Supporting Information

One-pot synthesis of 4-methylisoquinolines via sequential Pd-catalyzed Heck reaction and intramolecular cyclization

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General Information

Equipment  Melting points were determined on Yanaco MP-J3 microscope melting point apparatus. NMR spectra were recorded on Mercury-400 spectrometer. Chemical shifts are referenced to the residual solvent peak and reported in ppm (δ scale) and all coupling constant (J) values are given in Hz. The following multiplicity abbreviations are used: (s) singlet, (d) doublet, (t) triplet, (q) quartet, (m) multiplet, and (br) broad. ESI-HRMS data were measured on Thermo Exactive Orbitrap plus spectrometer. Flash column chromatography was performed on Biotage Isolera one.

Solvents and chemicals  All the solvents and chemicals were obtained from commercial sources and used without further purification.
Experimental Procedures and Characterization Data:

2-acetyl/benzoylephenyl triflates

**General procedure for the synthesis of 2-acetyl/benzoylephenyl triflates (1a-k, 5l-p)**:

To a solution of 2-acetyl/benzoylephenol (10.0 mmol) in pyridine (10 mL) was added Tf₂O (12.0 mmol) dropwise at 0 °C. The reaction mixture was then allowed to stir at room temperature for 12 h. Then the mixture was diluted by EtOAc (20 mL) and washed with 1M solution of CuSO₄ (10mL×4) and brine, dried over Na₂SO₄, filtered, and concentrated in vacuo. The crude residue was purified by flash column chromatography over silica gel (eluting with PE/EA=100/1) to provide the desired product.

1a

2-acetylphenyl triflate 1a. Yield:98%. Yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 7.82 (dd, J = 7.7, 1.7 Hz, 1H), 7.61 (td, J = 8.2, 1.8 Hz, 1H), 7.49 (td, J = 7.6, 1.0 Hz, 1H), 7.35 (d, J = 8.2 Hz, 1H), 2.64 (s, 3H); ESI-HRMS m/z calcd for C₉H₈O₄F₃S [M+H]+ 269.0090, found 269.0083.

1b

2-acetyl-4-methylphenyl triflate 1b. Yield:96%. White solid. m.p. 30-32 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.59 (s, 1H), 7.38 (d, J = 8.4 Hz, 1H), 7.21 (d, J = 8.4 Hz, 1H), 2.62 (s, 3H), 2.43 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 196.86, 144.74, 138.92, 134.12, 131.80, 131.20, 122.46 (d, J = 1 Hz), 118.64 (q, J = 319 Hz), 29.47, 20.86; ESI-HRMS m/z calcd for C₁₀H₁₀O₄FS [M+H]+ 283.0246, found 283.0248.

1c

2-acetyl-5-methylphenyl triflate 1c. Yield:98%. Yellow solid. m.p. 48-50 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.73 (d, J = 7.9 Hz, 1H), 7.28 (d, J = 9.0 Hz, 1H), 7.13 (s, 1H), 2.61 (s, 3H), 2.45 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 196.22, 146.90, 145.50, 130.92, 129.19, 129.04, 123.21 (d, J = 1 Hz), 118.64 (q, J = 319 Hz), 29.24, 21.41; ESI-HRMS m/z calcd for C₁₀H₁₀O₄FS [M+H]+ 283.0246, found
2-acetyl-4, 5-dimethylphenyl triflate 1d. Yield: 95%. Light yellow solid. m.p. 34-36 °C. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.58 (s, 1H), 7.08 (s, 1H), 2.60 (s, 3H), 2.34 (s, 3H), 2.32 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 196.39, 144.86, 143.85, 137.46, 131.82, 129.03, 123.44 (d, $J = 1$ Hz), 118.65 (q, $J = 319$ Hz) 29.25, 20.00, 19.21; ESI-HRMS m/z calcd for C$_{12}$H$_{12}$O$_4$F$_3$S [M+H]$^+$ 297.0403, found 297.0405.

2-acetyl-4-methoxyphenyl triflate 1e. Yield: 95%. Brown oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.28 – 7.23 (m, 2H), 7.06 (dd, $J = 9.1$, 3.1 Hz, 1H), 3.87 (s, 3H), 2.62 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 196.52, 158.88, 139.98, 132.96, 123.77 (d, $J = 1$ Hz), 118.61 (q, $J = 319$ Hz), 118.16, 115.73, 55.90, 29.33; ESI-HRMS m/z calcd for C$_{10}$H$_{10}$O$_5$F$_3$S [M+H]$^+$ 299.0196, found 299.0197.

