Supporting information for

Synthesis of 2,4-diarylsubstituted-pyridines through Ru-catalyzed four component reaction

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General information:

All experiments were carried out under an atmosphere of oxygen. Flash column chromatography was performed over silica gel 48-75 μm. 1H NMR and 13C NMR spectra were recorded on Bruker-AV (400 and 100 MHz, respectively) instrument internally referenced to SiMe₄ or chloroform signals. MS analyses were performed on an Agilent5975 GC-MS instrument (EI). The new compounds were characterized by 1H NMR, 13C NMR, MS, HRMS. Unless otherwise noted, all reagents were obtained from commercial suppliers and used without further purification. Ruthenium salts and acetophenones 1a, 1b, 1e, 1i, 1j, 1k, 1l, 1n, 1p were purchased from Aladdin, 1c, 1d, 1f, 1g, 1h, 1m, 1o, 1q, 1r were purchased from Accela. All of these were used as received without further purification.

General procedure for synthesis of diarylpyridine (2a):

A 20 mL reaction vessel was charged with RuCl₃·3H₂O (2.6 mg, 0.01 mmol), acetophenone (1a, 48 μL, 0.4 mmol), NH₄OAc (46.2 mg, 0.6 mmol). The sealed reaction vessel was purged with oxygen three times. DMF (0.5 mL) was added to the sealed reaction vessel by syringe. The resulting solution was stirred at 120 °C for 24 h. After cooling to room temperature, the volatiles were removed under vacuum and the residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 36.8 mg 2a as pale yellow oil; yield 80%.

2,4-Diphenylpyridine (2a) \[1\]

\[
\text{\text{H NMR (400 MHz, CDCl}₃, \text{ppm})} \delta \text{8.74 (d, } J = 5.2 \text{ Hz, 1H), 8.05 (d, } J = 7.6 \text{ Hz, 2H), 7.93 (s, 1H), 7.70 (m, 2H), 7.53–7.42 (m, 7H); } \\
\text{ \text{13C NMR (100 MHz, CDCl}₃, \text{ppm})} \delta \text{158.1, 150.1, 149.3, 139.5, 138.6, 138.6, 129.1, 129.0, 128.7, 127.1, 127.0, 120.3, 118.7; MS (EI) m/z (%) 231 (100), 202, 154, 102, 77.}
\]

2,4-Diptolylpyridine (2b) \[1\]


The reaction was conducted with 1-p-tolylethanone (1b, 53.7 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2b as off-white solid; yield 76%; mp 105-107 °C.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.69 (d, $J = 5.2$ Hz, 1H), 7.94 (d, $J = 8.0$ Hz, 2H), 7.89 (s, 1H), 7.59 (d, $J = 8.0$ Hz, 2H), 7.41 (d, $J = 4.0$ Hz, 1H), 7.32-7.30 (m, 4H), 2.43 (s, 3H), 2.42 (s, 3H); 13C NMR (100 MHz, CDCl$_3$, ppm) δ 158.0, 149.9, 149.0, 139.0, 138.9, 136.7, 135.6, 129.7, 129.4, 126.8, 126.8, 119.7, 118.1, 21.2, 21.1; MS (EI) m/z (%) 259 (100), 244, 115, 91, 77.

2,4-Bis(4-tert-butylphenyl)pyridine (2c)

The reaction was conducted with 1-(4-tert-butylphenyl)ethanone (1c, 70.5 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2c as off-white solid; yield 70%; mp 83-86 °C.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.70 (d, $J = 5.2$ Hz, 1H), 7.97 (d, $J = 8.2$ Hz, 2H), 7.91 (s, 1H), 7.64 (d, $J = 8.0$ Hz, 2H), 7.54-7.50 (m, 4H), 7.41 (d, $J = 5.2$ Hz, 1H), 1.38 (s, 9H), 1.37 (s, 9H); 13C NMR (100 MHz, CDCl$_3$, ppm) δ 158.0, 152.3, 152.1, 149.9, 149.0, 136.8, 135.7, 126.7, 126.0, 125.7, 119.8, 118.3, 34.7, 34.7, 31.3, 31.3; MS (EI) m/z (%) 343, 328 (100), 312, 128, 77; HRMS calcd. for: C$_{25}$H$_{29}$N [M+H]$^+$ 344.2373, found 344.2372.

2,4-Bis(4-isobutylphenyl)pyridine (2d)

The reaction was conducted with 1-(4-isobutylphenyl)ethanone (1d, 70.5 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2d as off-white solid; yield 70%; mp 83-86 °C.

