = 3.8 Hz), 123.7 (q, $J_{C\text{-}F}$ = 272.5 Hz), 39.4, 35.3.

piperidin-1-yl(pyridin-2-yl)methanone **3bb.**[7] Yield: 79% (30.0 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.59 (s, 1H), 7.82 (t, *J* = 7.4 Hz, 1H), 7.69 (d, *J* = 7.3 Hz, 1H), 7.36 (s, 1H), 3.88 – 3.76 (m, 4H), 3.76 – 3.61 (m, 6H).

morpholino(pyridin-2-yl)methanone **3bc.**[8] Yield: 81% (31.1 mg).^{1}H NMR (500 MHz, $CDCl_3$) δ 8.60 (d, *J* = 3.7 Hz, 1H), 7.84 (t, *J* = 7.7 Hz, 1H), 7.70 (d, *J* = 7.7 Hz, 1H), 7.45 – 7.33 (m, 1H), 3.91 – 3.76 (m, 4H), 3.76 – 3.59 (m, 4H).

N-methylpicolinamide **3bd.**[9] Yield: 91% (24.9 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.53 (d, *J* = 4.5 Hz, 1H), 8.18 (d, *J* = 7.8 Hz, 1H), 8.09 (s, 1H), 7.89 – 7.66 (m, 1H), 7.41 (dd, *J* = 7.1, 5.1 Hz, 1H), 3.03 (d, *J* = 5.1 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 165.2, 149.8, 148.1, 137.4, 126.2, 122.1, 26.1.

N-phenylpicolinamide **3be.**[10] Yield: 74% (29.3 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 10.04 (s, 1H), 8.62 (d, *J* = 4.3 Hz, 1H), 8.31 (d, *J* = 7.8 Hz, 1H), 7.91 (t, *J* = 7.7 Hz, 1H), 7.79 (d, *J* = 8.0 Hz, 2H), 7.55 – 7.45 (m, 1H), 7.39 (t, *J* = 7.8 Hz, 2H), 7.15 (t, *J* = 7.4 Hz, 1H).

4-cyano-*N*-methylbenzamide **3od.**[11] Yield: 89% (28.5 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.2 Hz, 2H), 7.74 (d, *J* = 8.2 Hz, 2H), 6.34 (s, 1H), 3.04 (d, *J* = 4.8 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 166.4, 138.5, 132.5(2C), 127.6(2C), 118.0, 115.0, 27.1.

4-cyano-*N*-phenylbenzamide **3oe.**[12] Yield: 63% (28.0 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.98 (d, *J* = 8.2 Hz, 2H), 7.84 (s, 1H), 7.79 (d, *J* = 8.3 Hz, 2H), 7.63 (d, *J* = 7.9 Hz, 2H), 7.40 (t, *J* = 7.9 Hz, 2H), 7.20 (t, *J* = 7.4 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 163.9, 138.9, 137.3, 132.7, 129.3, 127.8, 125.3, 120.4, 117.9, 115.5.

4-cyano-*N, N*-diethylbenzamide **3of.**[13] Yield: 72% (29.1 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.3 Hz, 2H), 7.48 (d, *J* = 8.3 Hz, 2H), 3.56 (q, *J* = 6.9 Hz, 2H), 3.21 (q, *J* = 6.8 Hz, 2H), 1.29 – 1.24 (m, 3H), 1.12 (t, *J* = 5.9 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 169.4, 141.4, 132.4, 127.1, 118.2, 113.1, 43.3, 39.6, 14.2, 12.8.

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[11] R. H. Miller, O. Gisvold *Journal of the American Pharmaceutical Association* 1953, 42, 369.

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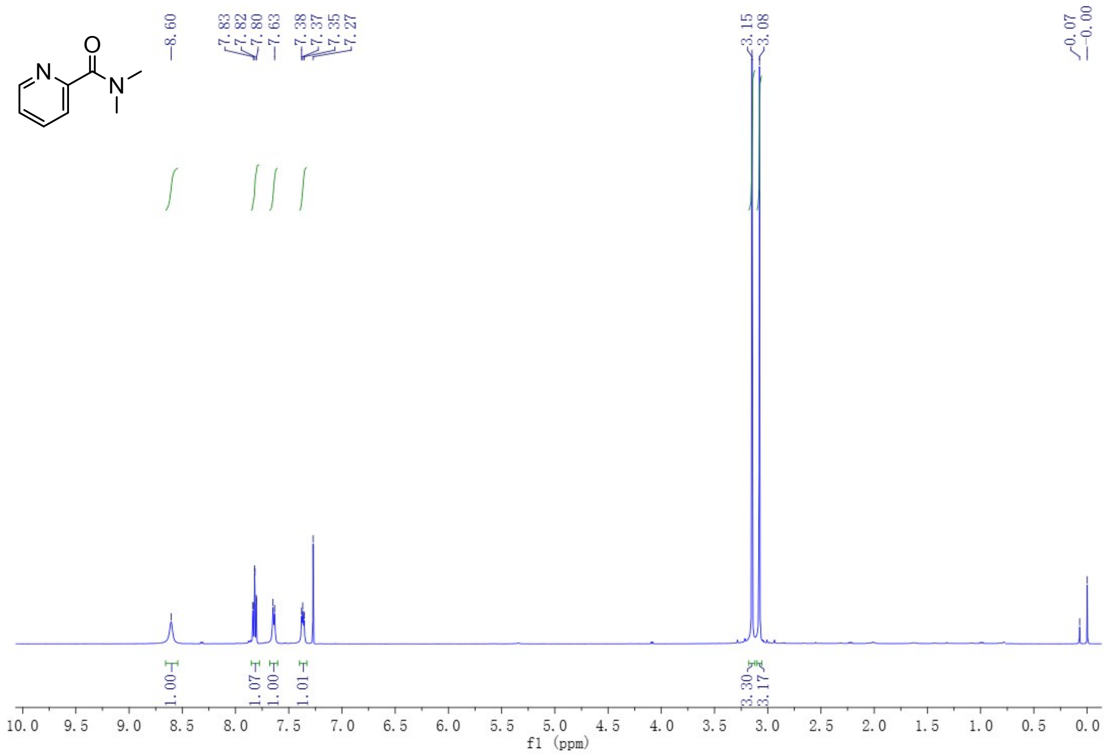
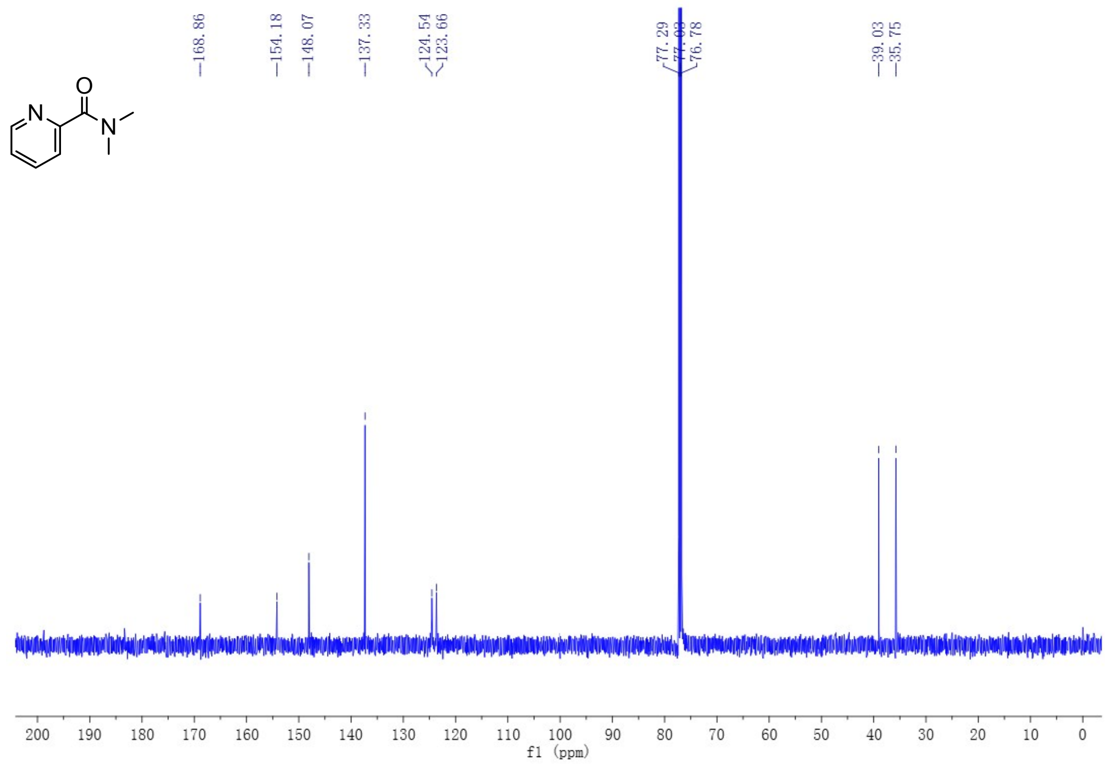
3. ^{1}H NMR and ^{13}C NMR Spectra of the Products