2-acetyl-4-fluorophenyl triflate 1f. Yield: 92%. White solid. m.p. 33-35 °C. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.50 (dd, $J = 8.0$, 2.7 Hz, 1H), 7.35 (dd, $J = 9.0$, 4.4 Hz, 1H), 7.32 – 7.25 (m, 1H), 2.64 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 195.26 (d, $J = 1.2$ Hz), 162.39, 159.88, 142.43 (d, $J = 3.4$ Hz), 133.83 (d, $J = 6.4$ Hz), 124.68 (dd, $J = 8.4$, 0.8 Hz), 118.98 (dd, $J = 277.3$, 23.7 Hz), 118.59 (q, $J = 319$ Hz), 29.41; ESI-HRMS m/z calcd for C$_9$H$_7$O$_4$F$_4$S [M+H]$^+$ 286.9996, found 286.9998.

2-acetyl-4-chlorophenyl triflate 1g. Yield: 94%. Yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.77 (d, $J$
= 2.6 Hz, 1H), 7.56 (dd, J = 8.8, 2.6 Hz, 1H), 7.30 (d, J = 8.8 Hz, 1H), 2.63 (s, 3H); ESI-HRMS m/z calcd for C_{9}H_{7}O_{4}ClF_{3}S [M+H]^+ 302.9700, found 302.9699.

1-acetylnaphthalen-2-yl triflate 1h. Yield: 92%. White solid. m.p. 35-37 °C. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.97 (d, J = 9.1 Hz, 1H), 7.92 (dd, J = 6.3, 3.0 Hz, 1H), 7.81 (dd, J = 6.7, 2.7 Hz, 1H), 7.66 – 7.55 (m, 2H), 7.45 (d, J = 9.1 Hz, 1H), 2.73 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 200.69, 142.37, 132.47, 132.00, 131.74, 129.66, 128.65, 128.58, 127.58, 124.93, 119.04, 118.53 (q, J = 318 Hz), 32.77; ESI-HRMS m/z calcd for C$_{13}$H$_{10}$O$_{4}$F$_{3}$S [M+H]$^+$ 319.0246, found 319.0249.

2-propionylphenyl triflate 1i. $^{2a}$ Yield: 95%. Yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.78 (dd, J = 7.7, 1.7 Hz, 1H), 7.62 – 7.56 (m, 1H), 7.48 (td, J = 7.6, 1.0 Hz, 1H), 7.34 (d, J = 8.2 Hz, 1H), 2.97 (q, J = 7.2 Hz, 2H), 1.22 (t, J = 7.2 Hz, 3H); ESI-HRMS m/z calcd for C$_{13}$H$_{10}$O$_{4}$F$_{3}$S [M+H]$^+$ 283.0246, found 283.0241.

2-isobutyrylphenyl triflate 1j. $^{2a}$ Yield: 90%. Yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ 7.71 (dd, J = 7.7, 1.6 Hz, 1H), 7.58 (td, J = 8.0, 1.6 Hz, 1H), 7.48 (td, J = 7.6, 0.7 Hz, 1H), 7.35 (d, J = 8.2 Hz, 1H), 3.41 – 3.34 (m, 1H), 1.20 (d, J = 6.9 Hz, 6H); ESI-HRMS m/z calcd for C$_{11}$H$_{12}$O$_{4}$F$_{3}$S [M+H]$^+$ 297.0403, found 297.0398.

2-(cyclohexanecarbonyl)phenyl triflate 1k. Yield: 92%. Yellow oil. $^1$H NMR (400 MHz, CDCl$_3$) δ
7.70 (dd, J = 7.7, 1.7 Hz, 1H), 7.62 – 7.52 (m, 1H), 7.47 (td, J = 7.6, 1.0 Hz, 1H), 7.34 (d, J = 8.2 Hz, 1H), 3.07 (tt, J = 11.3, 3.3 Hz, 1H), 1.89 (d, J = 13.1 Hz, 2H), 1.85 – 1.77 (m, 2H), 1.75 – 1.65 (m, 1H), 1.53 – 1.40 (m, 2H), 1.39 – 1.19 (m, 2H); 13C NMR (100 MHz, CDCl3) δ 202.97, 146.63, 132.87, 132.38, 130.11, 128.44, 122.58 (d, j = 0.8 Hz), 118.59 (q, J = 319 Hz), 48.89, 28.72, 25.79, 25.65; ESI-HRMS m/z calcd for C14H16O4F3S [M+H]+ 337.0716, found 337.0711.

2-(4-fluorobenzoyl)phenyl triflate 5l. Yield: 94%. Brown oil. 1H NMR (400 MHz, Acetone) δ 7.97 – 7.88 (m, 2H), 7.84 (ddd, J = 8.3, 7.3, 2.0 Hz, 1H), 7.77 – 7.59 (m, 3H), 7.40 – 7.30 (m, 2H); 13C NMR (100 MHz, Acetone) δ 191.35, 154.00, 150.88, 146.78, 137.04, 133.93, 132.20, 131.68, 128.94, 123.73, 122.80, 118.52 (q, J = 318 Hz); ESI-HRMS m/z calcd for C14H9O4F4S [M+H]+ 349.0152, found 349.0148.