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.70 (d, $J = 5.2$ Hz, 1H), 7.97 (d, $J = 8.2$ Hz, 2H), 7.91 (s, 1H), 7.64 (d, $J = 8.0$ Hz, 2H), 7.54-7.50 (m, 4H), 7.41 (d, $J = 5.2$ Hz, 1H), 1.38 (s, 9H), 1.37 (s, 9H); 13C NMR (100 MHz, CDCl$_3$, ppm) δ 158.0, 152.3, 152.1, 149.9, 149.0, 136.8, 135.7, 126.7, 126.0, 125.7, 119.8, 118.3, 34.7, 34.7, 31.3, 31.3; MS (EI) m/z (%) 343, 328 (100), 312, 128, 77; HRMS calcd. for: C$_{25}$H$_{29}$N [M+H]$^+$ 344.2373, found 344.2372.
3:1) to give 2d as off-white solid; yield 68%; mp 90-93 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.69 (d, $J = 5.2$ Hz, 1H), 7.95 (d, $J = 8.0$ Hz, 2H), 7.91 (s, 1H), 7.61 (d, $J = 8.0$ Hz, 2H), 7.42 (d, $J = 4.8$ Hz, 1H), 7.29-7.26 (m, 4H), 2.54 (d, $J = 6.0$ Hz, 4H), 1.95-1.89 (m, 2H), 0.95-0.93 (m, 12H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) δ 158.1, 149.9, 149.1, 142.9, 142.7, 137.1, 135.9, 129.8, 129.5, 126.8, 126.7, 119.7, 118.2, 45.2, 45.1, 30.2, 30.2, 22.4; MS (EI) m/z (%) 343, 300 (100), 257, 91, 77; HRMS calcd. for: C$_{25}$H$_{29}$N [M+H]$^+$ 344.2372, found 344.2372.

2,4-Bis(4-methoxyphenyl)pyridine (2e) $^{[1]}$

The reaction was conducted with 1-(4-methoxyphenyl)ethanone (1e, 60.1 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2e as off-white solid; yield 65%; mp 133-135 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.65 (d, $J = 4.8$ Hz, 1H), 8.01 (d, $J = 8.8$ Hz, 2H), 7.83 (s, 1H), 7.65 (d, $J = 8.4$ Hz, 2H), 7.36 (d, $J = 4.0$ Hz, 1H), 7.04-7.01 (m, 4H), 3.88 (s, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) δ 160.5, 157.6, 149.9, 148.6, 132.2, 130.9, 129.8, 128.2, 128.1, 119.0, 117.3, 114.5, 114.1, 55.3, 55.3; MS (EI) m/z (%) 291 (100), 276, 204, 145, 77.

2,4-Bis(3-methoxyphenyl)pyridine (2f) $^{[1]}$

The reaction was conducted with 1-(3-methoxyphenyl)ethanone (1f, 60.1 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2f as orange oil; yield 68%.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.73 (d, $J = 4.8$ Hz, 1H), 7.90 (s, 1H), 7.63-7.59 (m, 2H), 7.44-7.38 (m, 3H), 7.28 (s, 1H), 7.20 (s, 1H), 7.00-6.98 (m, 2H), 3.91 (s, 3H), 3.89 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) δ 160.2, 160.1, 157.9, 149.9, 149.2, 140.9, 140.0, 130.1, 129.7,
2,4-Di(biphenyl-4-yl)pyridine (2g) [1]

The reaction was conducted with 1-(biphenyl-4-yl)ethanone (1g, 78.5 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2g as a light-yellow solid; yield 48%; mp 176-178 °C.

1H NMR (400 MHz, CDCl3, ppm) \( \delta \) 8.78 (d, \( J = 4.0 \) Hz, 1H), 8.16 (d, \( J = 7.2 \) Hz, 2H), 8.03 (s, 1H), 7.82-7.68 (m, 10H), 7.49-7.38 (m, 7H); 13C NMR (100 MHz, CDCl3, ppm) \( \delta \) 157.7, 150.2, 148.8, 141.9, 141.8, 140.5, 140.2, 138.3, 137.3, 128.9, 128.8, 127.8, 127.7, 127.5, 127.4, 127.1, 120.1, 118.5.

2,4-Bis(4-(methylsulfonyl)phenyl)pyridine (2h)

The reaction was conducted with 1-(4-(methylsulfonyl)phenyl)ethanone (1h, 79.3 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/ethyl acetate = 1:1) to give 2h as a yellow solid; yield 57%; mp 248-249 °C.