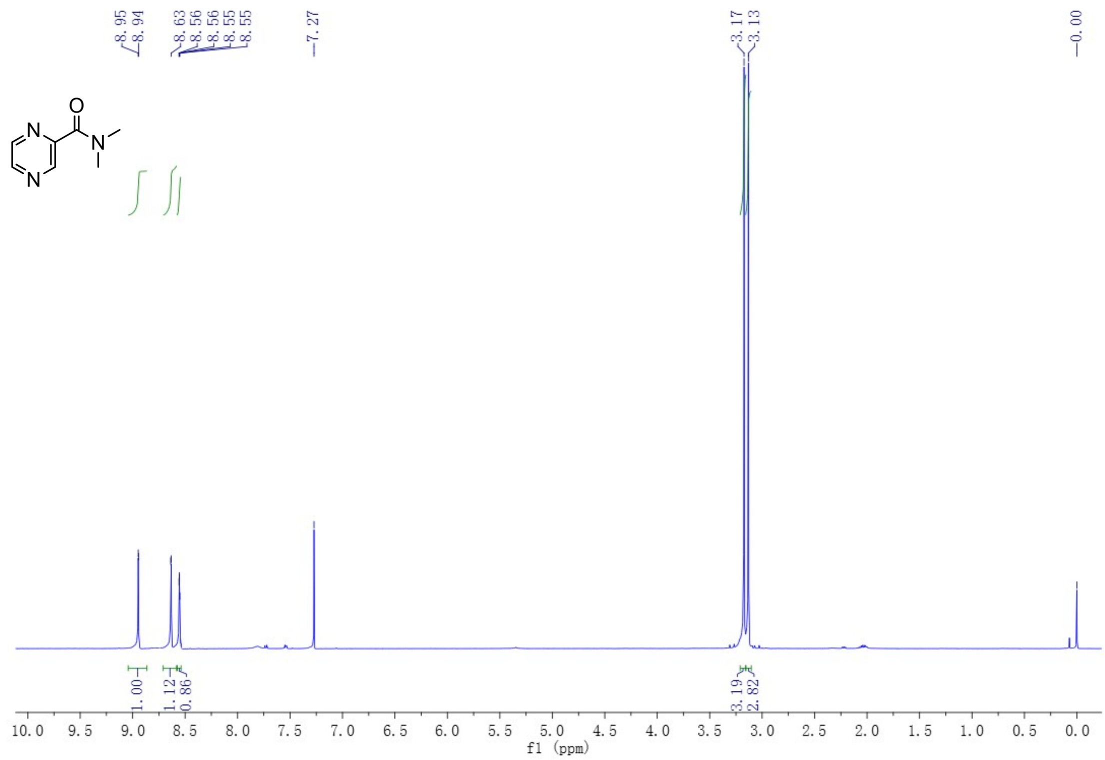
^{1}H NMR of *N, N-dimethylpicolinamide* **3aa**



^{13}C NMR of *N, N-dimethylpicolinamide* **3aa**



^{1}H NMR of *N, N-dimethylpyrazine-2-carboxamide* **3ja**



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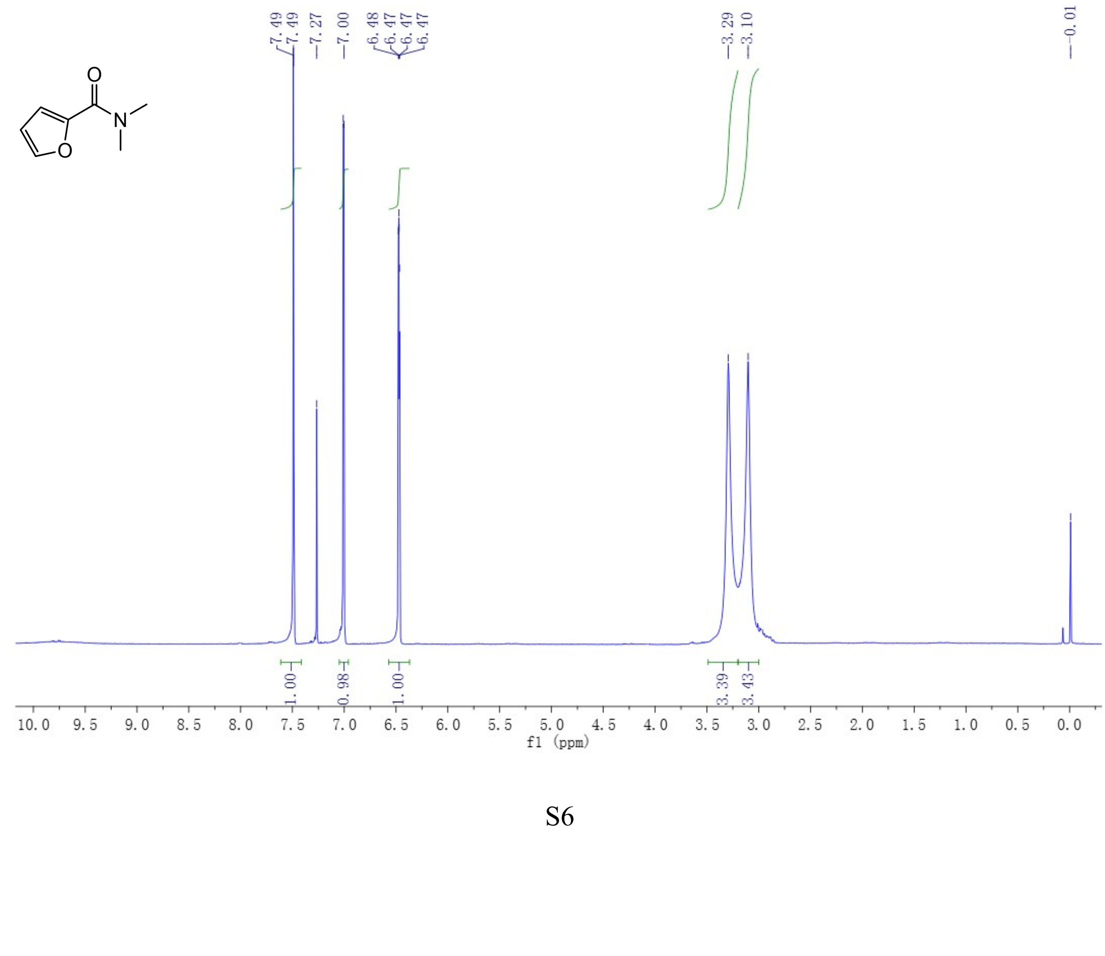
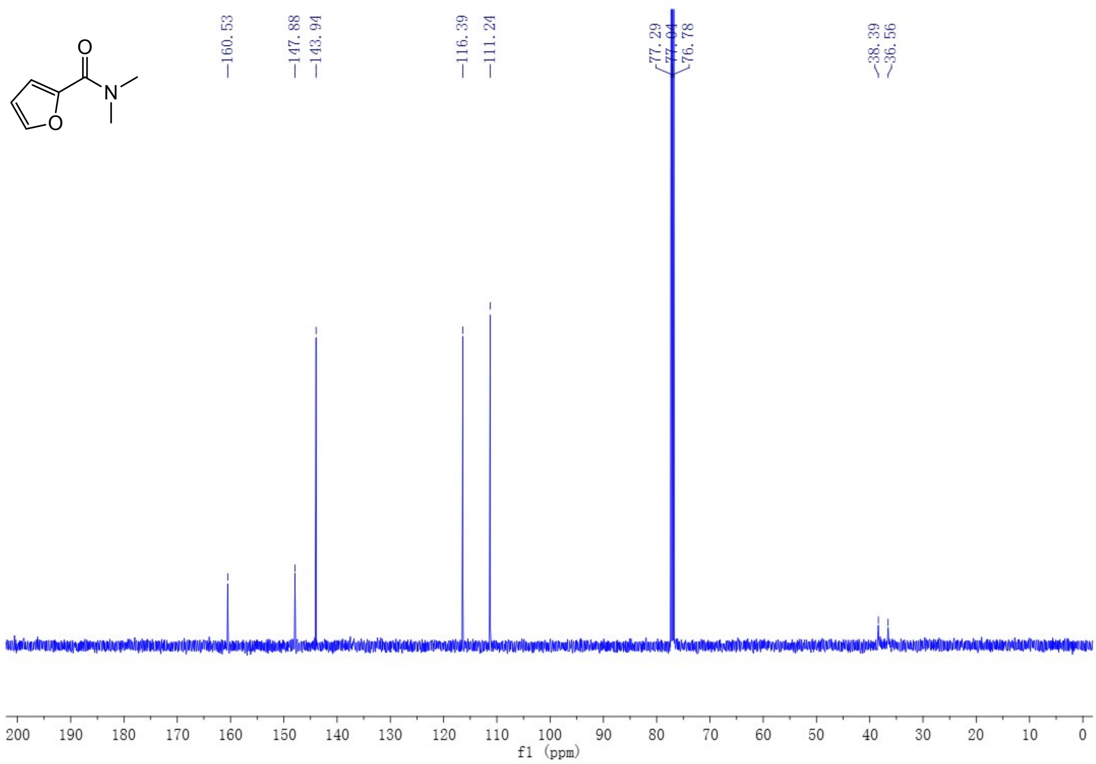
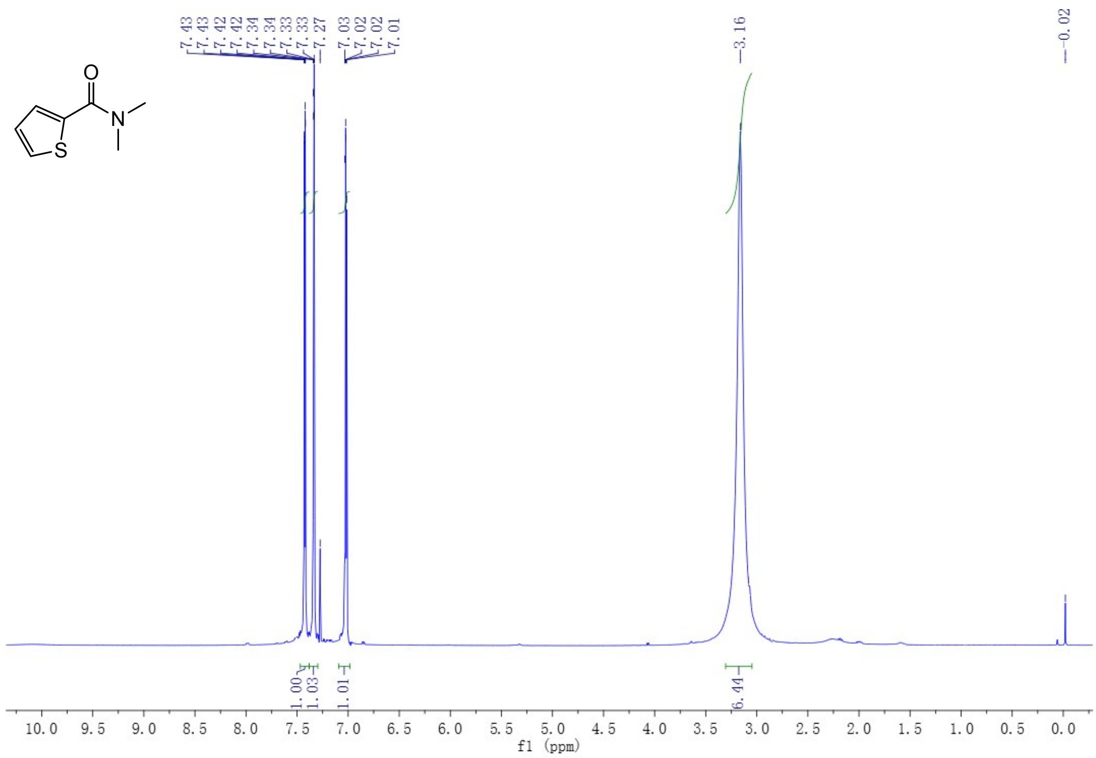