2-(4-chlorobenzoyl)phenyl triflate 5m. Yield: 94%. Yellow solid. m.p. 35 – 37 °C. 1H NMR (400 MHz, Acetone) δ 7.89 – 7.82 (m, 3H), 7.74 (dd, J = 7.6, 1.9 Hz, 1H), 7.72 – 7.66 (m, 1H), 7.66 – 7.59 (m, 3H); 13C NMR (100 MHz, Acetone) δ 191.05, 146.72, 139.65, 135.21, 133.45, 131.91, 131.64, 131.36, 128.96, 128.75, 122.64 (d, J = 0.6 Hz), 118.50 (q, J = 318 Hz); ESI-HRMS m/z calcd for C14H9O4ClF3S [M+H]+ 364.9857, found 364.9853.

2-(4-(trifluoromethyl)benzoyl)phenyl triflate 5n. Yield: 91%. White solid. m.p. 62 – 64 °C. 1H NMR (400 MHz, Acetone) δ 8.04 (d, J = 8.2 Hz, 2H), 7.97 – 7.92 (m, 2H), 7.89 (td, J = 8.3, 1.8 Hz, 1H), 7.79 (dd, J = 7.7, 1.8 Hz, 1H), 7.72 (dd, J = 7.5, 0.8 Hz, 1H), 7.68 (dd, J = 11.0, 4.6 Hz, 1H); 13C NMR (100 MHz, Acetone) δ 191.48, 146.84, 139.84, 133.90, 131.70, 131.53, 130.59, 129.57, 128.86, 125.73 (q, J = 3.8 Hz), 123.89 (q, J = 270 Hz), 122.78 (d, J = 0.6 Hz), 118.51 (q, J = 318 Hz); ESI-HRMS m/z calcd for C15H16O4F6S [M+H]+ 399.0120, found 399.0118.
2-(4-cyanobenzoyl)phenyl triflate 5o. Yield: 95%. Yellow solid. m.p. 79-81 °C. \( ^1H \text{NMR} \) (400 MHz, Acetone) \( \delta \) 8.06 – 7.95 (m, 4H), 7.93 – 7.85 (m, 1H), 7.78 (dd, \( J = 7.7, 1.8 \text{ Hz}, 1H \)), 7.71 (td, \( J = 7.6, 1.0 \text{ Hz}, 1H \)), 7.66 (d, \( J = 8.3 \text{ Hz}, 1H \)); \( ^{13}C \text{NMR} \) (100 MHz, Acetone) \( \delta \) 191.36, 146.83, 139.85, 134.04, 132.63, 131.73, 130.46, 128.90, 128.15, 122.81 (d, \( J = 0.6 \text{ Hz} \)), 118.50 (q, \( J = 318 \text{ Hz} \)), 117.65, 116.65; ESI-HRMS m/z calcd for C\(_{15}\)H\(_9\)O\(_4\)NF\(_3\)S [M+H]\(^+\) 356.0199, found 356.0199.

2-nicotinoylphenyl triflate 5p. Yield: 90%. Brown oil. \( ^1H \text{NMR} \) (400 MHz, Acetone) \( \delta \) 8.95 (d, \( J = 1.6 \text{ Hz}, 1H \)), 8.87 (dd, \( J = 4.8, 1.6 \text{ Hz}, 1H \)), 8.22 – 8.15 (m, 1H), 7.89 (ddd, \( J = 8.3, 7.5, 1.8 \text{ Hz}, 1H \)), 7.81 (dd, \( J = 7.7, 1.8 \text{ Hz}, 1H \)), 7.72 (td, \( J = 7.6, 1.0 \text{ Hz}, 1H \)), 7.66 (d, \( J = 8.4 \text{ Hz}, 1H \)), 7.61 (ddd, \( J = 8.0, 4.8, 0.8 \text{ Hz}, 1H \)); \( ^{13}C \text{NMR} \) (100 MHz, Acetone) \( \delta \) 190.68, 167.30, 164.78, 146.67, 133.28, 132.97, 132.87, 131.25, 128.73, 122.58 (d, \( J = 0.6 \text{ Hz} \)), 118.59 (q, \( J = 318 \text{ Hz} \)), 115.88, 115.66; ESI-HRMS m/z calcd for C\(_{13}\)H\(_9\)O\(_4\)NF\(_3\)S [M+H]\(^+\) 332.0199, found 332.0195.
Experimental Procedures and Characterization Data:

2-benzoylphenyl halide

General procedure for the synthesis of 2-benzoylphenyl halide  Method A:(5a-g)\(^5\):

The substituted 2-bromobenzoic acid (10.0 mmol), thionyl chloride (15 mL) and one drop of N, N-dimethylformamide were heated under reflux for 2 h. The excess thionyl chloride was removed from the cooled reaction mixture and the remaining acid chloride was dissolved in benzene (20 mL). Aluminium chloride (11.0 mmol) was added portion-wise over 10 min to this solution and the resulting suspension was refluxed for 1 h. The reaction mixture was poured slowly into 2N HCl (20 mL) and ice. The organic layer was separated and the aqueous layer extracted with EtOAc (5 mL x3). The combined organic layers were washed with saturated aqueous NaHCO\(_3\) solution and brine, dried over Na\(_2\)SO\(_4\), filtered and concentrated in vacuo. The crude residue was purified by flash column chromatography over silica gel (eluting with PE/EA=100/1) to provide the desired product.