1H NMR (400 MHz, CDCl3, ppm) \( \delta \) 8.86 (d, \( J = 4.8 \) Hz, 1H), 8.28 (d, \( J = 8.0 \) Hz, 2H), 8.13-8.08 (m, 4H), 7.99 (s, 1H), 7.89 (d, \( J = 8.0 \) Hz, 2H), 7.56 (d, \( J = 4.8 \) Hz, 1H), 3.13 (s, 3H), 3.12 (s, 3H); 13C NMR (100 MHz, CDCl3, ppm) \( \delta \) 156.3, 150.8, 147.8, 144.1, 143.6, 141.2, 141.0, 128.8, 128.4, 128.2, 128.0, 121.5, 119.4, 44.6, 44.5; HRMS calcd. for: C_{19}H_{18}O_{4}NS_{2} [M+H]^+ 388.0672, found 388.0667.

4,4'-(Pyridine-2,4-diyl)dibenzonitrile (2i)
The reaction was conducted with 4-acetylbenzonitrile (1i, 58.1 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2i as pale yellow solid; yield 45%; mp 175-178 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.84 (d, $J$ = 4.2 Hz, 1H), 8.26-8.17 (m, 2H), 7.94 (s, 1H), 7.84-7.80 (m, 6H), 7.52 (d, $J$ = 4.4 Hz, 1H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) δ 156.2, 150.7, 147.7, 142.9, 138.2, 132.9, 132.5, 132.5, 127.8, 127.5, 127.4, 121.2, 120.2, 118.9, 118.2; MS (EI) m/z (%) 281 (100), 252, 179, 127, 75; HRMS calcd. for: C$_{19}$H$_{11}$N$_3$ [M+H]$^+$ 282.1026, found 282.1024.

2,4-Di(naphthalen-1-yl)pyridine (2j)

The reaction was conducted with 1-(naphthalen-1-yl)ethanone (1j, 68.1 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2j as a yellow solid; yield 38%; mp 112-114 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.92 (d, $J$ = 4.8 Hz, 1H), 8.26 (d, $J$ = 2.4 Hz, 1H), 8.01-7.92 (m, 5H), 7.77 (s, 1H), 7.70 (d, $J$ = 6.8 Hz, 1H), 7.71-7.51 (m, 8H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) 159.3, 149.5, 149.2, 138.3, 137.4, 134.0, 133.8, 131.2, 130.8, 129.1, 128.9, 128.5, 128.4, 127.7, 127.0, 126.7, 126.6, 126.3, 126.2, 125.9, 125.4, 125.3, 125.2, 123.4; MS (EI) m/z (%) 330 (100), 204, 176, 164, 151; HRMS calcd. for: C$_{25}$H$_{18}$N [M+H]$^+$ 332.1434, found 332.1429.

2,4-Bis(4-fluorophenyl)pyridine (2k)

The reaction was conducted with 1-(4-fluorophenyl)ethanone (1k, 55.3 mg, 0.4 mmol). The
residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2k as orange oil; yield 60%; mp 83-85 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.71 (d, $J = 4.8$ Hz, 1H), 8.05-8.01 (m, 2H), 7.83 (s, 1H), 7.68-7.65 (m, 2H), 7.40 (d, $J = 4.8$ Hz, 1H), 7.22-7.16 (m, 4H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) δ 163.7 (d, $J = 247.2$ Hz), 163.5 (d, $J = 247.9$ Hz), 157.2, 150.2, 148.4, 135.6 (d, $J = 3.1$ Hz), 134.6 (d, $J = 3.4$ Hz), 128.9 (d, $J = 1.3$ Hz), 128.8 (d, $J = 1.3$ Hz), 120.0, 118.2, 116.2 (d, $J = 21.6$ Hz), 115.6 (d, $J = 21.5$ Hz); MS (EI) m/z (%) 267 (100), 238, 172, 120, 75; HRMS calcd. for: C$_{17}$H$_{11}$F$_2$N [M+H$^+$] 268.0932, found 268.0933.