^{13}C NMR of *N, N-dimethylfuran-2-carboxamide* **3ka**



^{1}H NMR of *N, N-dimethylthiophene-2-carboxamide* **3la**



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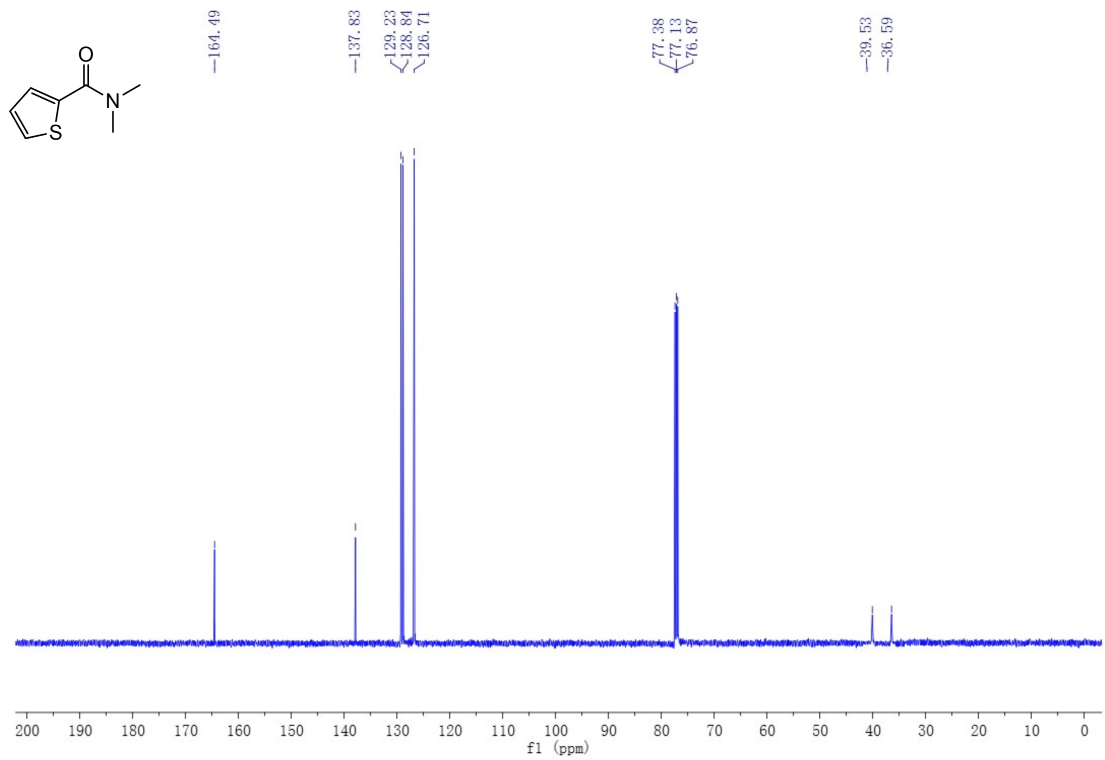
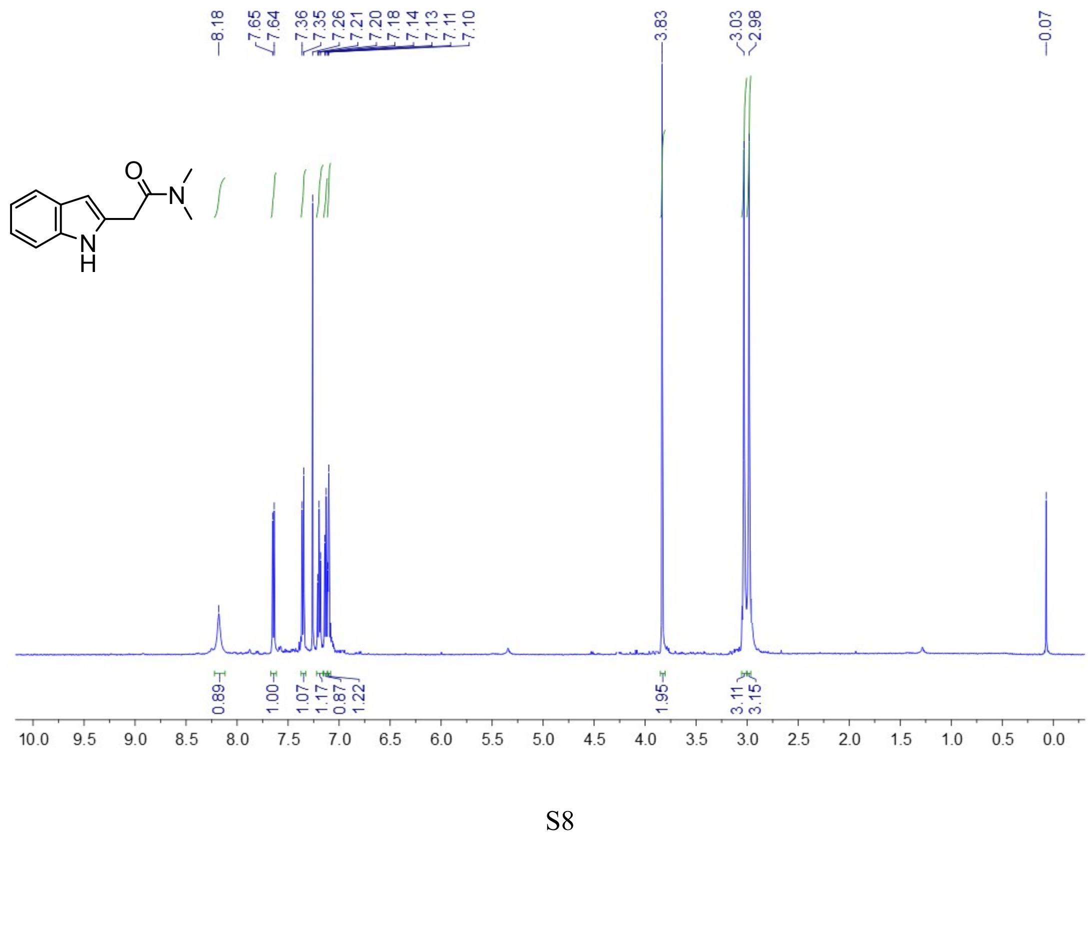
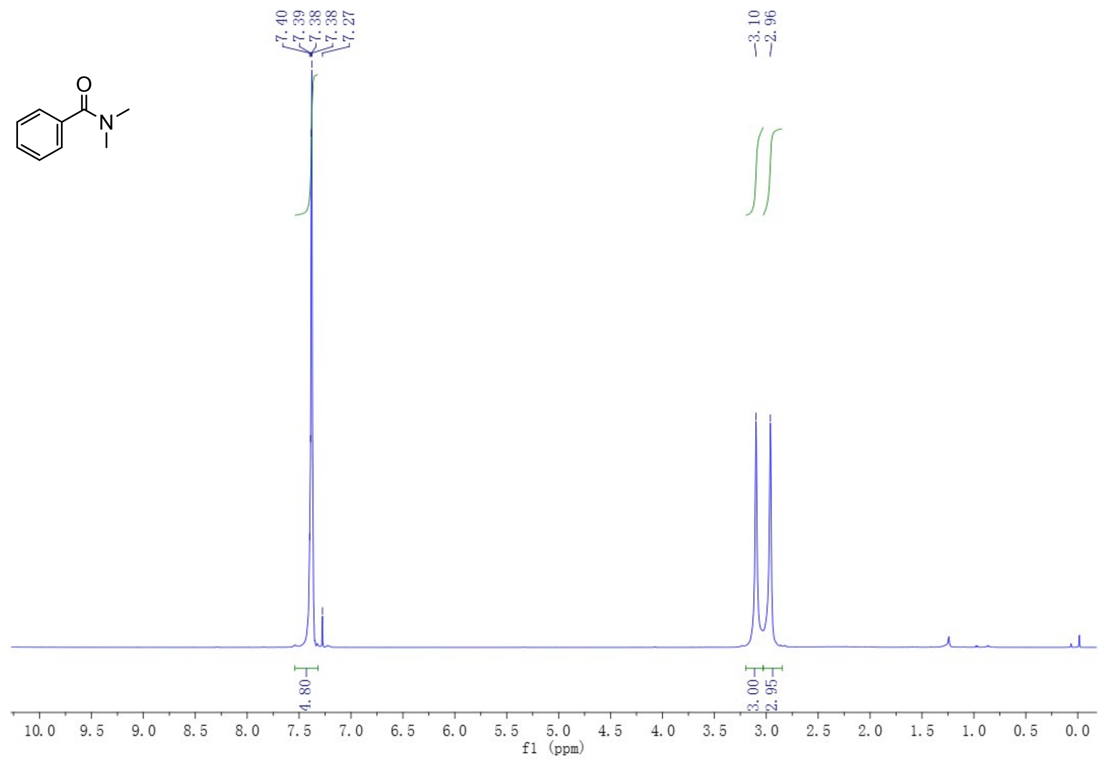