General procedure for the synthesis of 2-benzoylphenyl halide  Method B:(5h-k)\(^6\):

A solution of 2-iodobenzoic acid (10.0 mmol) and SOCl\(_2\) (25.0 mmol) in CH\(_2\)Cl\(_2\) (20 mL) was stirred overnight. The excess SOCl\(_2\) was removed and the remaining acid chloride was dissolved in anhydrous CH\(_2\)Cl\(_2\) (20 mL), then substituted benzene (12.0 mmol) was added. After the mixture was cooled to 0 °C, AlCl\(_3\) (11.0 mmol) was added portion-wise over 10 min. The reaction mixture was allowed to stir at room temperature for 6 h, then poured slowly into 2N HCl (20 mL) and ice. The organic layer was separated and the aqueous layer extracted with CH\(_2\)Cl\(_2\) (5 mL x3). The combined organic layers were washed with saturated aqueous NaHCO\(_3\) solution and brine, dried over Na\(_2\)SO\(_4\), filtered and concentrated in vacuo. The crude residue was purified by flash column chromatography over silica gel (eluting with PE/EA=100/1) to provide the desired product.

2-benzoyl-1-bromobenzene 5a.\(^7\) Yield: 85%. Yellow oil. \(^1\)H NMR (400 MHz, Acetone) \(\delta\) 7.81 – 7.73 (m, 3H), 7.70 (dd, \(J = 8.7, 2.5, 1.3\) Hz, 1H), 7.60 – 7.53 (m, 3H), 7.50 (td, \(J = 7.7, 1.9\) Hz, 1H), 7.45 (dd, \(J = 7.3, 1.8\) Hz, 1H); ESI-HRMS m/z calcd for C\(_{13}\)H\(_{10}\)OBr [M+H]\(^+\) 260.9910, found 260.9910.

2-benzoyl-4-methyl-1-bromobenzene 5b.\(^8\) Yield: 87%. Yellow solid. m.p. 30-32 °C. \(^1\)H NMR (400 MHz, Acetone) \(\delta\) 7.81 – 7.74 (m, 2H), 7.72 – 7.64 (m, 1H), 7.63 – 7.50 (m, 3H), 7.31 (dd, \(J = 8.2, 1.6\) Hz, 1H), 7.25 (d, \(J = 1.5\) Hz, 1H), 2.37 (s, 3H); \(^1\)C NMR (100 MHz, Acetone) \(\delta\) 195.08, 140.76, 137.85, 136.27, 133.73, 132.74, 132.13, 129.83, 129.38, 128.81, 115.39, 19.98; ESI-HRMS m/z
calcd for C_{14}H_{12}OBr [M+H]^+ 275.0066, found 275.0071.

![5c](image)

**2-benzoyl-5-methyl-1-bromobenzene 5c.** Yield: 82%. White solid. m.p. 28-30 °C. $^1$H NMR (400 MHz, Acetone) $\delta$ 7.82 – 7.73 (m, 2H), 7.70 – 7.64 (m, 1H), 7.59 – 7.49 (m, 3H), 7.37 – 7.29 (m, 2H), 2.43 (s, 3H); ESI-HRMS m/z calcd for C_{14}H_{12}OBr [M+H]^+ 275.0066, found 275.0071.

![5d](image)

**2-benzoyl-4-methoxy-1-bromobenzene 5d.** Yield: 78%. Yellow oil. $^1$H NMR (400 MHz, Acetone) $\delta$ 7.82 – 7.77 (m, 2H), 7.73 – 7.65 (m, 1H), 7.61 (d, $J = 8.8$ Hz, 1H), 7.59 – 7.52 (m, 2H), 7.07 (dd, $J = 8.8$, 3.0 Hz, 1H), 7.02 (d, $J = 3.0$ Hz, 1H), 3.86 (s, 3H); ESI-HRMS m/z calcd for C_{14}H_{12}OBr [M+H]^+ 291.0015, found 291.0019.

![5e](image)

**2-benzoyl-4, 5-dimethoxy-1-bromobenzene 5e.** Yield: 80%. Light yellow solid. m.p. 60-62 °C. $^1$H NMR (400 MHz, Acetone) $\delta$ 7.81 – 7.76 (m, 2H), 7.67 (t, $J = 7.4$ Hz, 1H), 7.54 (t, $J = 7.7$ Hz, 2H), 7.22 (s, 1H), 7.03 (s, 1H), 3.94 (s, 3H), 3.84 (s, 3H); ESI-HRMS m/z calcd for C_{15}H_{14}OBr [M+H]^+ 321.0121, found 321.0123.