2,4-Bis(4-chlorophenyl)pyridine (2l)$^{[1]}$

![2,4-Bis(4-chlorophenyl)pyridine](image)

The reaction was conducted with 1-(4-chlorophenyl)ethanone (1l, 61.8 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2l as red-brown solid; yield 65%; mp 103-105 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.73 (d, $J = 4.8$ Hz, 1H), 7.99 (d, $J = 8.0$ Hz, 2H), 7.85 (s, 1H), 7.62 (d, $J = 8.4$ Hz, 2H), 7.50-7.41 (m, 5H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) δ 156.9, 150.2, 148.1, 137.6, 136.7, 135.4, 135.3, 129.3, 128.9, 128.3, 128.2, 120.1, 118.1; MS (EI) m/z (%) 299 (100), 264, 202, 114, 75.

2,4-Bis(4-bromophenyl)pyridine (2m)$^{[1]}$

![2,4-Bis(4-bromophenyl)pyridine](image)

The reaction was conducted with 1-(4-bromophenyl)ethanone (1m, 79.6 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2m as orange solid; yield 64%; mp 136-138 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) δ 8.73 (d, $J = 5.2$ Hz, 1H), 7.93 (d, $J = 8.4$ Hz, 2H), 8.51 (s, 1H), 7.66-7.62 (m, 4H), 7.55 (d, $J = 8.0$ Hz, 2H), 7.43 (d, $J = 4.8$ Hz, 1H); $^{13}$C NMR (100 MHz,
CDCl₃, ppm) δ 157.0, 150.3, 148.2, 138.1, 137.2, 132.3, 131.9, 128.6, 128.5, 123.6, 123.6, 120.2, 118.1; MS (EI) m/z (%) 389 (100), 310, 228, 114, 75.

2,4-Bis(3-chlorophenyl)pyridine (2n)

\[
\begin{array}{c}
\text{Cl} \\
\text{N} \\
\text{Cl}
\end{array}
\]

The reaction was conducted with 1-(3-chlorophenyl)ethanone (1n, 61.8 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2n as red-brown solid; yield 66%; mp 95-97 °C.

\(^1\)H NMR (400 MHz, CDCl₃, ppm) δ 8.75 (d, \(J = 4.8\) Hz, 1H), 8.06 (s, 1H), 7.94-7.92 (dd, \(J = 3.6\) Hz, 2.4Hz, 1H), 7.86 (s, 1H), 7.67 (s, 1H), 7.57-7.55 (dd, \(J = 2.8\) Hz, 4.0 Hz, 1H), 7.45-7.42 (m, 5H); \(^1\)C NMR (100 MHz, CDCl₃, ppm) δ 156.7, 150.2, 148.0, 140.9, 140.1, 135.1, 134.9, 130.4, 130.0, 129.1, 127.2, 127.2, 125.2, 125.0, 120.6, 118.6, 118.5; MS (EI) m/z (%) 299 (100), 264, 202, 114, 75; HRMS calcd. for: C₁₇H₁₁Cl₂N \([\text{M+H}]^+\) 300.0341, found 300.0342.

2,4-Bis(3-bromophenyl)pyridine (2o)

\[
\begin{array}{c}
\text{Br} \\
\text{N} \\
\text{Br}
\end{array}
\]

The reaction was conducted with 1-(3-chlorophenyl)ethanone (1o, 79.6 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2o as red-brown solid; yield 66%; mp 89-91 °C.

\(^1\)H NMR (400 MHz, CDCl₃, ppm) δ 8.76 (d, \(J = 4.4\) Hz, 1H), 8.22 (s, 1H), 7.98 (d, \(J = 7.6\) Hz, 1H), 7.84 (d, \(J = 10.0\) Hz, 2H), 7.62-7.57 (m, 3H), 7.45-7.36 (m, 3H); \(^1\)C NMR (100 MHz, CDCl₃, ppm) δ 155.8, 150.5, 147.2, 138.8, 138.0, 133.6, 133.7, 131.2, 130.7, 128.9, 128.9, 127.2, 126.2, 126.0, 120.6, 118.1, 109.9; MS (EI) m/z (%) 389 (100), 310, 228, 114, 75.

2,4-Bis(2-chlorophenyl)pyridine (2p)
The reaction was conducted with 1-(2-chlorophenyl)ethanone (1p, 61.8 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2p as red-brown oil; yield 38%.

\[ \text{1H NMR (400 MHz, CDCl}_3\text{, ppm) } \delta \ 8.78 \text{ (d, } J = 4.8 \text{ Hz, 1H)}, 7.76 \text{ (s, 1H)}, 7.68-7.66 \text{ (m, 1H), 7.53-7.48} \text{ (m, 2H), 7.40-7.33} \text{ (m, 6H); } \text{13C NMR (100 MHz, CDCl}_3\text{, ppm) } \delta \ 156.8, 149.34, 146.9, 139.1, 135.4, 132.3, 131.7, 131.0, 130.3, 130.1, 129.8, 129.7, 129.3, 127.2, 127.0, 125.5, 123.0; \text{ MS (EI) m/z (%)} \ 299 \ (100), 264, 202, 114, 75; \text{ HRMS calcd. for: C}_{17}H_{11}Cl_{2}N [M+H]^+ \ 300.0341, \text{ found 300.0342.} \]