^{1}H NMR of 2-(*1H*-indol-2-yl)-*N, N*-dimethylacetamide **3ma**



[1]H NMR of *N,N-dimethylbenzamide* **3na**



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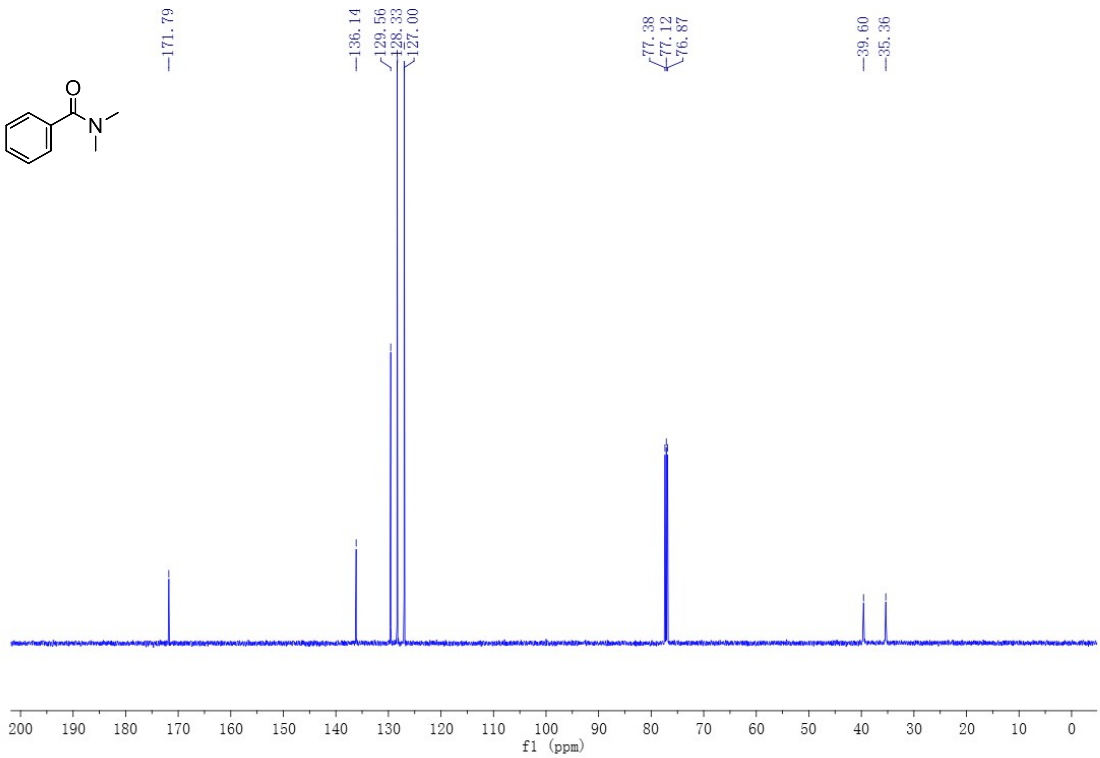
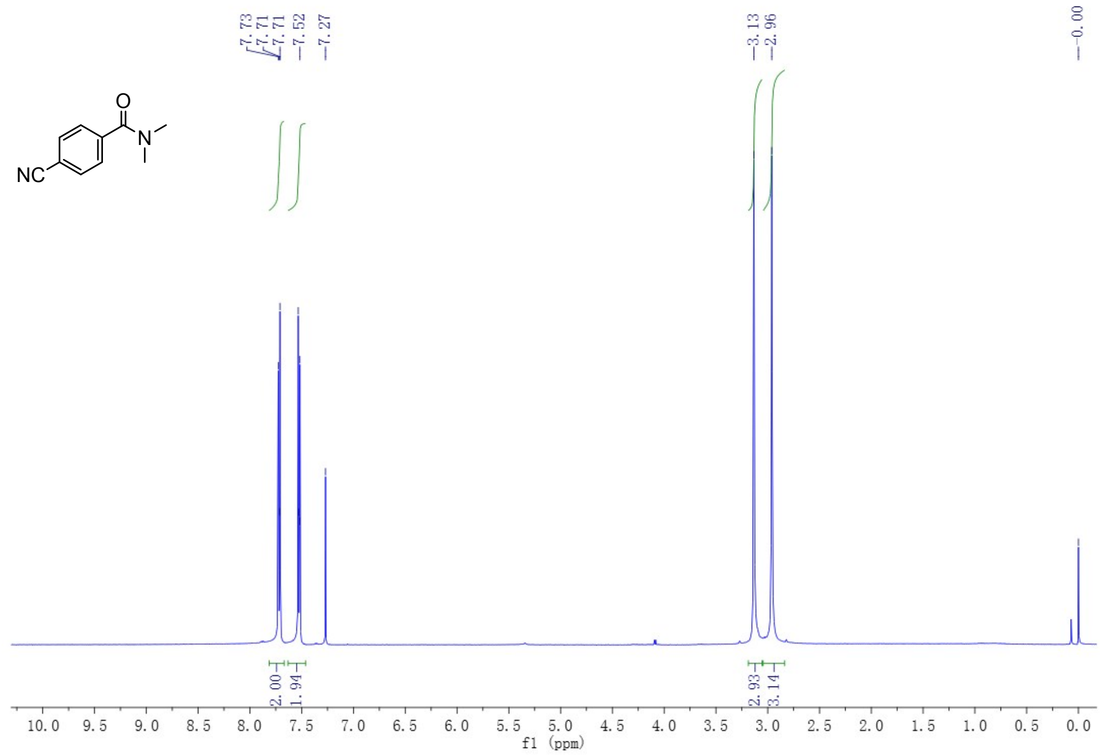


^{1}H NMR of *4-cyano-N, N-dimethylbenzamide* **3oa**



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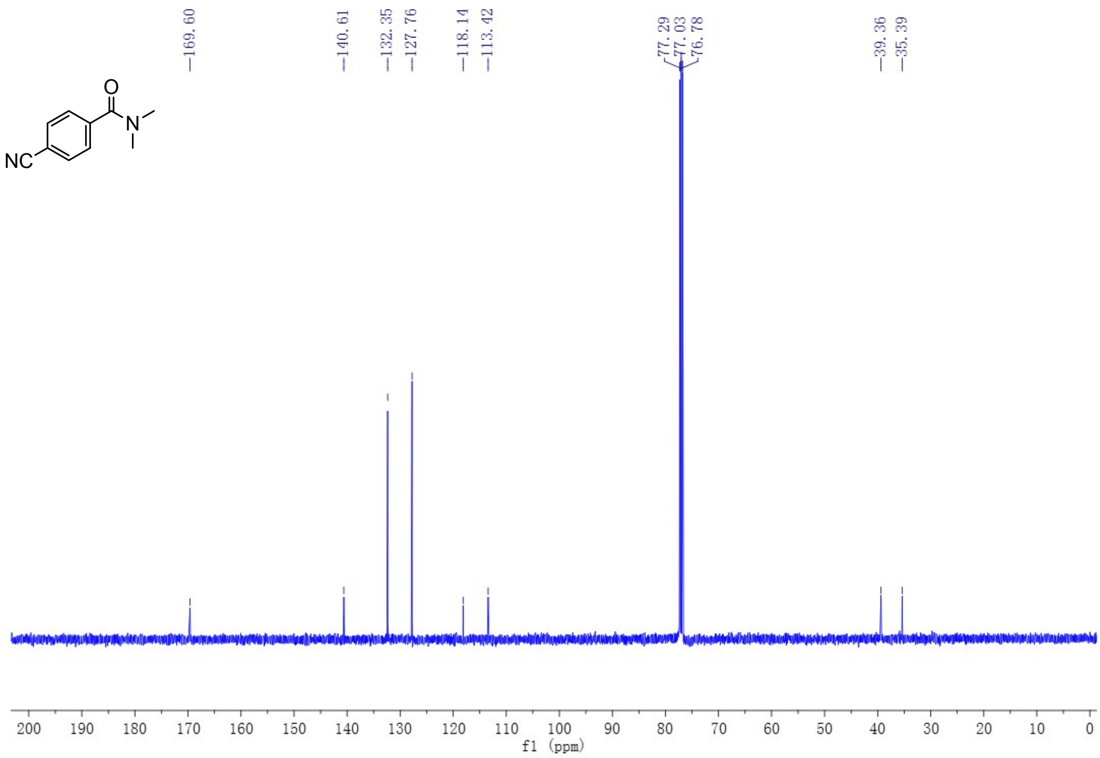
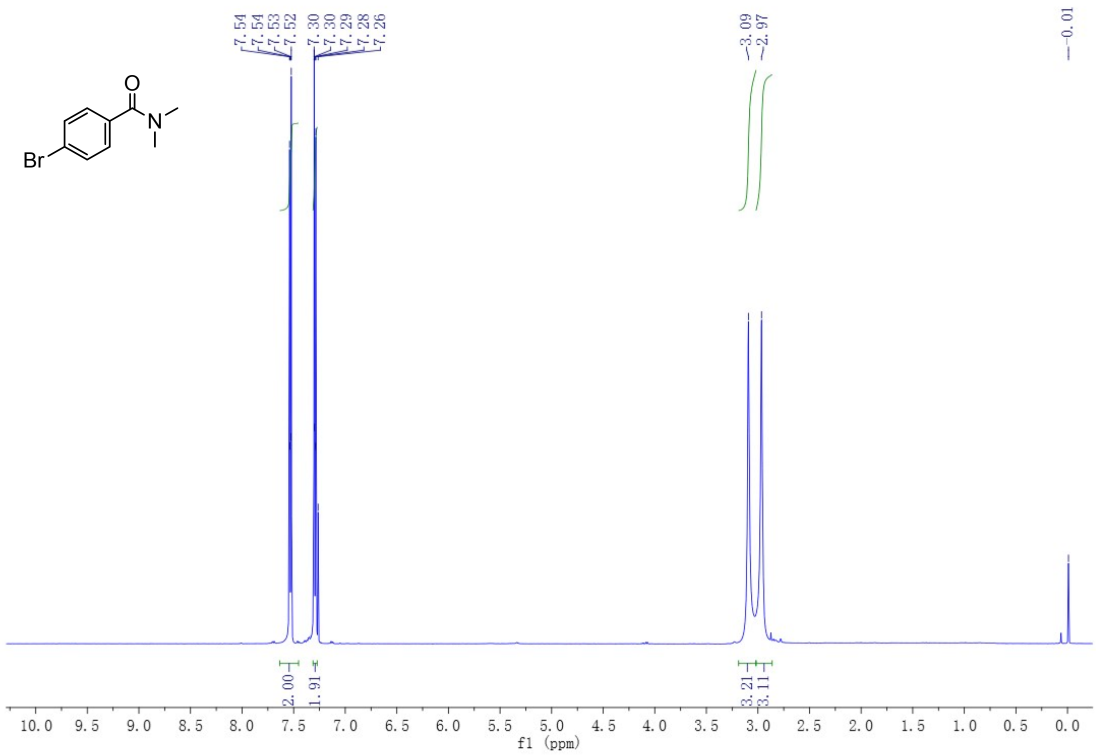