![5f](image)

**2-benzoyl-5-fluoro-1-bromobenzene 5f.** Yield: 88%. Yellow oil. $^1$H NMR (400 MHz, Acetone) $\delta$ 7.83 – 7.76 (m, 1H), 7.69 (q, $J = 7.0$ Hz, 1H), 7.64 – 7.50 (m, 3H), 7.42 – 7.25 (m, 2H), 7.11 (dd, $J = 15.8$, 7.9 Hz, 1H); ESI-HRMS m/z calcd for C_{13}H_{9}OBrF [M+H]^+ 278.9815, found 278.9818.
2-benzoyl-4-chloro-1-bromobenzene 5g. Yield: 85%. Yellow solid. m.p. 88-90 °C. $^1$H NMR (400 MHz, Acetone) δ 7.82 (d, $J = 1.1$ Hz, 1H), 7.80 (t, $J = 1.6$ Hz, 1H), 7.79 – 7.74 (m, 1H), 7.72 (ddd, $J = 8.7, 2.5, 1.2$ Hz, 1H), 7.59 (d, $J = 1.5$ Hz, 1H), 7.57 (s, 1H), 7.53 (d, $J = 1.5$ Hz, 1H); $^{13}$C NMR (100 MHz, Acetone) δ 193.54, 142.55, 135.64, 134.65, 134.14, 133.46, 131.32, 129.90, 128.97, 128.60, 116.99; ESI-HRMS m/z calcd for C$_{13}$H$_9$OBrCl [M+H]$^+$ 294.952, found 294.9526.

2-(4-methylbenzoyl)-1-iodobenzene 5h. Yield: 86%. Light yellow solid. m.p. 42-44 °C. $^1$H NMR (400 MHz, Acetone) δ 8.00 (dd, $J = 8.0, 0.8$ Hz, 1H), 7.66 (d, $J = 8.2$ Hz, 2H), 7.57 (td, $J = 7.5, 1.1$ Hz, 1H), 7.36 (d, $J = 7.8$ Hz, 3H), 7.33 – 7.27 (m, 1H), 2.43 (s, 3H); ESI-HRMS m/z calcd for C$_{14}$H$_{12}$OI [M+H]$^+$ 322.9927, found 322.9932.

2-(4-ethylbenzoyl)-1-iodobenzene 5i. Yield: 82%. Yellow oil. $^1$H NMR (400 MHz, Acetone) δ 8.00 (dd, $J = 8.0, 0.8$ Hz, 1H), 7.72 – 7.66 (m, 2H), 7.57 (tt, $J = 6.0, 3.0$ Hz, 1H), 7.42 – 7.35 (m, 3H), 7.30 (td, $J = 7.8, 1.7$ Hz, 1H), 2.77 – 2.71 (m, 2H), 1.25 (t, $J = 7.6$ Hz, 3H); $^{13}$C NMR (100 MHz, Acetone) δ 196.01, 150.85, 145.04, 139.54, 133.46, 131.12, 130.40, 128.36, 128.21, 128.10, 91.73, 28.73, 14.84; ESI-HRMS m/z calcd for C$_{15}$H$_{14}$OI [M+H]$^+$ 337.0084, found 337.0085.

2-(4-isopropylbenzoyl)-1-iodobenzene 5j. Yield: 80%. Brown oil. $^1$H NMR (400 MHz, Acetone) δ 8.00 (dd, $J = 8.0, 0.8$ Hz, 1H), 7.73 – 7.67 (m, 2H), 7.57 (td, $J = 7.5, 1.1$ Hz, 1H), 7.43 (d, $J = 8.2$ Hz,
2H), 7.36 (dd, J = 7.6, 1.6 Hz, 1H), 7.34 – 7.26 (m, 1H), 3.02 (hept, J = 6.9 Hz, 1H), 1.27 (d, J = 6.9 Hz, 6H); 13C NMR (100 MHz, Acetone) δ 195.97, 155.31, 145.01, 139.66, 133.66, 131.25, 130.61, 128.35, 128.18, 127.05, 92.07, 34.26, 30.10; ESI-HRMS m/z calcd for C16H16OI [M+H]+ 351.0240, found 351.0239.