2,4-Bis(2,5-dichlorophenyl)pyridine (2q)

The reaction was conducted with 1-(2,4-dichlorophenyl)ethanone (1q, 75.6 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane = 3:1) to give 2q as red-brown solid; yield 40%; mp 161-163 °C.

\[ \text{1H NMR (400 MHz, CDCl}_3\text{, ppm) } \delta \ 8.80 \text{ (d, } J = 4.8 \text{ Hz, 1H)}, 7.73 \text{ (s, 1H), 7.681} \text{ (d, } J = 2.4 \text{ Hz, 1H), 7.47-7.32} \text{ (m, 6H); } \text{13C NMR (100 MHz, CDCl}_3\text{, ppm) } \delta \ 155.7, 149.7, 146.0, 140.1, 139.0, 133.1, 133.1, 131.6, 131.4, 131.3, 130.7, 130.6, 130.5, 129.9, 129.8, 125.1, 123.1; \text{ MS (EI) m/z (%)} \ 299 \ (100), 264, 202, 114, 75; \text{ HRMS calcd. for: C}_{17}H_{9}Cl_{4}N [M+H]^+ \ 367.9562, \text{ found 367.9562.} \]

2,4-Bis(3,4-dichlorophenyl)pyridine (2r)

The reaction was conducted with 1-(3-chlorophenyl)ethanone (1r, 75.6 mg, 0.4 mmol). The residue was purified by column chromatography (silica gel, petroleum ether/dichloromethane =
3:1) to give $2r$ as red-brown solid; yield 70%; mp 130-133 °C.

$^1$H NMR (400 MHz, CDCl$_3$, ppm) $\delta$ 8.76 (d, $J = 4.8$ Hz, 1H), 8.184 (s, 1H), 7.896 (d, $J = 8.0$ Hz, 1H), 7.83 (s, 1H), 7.77 (s, 1H), 7.61-7.51 (m, 3H), 7.44 (d, $J = 4.8$ Hz, 1H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) $\delta$ 156.6, 150.3, 148.0, 141.2, 140.3, 132.1, 132.1, 130.7, 130.3, 130.1, 130.1, 125.7, 125.5, 123.3, 123.1, 120.7, 118.6; MS (El) m/z (%) 369, 334 (100), 261, 148, 75; HRMS calcd. for: C$_{17}$H$_9$Cl$_4$N [M+H]$^+$ 367.9562, found 367.9558.

$2,4$-Diphenyl-$^6$D-pyridine ($2s$)

![Diagram of $2,4$-Diphenyl-$^6$D-pyridine ($2s$)]

$^1$H NMR (400 MHz, CDCl$_3$, ppm) $\delta$ 8.05 (d, $J = 7.6$ Hz, 2H), 7.94 (s, 1H), 7.71 (d, $J = 7.2$ Hz, 2H), 7.54-7.46 (m, 7H).

$2$-Methyl-$4,6$-diphenylpyridine ($2t$)

![Diagram of $2$-Methyl-$4,6$-diphenylpyridine ($2t$)]

$^1$H NMR (400 MHz, CDCl$_3$, ppm) $\delta$ 8.03 (d, $J = 7.6$ Hz, 2H), 7.72 (s, 1H), 7.68 (d, $J = 7.2$ Hz, 2H), 7.52-7.40 (m, 6H), 7.32 (s, 1H); $^{13}$C NMR (100 MHz, CDCl$_3$, ppm) $\delta$ 158.8, 157.7, 149.5, 139.8, 138.8, 129.0, 128.8, 128.8, 128.7, 127.1, 127.1, 119.8, 116.1, 24.8; MS (El) m/z (%) 245 (100), 230, 202, 115, 77.

$2,4$-Diphenyl-$^{15}$N-pyridine ($2u$)

![Diagram of $2,4$-Diphenyl-$^{15}$N-pyridine ($2u$)]

MS (El) m/z (%) 232 (100), 202, 155, 102, 77.
References

Copies of $^1$H and $^{13}$C NMR spectra of products