^{1}H NMR of *4-bromo-N,N-dimethylbenzamide* **3pa**



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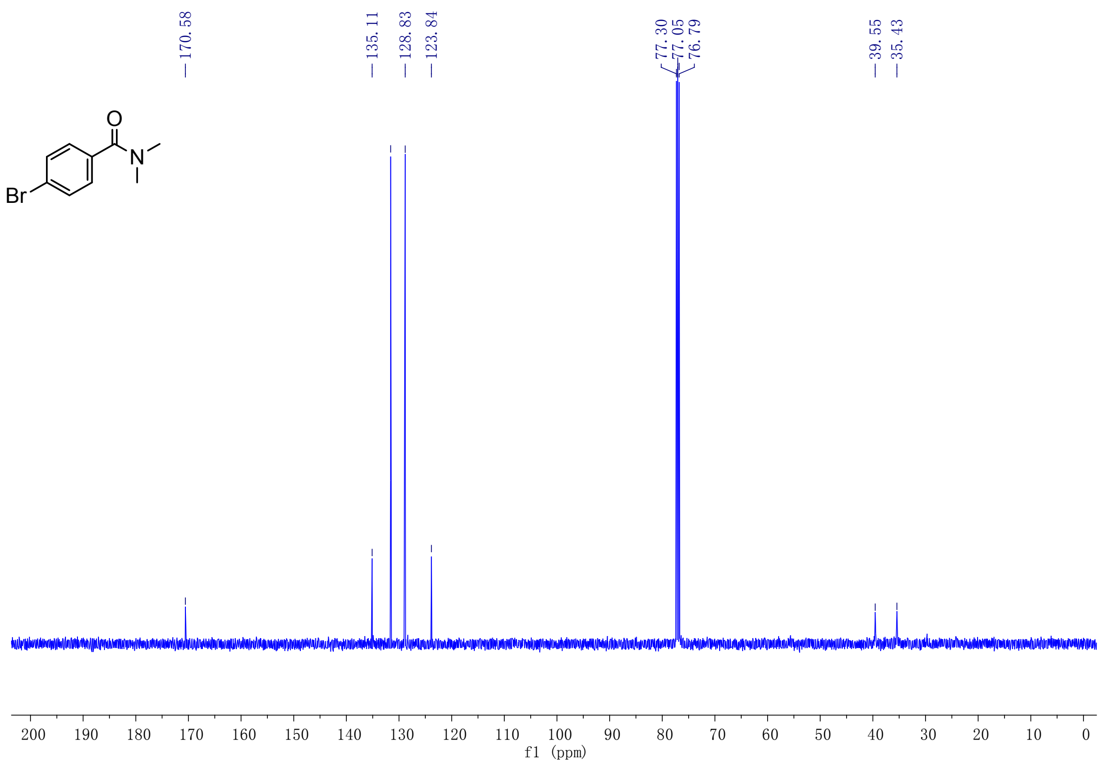
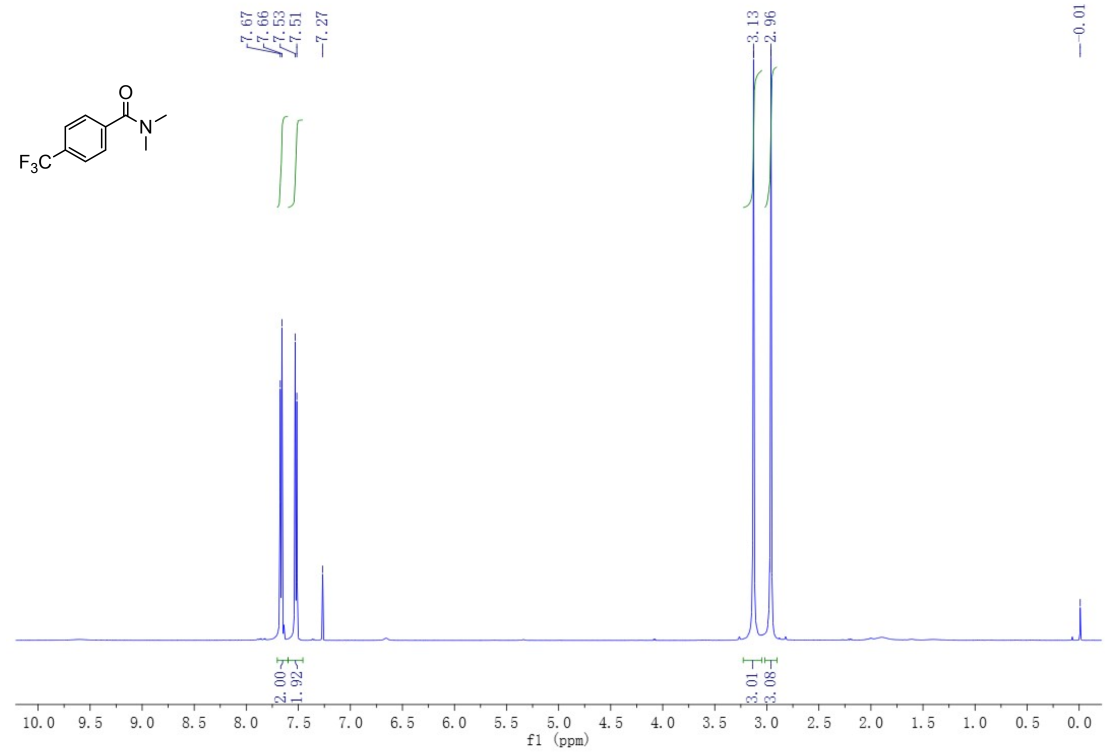
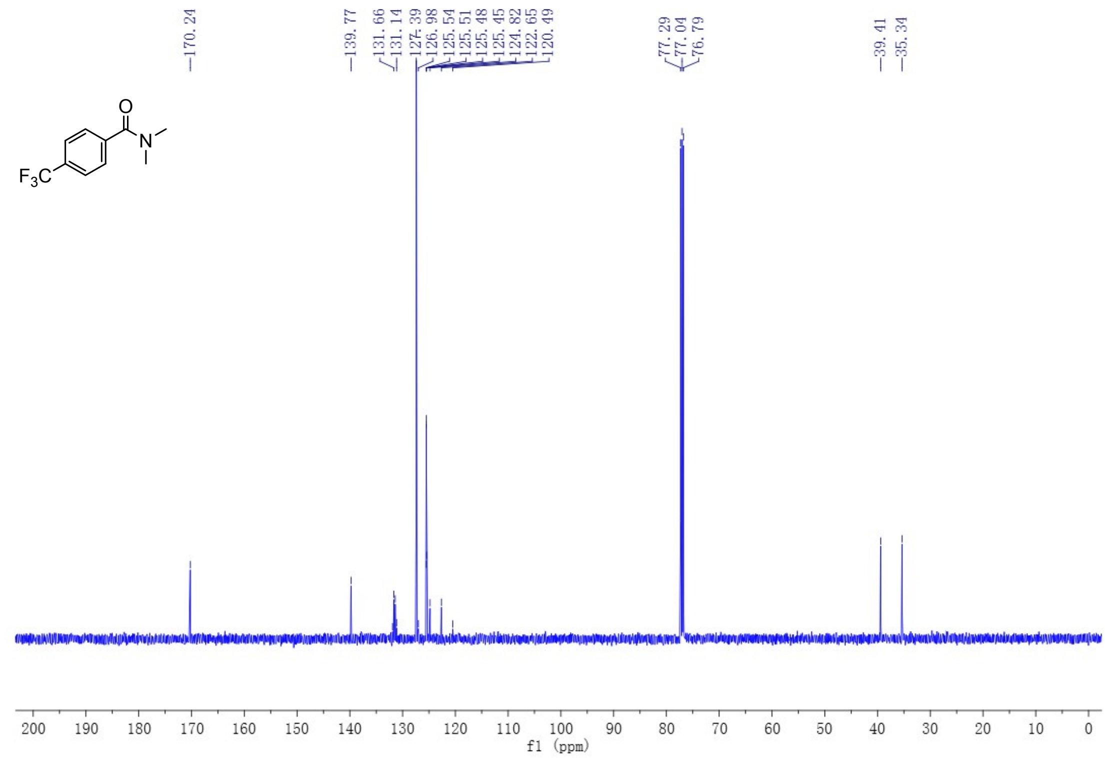