![5k](image)

**5k**

2-(4-methoxybenzoyl)-1-iodobenzene 5j. Yield: 77%. White solid, m.p. 78-80 °C. 1H NMR (400 MHz, Acetone) δ 7.98 (d, J = 8.0 Hz, 1H), 7.73 (d, J = 8.9 Hz, 2H), 7.55 (td, J = 7.5, 0.7 Hz, 1H), 7.34 (dd, J = 7.6, 1.5 Hz, 1H), 7.27 (td, J = 7.8, 1.6 Hz, 1H), 7.05 (d, J = 8.9 Hz, 2H), 3.90 (s, 3H); ESI-HRMS m/z calcd for C14H12O2I [M+H]+ 338.9877, found 338.9879.
Experimental Procedures and Characterization Data:

4-methyli soquinolines

General procedure for the synthesis of 4-methyli soquinolines:

To a solution of the 2-acetyl/benzoylphenyl triflates/halide (1.0 mmol) in ethylene glycol (10 mL) was sequentially added N-Boc allylamine (1.2 mmol), Pd(OA)2 (0.05 mmol), dppp (0.1 mmol) and NaOAc (2.0 mmol). The reaction mixture was heated at 120 °C under argon for 12 h, then cooled to room temperature. Water (10 mL) was added and the mixture was extracted with CH₂Cl₂ (10mL×3). The combined organic layer was washed with brine, dried over Na₂SO₄, filtered, and concentrated in vacuo. The crude residue was purified by flash column chromatography over silica gel (eluting with CH₂Cl₂/EA=100/1 to 20/1) to provide the desired product.

**1,4-dimethyli soquinoline 4a** Yield: 62%. Brown oil. ¹H NMR (400 MHz, CD₃OD) δ 8.09 (d, J = 8.4 Hz, 1H), 7.98 (s, 1H), 7.90 (d, J = 8.4 Hz, 1H), 7.69 (t, J = 7.6 Hz, 1H), 7.57 (t, J = 7.6 Hz, 1H), 2.77 (s, 3H), 2.47 (s, 3H); ¹³C NMR (100 MHz, CD₃OD) δ 156.50, 139.52, 135.30, 130.16, 126.85, 126.70, 126.37, 125.81, 123.33, 20.15, 14.43; ESI-HRMS m/z calcd for C₁₁H₁₂N [M+H]^+ 158.0964, found 158.0965.

**1,4,7-trimethyli soquinoline 4b** Yield: 65%. Brown oil. ¹H NMR (400 MHz, CD₃OD) δ 7.79 (s, 1H), 7.67 (s, 1H), 7.60 (d, J = 8.5 Hz, 1H), 7.37 (d, J = 8.5 Hz, 1H), 2.61 (s, 3H), 2.36 (s, 3H), 2.31 (s, 3H); ¹³C NMR (100 MHz, CD₃OD) δ 155.73, 138.72, 136.98, 133.50, 132.15, 126.86, 126.21, 124.66, 123.18, 20.49, 20.11, 14.41; ESI-HRMS m/z calcd for C₁₂H₁₄N [M+H]^+ 172.1121, found 172.1122.

**1,4,6-trimethyli soquinoline 4c** Yield: 65%. Brown oil. ¹H NMR (400 MHz, CD₃OD) δ 8.04 (d, J = 8.6 Hz, 1H), 7.98 (s, 1H), 7.74 (s, 1H), 7.46 (d, J = 8.6 Hz, 1H), 2.78 (s, 3H), 2.51 (s, 3H), 2.49 (s, 3H); ¹³C NMR (100 MHz, CD₃OD) δ 156.19, 140.97, 139.51, 135.70, 128.95, 125.97, 125.78, 125.11, 122.41, 20.74, 20.01, 14.47; ESI-HRMS m/z calcd for C₁₂H₁₄N [M+H]^+ 172.1121, found 172.1122.
1,4,6,7-tetramethylisoquinoline 4d Yield: 70%. Brown solid. m.p. 39-42 °C. $^1H$ NMR (400 MHz, CD$_3$OD) δ 7.88 (s, 1H), 7.82 (s, 1H), 7.64 (s, 1H), 2.73 (s, 3H), 2.44 (s, 3H), 2.40 (s, 3H), 2.39 (s, 3H); $^{13}C$ NMR (100 MHz, CD$_3$OD) δ 155.29, 140.66, 138.63, 136.80, 134.16, 125.62, 125.59, 125.12, 122.81, 19.99, 19.25, 18.98, 14.44; ESI-HRMS m/z calcd for C$_{13}$H$_{16}$N [M+H]$^+$ 186.1277, found 186.1281.

7-methoxy-1,4-dimethylisoquinoline 4e Yield: 72%. Brown oil. $^1H$ NMR (400 MHz, CD$_3$OD) δ 7.89 (s, 1H), 7.85 (d, $J = 9.0$ Hz, 1H), 7.37 – 7.29 (m, 2H), 3.88 (s, 3H), 2.75 (s, 3H), 2.46 (s, 3H); $^{13}C$ NMR (100 MHz, CD$_3$OD) δ 158.34, 154.89, 137.70, 130.70, 128.05, 126.36, 125.06, 122.52, 103.70, 54.54, 20.21, 14.42; ESI-HRMS m/z calcd for C$_{12}$H$_{14}$O$_2$N [M+H]$^+$ 188.1070, found 188.1071.