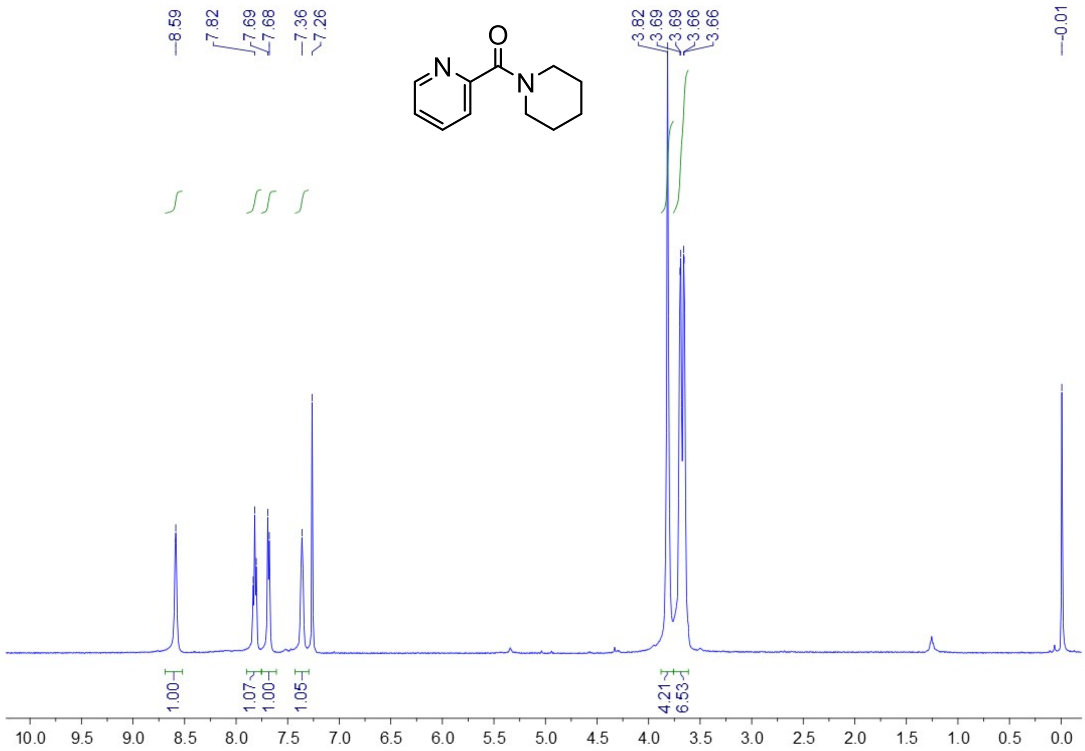
[1]H NMR of *N, N-dimethyl-4-(trifluoromethyl)benzamide* **3qa**



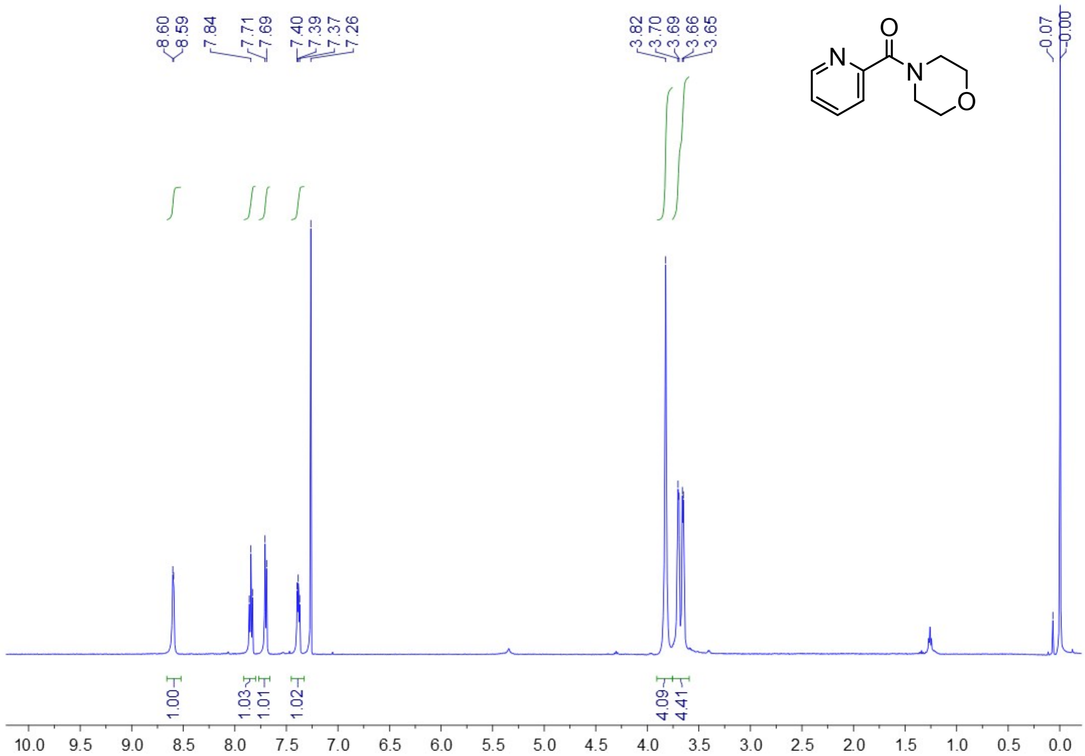
[13]C NMR of *N, N-dimethyl-4-(trifluoromethyl)benzamide* **3qa**



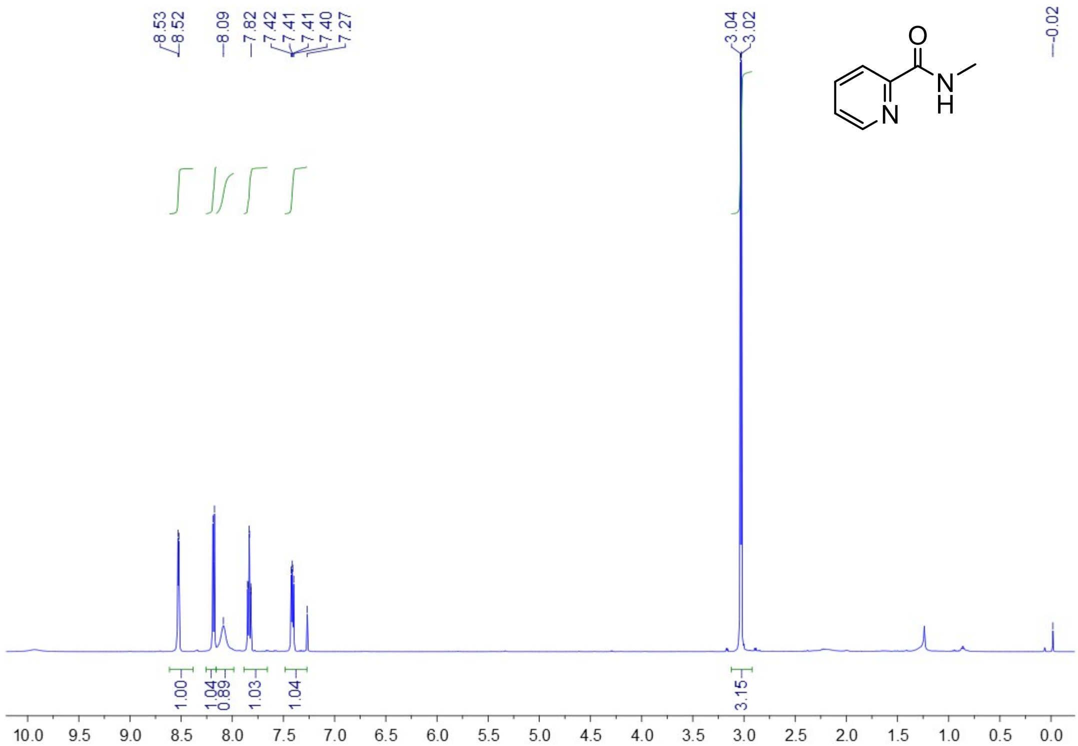
[1]H NMR of piperidin-1-yl(pyridin-2-yl)methanone **3bb**



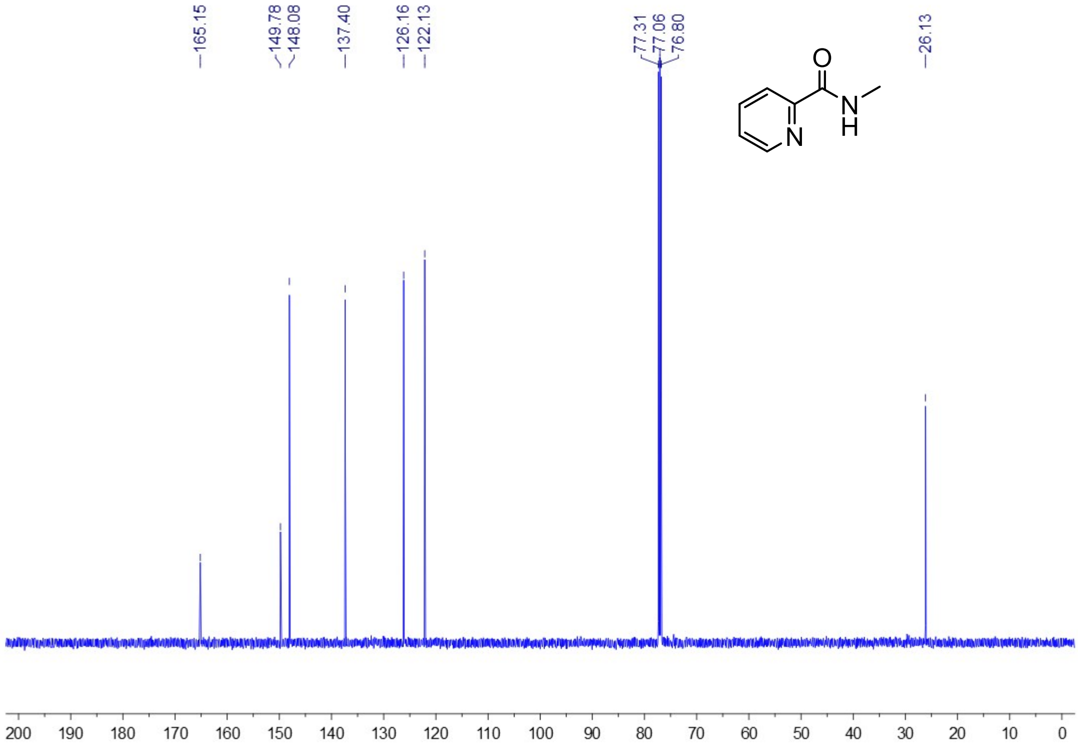
[1]H NMR of morpholino(pyridin-2-yl)methanone **3bc**



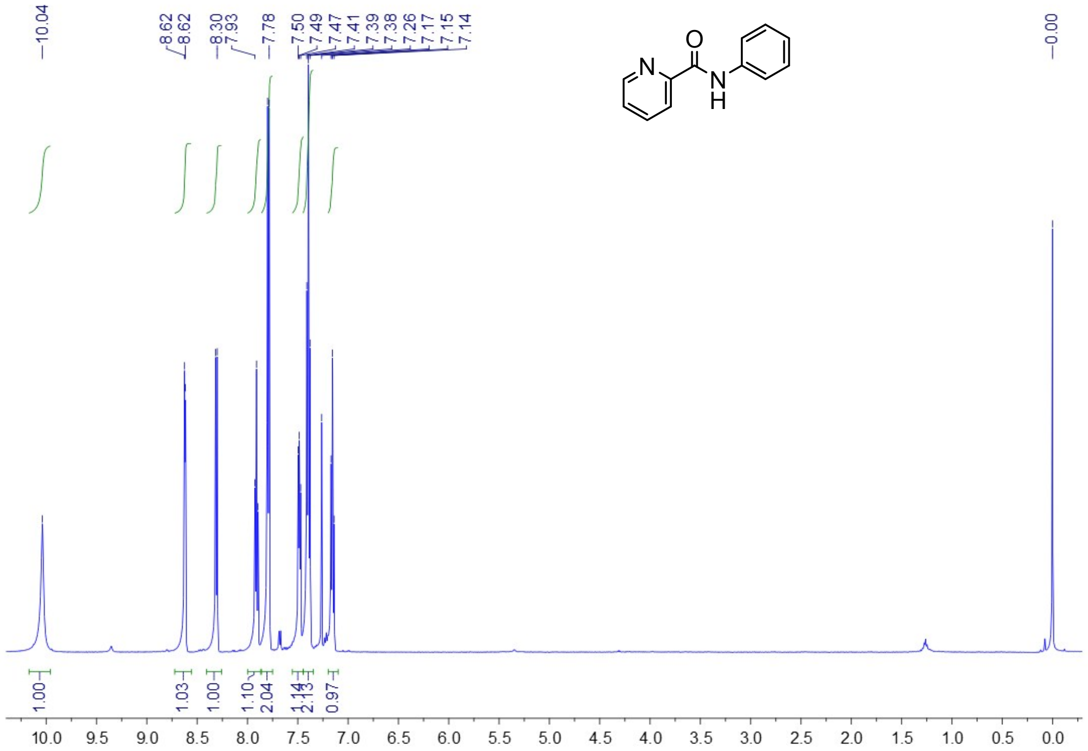
^{1}H NMR of *N*-methylpicolinamide **3bd**



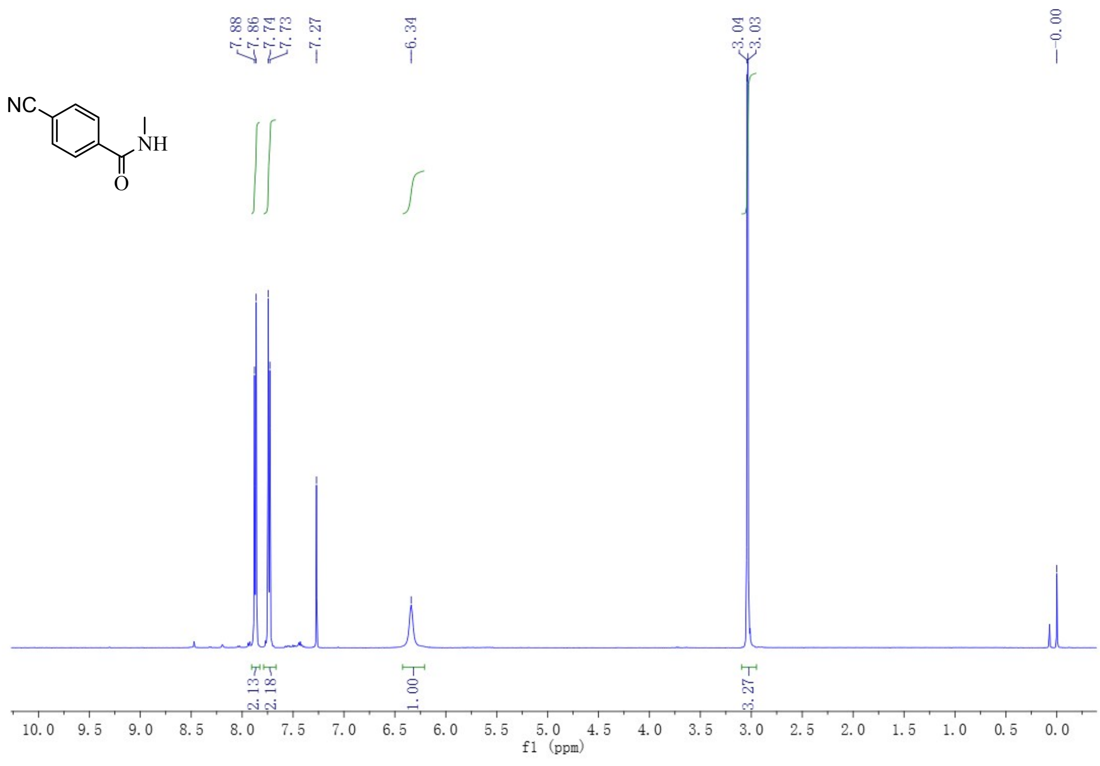
^{13}C NMR of *N*-methylpicolinamide **3bd**



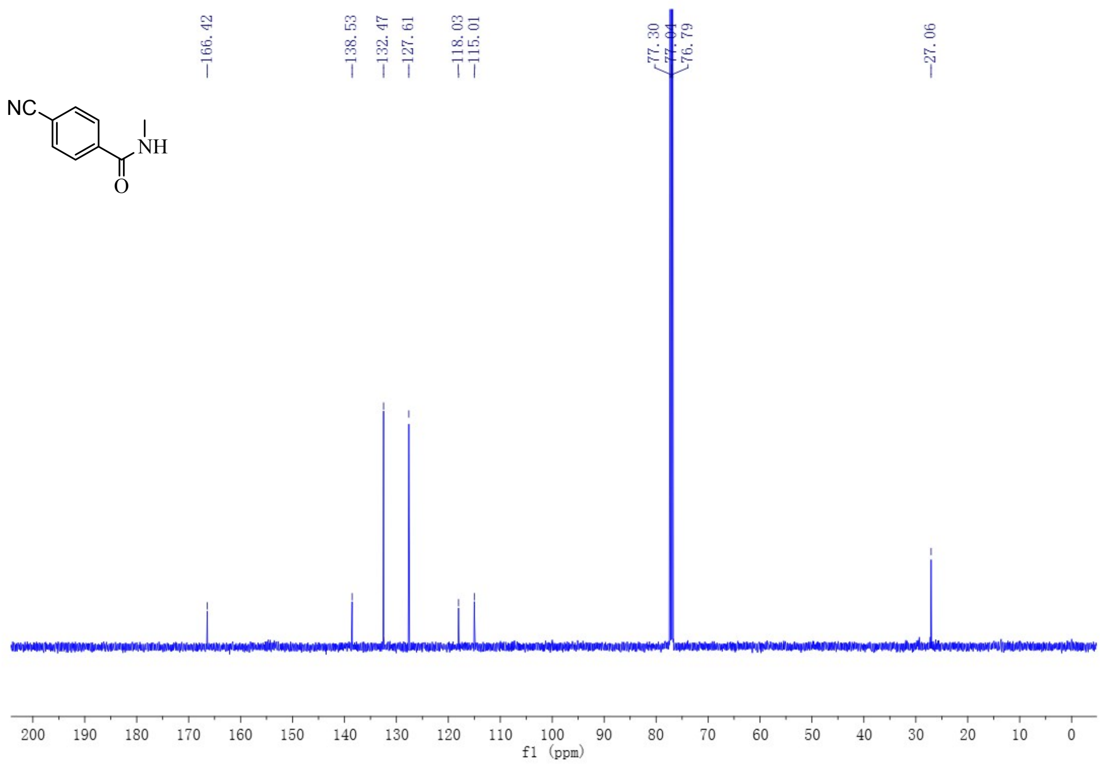
[1]H NMR of N-phenylpicolinamide **3be**