7-fluoro-1,4-dimethylisoquinoline 4f Yield: 63%. Brown oil. $^1H$ NMR (400 MHz, CD$_3$OD) δ 8.05 (dd, $J = 8.6$, 4.5 Hz, 2H), 7.80 (dd, $J = 10.1$, 2.4 Hz, 1H), 7.56 (td, $J = 8.5$, 1.9 Hz, 1H), 2.78 (s, 3H), 2.53 (s, 3H); $^{13}C$ NMR (100 MHz, CD$_3$OD) δ 162.03, 159.57, 156.16, 156.10, 139.33, 139.30, 132.53, 127.87, 127.78, 126.70, 126.61, 126.52, 126.50, 120.30, 120.05, 109.42, 109.21, 20.22, 14.46; ESI-HRMS m/z calcd for C$_{12}$H$_{11}$FN [M+H]$^+$ 176.0870, found 176.0874.

7-chloro-1,4-dimethylisoquinoline 4g Yield: 60%. Brown oil. $^1H$ NMR (400 MHz, CD$_3$OD) δ 8.11 (s, 1H), 8.04 (s, 1H), 7.93 (d, $J = 8.9$ Hz, 1H), 7.67 (d, $J = 9.0$ Hz, 1H), 2.77 (s, 3H), 2.49 (s, 3H); $^{13}C$ NMR (100 MHz, CD$_3$OD) δ 155.96, 140.19, 133.76, 132.58, 130.82, 127.51, 126.49, 125.64, 124.81, 20.17, 14.33; ESI-HRMS m/z calcd for C$_{12}$H$_{11}$NCl [M+H]$^+$ 192.0575, found 192.0578.
1,4-dimethylbenzo[h]isoquinoline 4h Yield: 65%. Brown oil. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.82 (d, $J = 8.5$ Hz, 1H), 8.26 (s, 1H), 8.00 (d, $J = 9.0$ Hz, 1H), 7.96 (d, $J = 7.7$ Hz, 1H), 7.87 (d, $J = 9.1$ Hz, 1H), 7.69 (t, $J = 7.7$ Hz, 1H), 7.63 (t, $J = 7.4$ Hz, 1H), 3.19 (s, 3H), 2.60 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 154.42, 141.89, 136.72, 133.16, 131.82, 130.04, 128.82, 126.86, 126.77, 126.58, 126.53, 124.52, 121.06, 28.19, 15.09; ESI-HRMS m/z calcd for C$_{15}$H$_{14}$N [M+H]$^+$ 208.1124, found 208.1124.

1-ethyl-4-methylisoquinoline 4i Yield: 64%. Brown oil. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.05 (d, $J = 8.4$ Hz, 1H), 7.99 (s, 1H), 7.82 (d, $J = 8.4$ Hz, 1H), 7.65–7.58 (m, 1H), 7.55–7.47 (m, 1H), 3.11 (q, $J = 7.6$ Hz, 2H), 2.40 (s, 3H), 1.25 (t, $J = 7.6$ Hz, 3H); $^{13}$C NMR (100 MHz, MeOD) δ 164.65, 140.06, 135.80, 129.80, 126.71, 125.79, 125.53, 124.95, 123.58, 30.18, 21.14, 14.52; ESI-HRMS m/z calcd for C$_{12}$H$_{14}$N [M+H]$^+$ 172.1117, found 172.1117.

1-isopropyl-4-methylisoquinoline 4j Yield: 63%. Brown oil. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.18 (d, $J = 8.5$ Hz, 1H), 8.07 (s, 1H), 7.88 (d, $J = 8.4$ Hz, 1H), 7.67–7.59 (m, 1H), 7.56–7.46 (m, 1H), 3.91–3.81 (m, 1H), 2.44 (s, 3H), 1.27 (d, $J = 6.8$ Hz, 6H); $^{13}$C NMR (100 MHz, MeOD) δ 161.44, 139.76, 135.70, 130.01, 126.81, 126.23, 125.77, 125.47, 123.49, 27.42, 14.46, 13.19; ESI-HRMS m/z calcd for C$_{13}$H$_{16}$N [M+H]$^+$ 186.1277, found 186.1275.

1-cyclohexyl-4-methylisoquinoline 4k Yield: 66%. Brown oil. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.12 (d,
$J = 8.5$ Hz, 1H), 8.00 (s, 1H), 7.83 (d, $J = 8.4$ Hz, 1H), 7.63 – 7.54 (m, 1H), 7.52 – 7.41 (m, 1H), 3.49 – 3.35 (m, 1H), 2.39 (s, 3H), 1.73 (d, $J = 11.1$ Hz, 4H), 1.49 – 1.33 (m, 2H), 1.26 – 1.15 (m, 1H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 165.35, 141.51, 137.27, 131.22, 128.13, 127.12, 127.03, 126.32, 125.04, 42.32, 33.69, 27.81, 27.35, 15.95; ESI-HRMS m/z calcd for C$_{16}$H$_{20}$N [M+H]$^+$ 226.1590, found 226.1587.