[1]H NMR of *4-cyano-N-methylbenzamide* **3nd**



^{13}C NMR of *4-cyano-N-methylbenzamide* **3nd**



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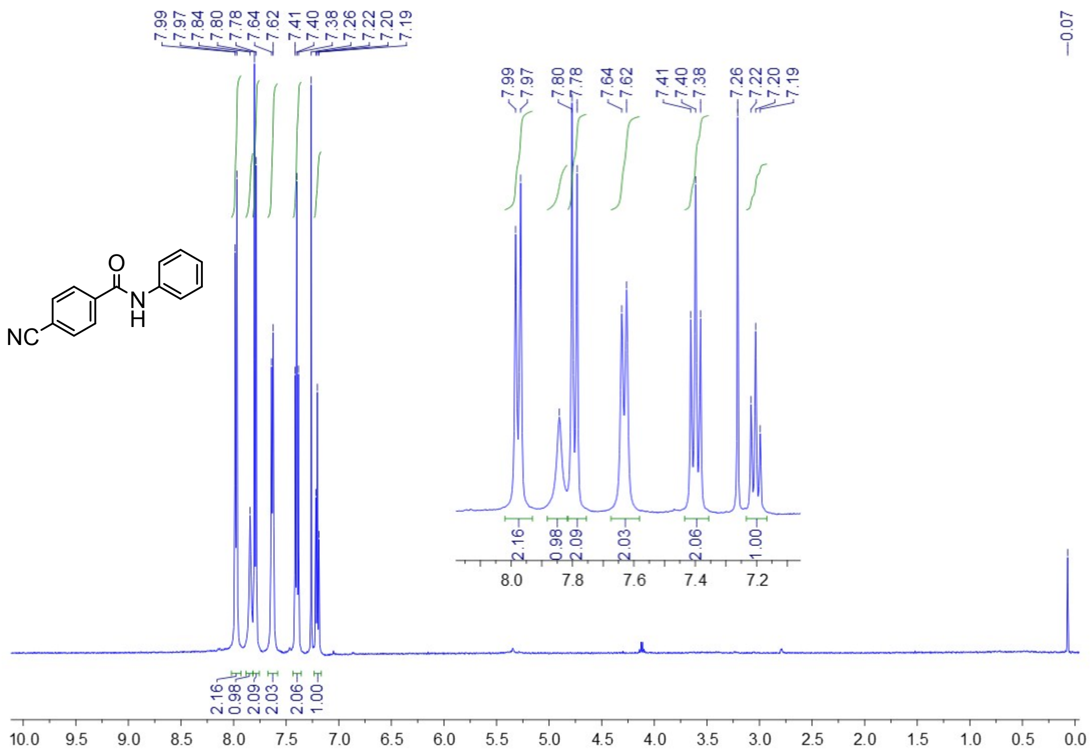
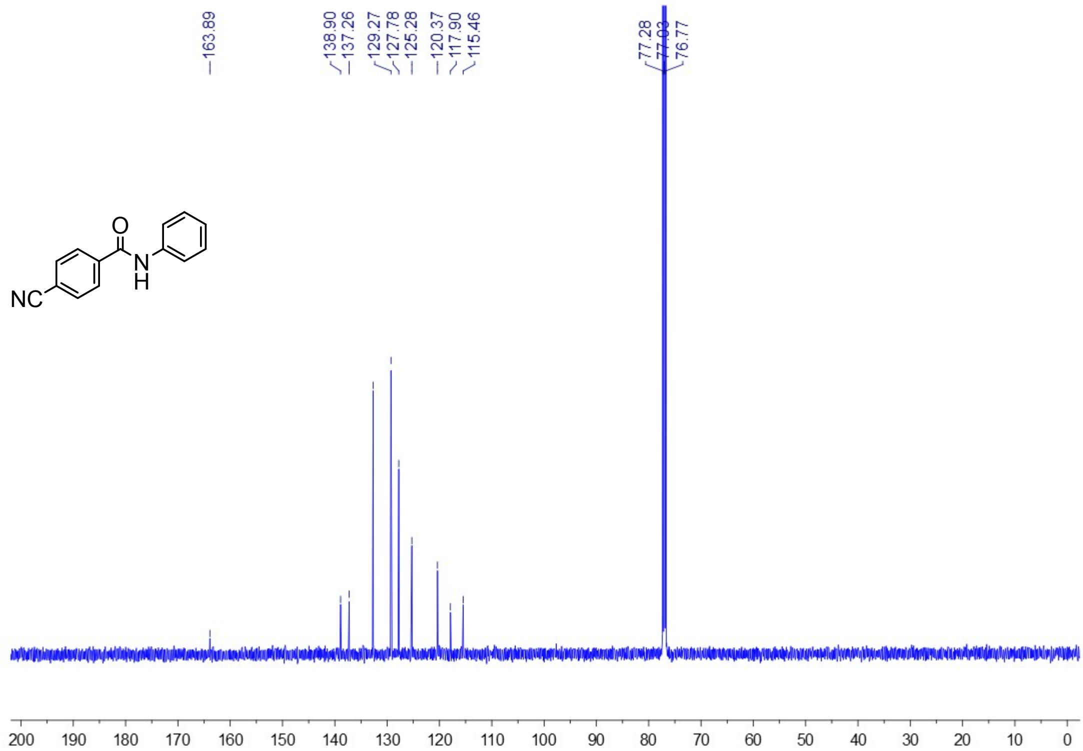
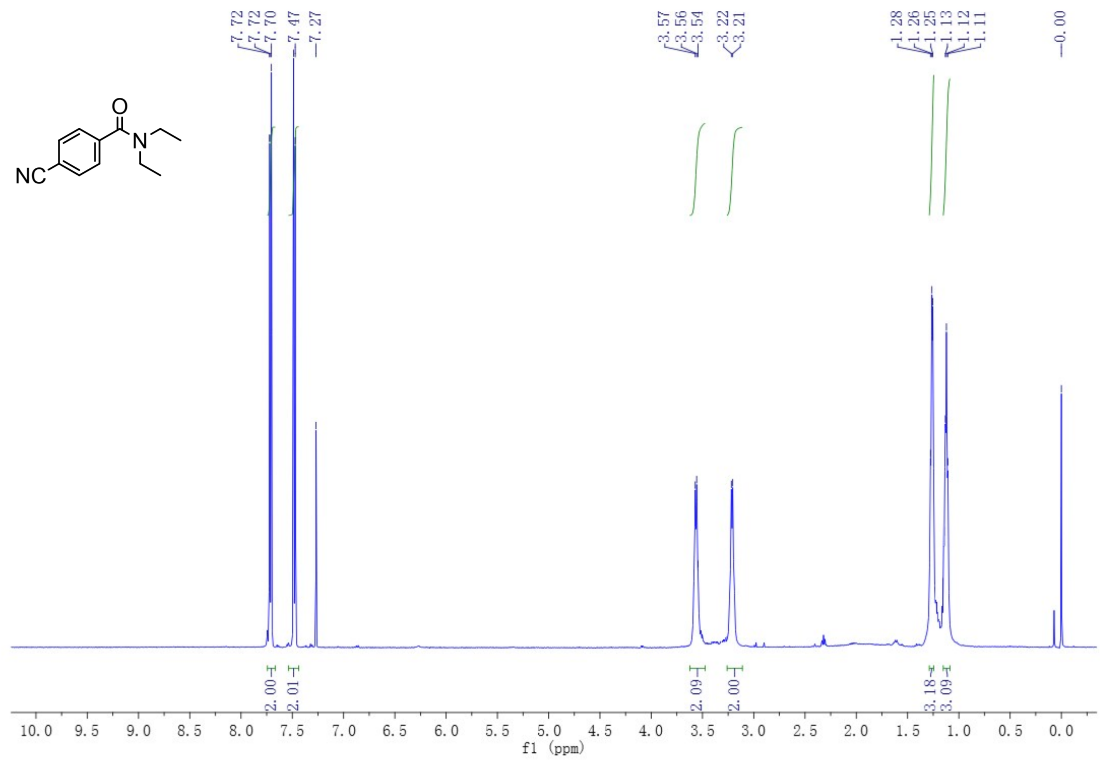


[13]C NMR of 4-cyano-N-phenylbenzamide **3ne**



[1]H NMR of *4-cyano-N,N-diethylbenzamide* **3nf**



^{13}C NMR of *4-cyano-N,N-diethylbenzamide* **3nf**