![Image 6a](image)

**6a**

4-methyl-1-phenylisoquinoline 6a Yield: 65%. Brown solid. m.p. 58-60 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.17 (s, 1H), 7.93 (d, $J = 8.5$ Hz, 1H), 7.83 (d, $J = 8.6$ Hz, 1H), 7.68 – 7.60 (m, 1H), 7.41 – 7.39 (m, 6H), 2.50 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 159.17, 140.26, 138.88, 136.21, 130.35, 129.54, 128.45, 128.05, 127.67, 127.51, 127.06, 126.08, 123.31, 14.66; ESI-HRMS m/z calcd for C$_{16}$H$_{14}$N [M+H]$^+$ 220.1121, found 220.1122.

![Image 6b](image)

**6b**

4,7-dimethyl-1-phenylisoquinoline 6b Yield: 70%. Brown solid. m.p. 85-88 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.11 (s, 1H), 7.83 (d, $J = 8.6$ Hz, 1H), 7.61 (s, 1H), 7.50 (d, $J = 8.6$ Hz, 1H), 7.42 (s, 5H), 2.49 (s, 3H), 2.30 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 158.50, 139.54, 139.04, 137.07, 134.49, 132.41, 129.50, 128.35, 128.03, 127.37, 126.34, 126.30, 123.22, 20.47, 14.62; ESI-HRMS m/z calcd for C$_{17}$H$_{16}$N [M+H]$^+$ 234.1277, found 234.1280.

![Image 6c](image)

**6c**

4,6-dimethyl-1-phenylisoquinoline 6c Yield: 70%. Brown solid. m.p. 75-78 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.11 (s, 1H), 7.71 (d, $J = 9.1$ Hz, 2H), 7.40 (s, 5H), 7.24 (d, $J = 8.7$ Hz, 1H), 2.47 (s, 3H), 2.41 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 158.80, 141.09, 140.30, 138.97, 136.47, 129.51, 129.13, 128.37, 128.00, 127.52, 126.91, 124.39, 122.28, 20.78, 14.70; ESI-HRMS m/z calcd for C$_{17}$H$_{16}$N [M+H]$^+$ 234.1277, found 234.1279.
7-methoxy-4-methyl-1-phenylisoquinoline 6d Yield: 71%. Brown solid. m.p. 91-93 °C. ¹H NMR (400 MHz, CD₃OD) δ 8.10 (s, 1H), 7.91 (d, J = 9.2 Hz, 1H), 7.54 – 7.41 (m, 5H), 7.38 – 7.31 (m, 1H), 7.19 (d, J = 2.4 Hz, 1H), 3.66 (s, 3H), 2.54 (s, 3H); ¹³C NMR (100 MHz, CD₃OD) δ 158.44, 157.65, 139.18, 138.66, 131.72, 129.33, 128.38, 128.16, 127.51, 127.46, 125.08, 122.79, 105.30, 54.33, 14.61; ESI-HRMS m/z calcd for C₁₇H₁₆ON [M+H]⁺ 250.1226, found 250.1228.

6,7-dimethoxy-4-methyl-1-phenylisoquinoline 6e Yield: 75%. Brown solid. m.p. 150-152 °C. ¹H NMR (400 MHz, CD₃OD) δ 8.08 (s, 1H), 7.55 – 7.41 (m, 5H), 7.19 (d, J = 8.2 Hz, 2H), 3.95 (s, 3H), 3.69 (s, 3H), 2.54 (s, 3H); ¹³C NMR (100 MHz, CD₃OD) δ 156.58, 153.18, 150.13, 139.34, 139.29, 133.21, 129.32, 128.31, 128.15, 126.35, 122.00, 105.68, 101.76, 55.07, 54.68, 14.85; ESI-HRMS m/z calcd for C₁₈H₁₈O₂N [M+H]⁺ 280.1332, found 280.1335.

6-fluoro-4-methyl-1-phenylisoquinoline 6f Yield: 65%. Brown solid. m.p. 106-109 °C. ¹H NMR (400 MHz, CD₃OD) δ 8.28 (s, 1H), 8.02 (dd, J = 9.3, 5.7 Hz, 1H), 7.70 (dd, J = 10.3, 2.4 Hz, 1H), 7.55 – 7.47 (m, 5H), 7.36 (td, J = 9.1, 2.5 Hz, 1H), 2.58 (s, 3H); ¹³C NMR (100 MHz, CD₃OD) δ 164.60, 162.09, 159.11, 141.18, 138.67, 138.24, 138.14, 131.43, 131.33, 129.48, 128.62, 128.13, 127.36, 127.31, 123.42, 117.22, 116.97, 107.19, 106.98, 14.64; ESI-HRMS m/z calcd for C₁₆H₁₃NF [M+H]⁺ 238.1027, found 238.1028.
6-chloro-4-methyl-1-phenylisoquinoline 6g Yield: 64%. Brown solid. m.p. 80-82 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.27 (s, 1H), 8.03 (d, $J = 8.9$ Hz, 1H), 7.83 (s, 1H), 7.69 (d, $J = 9.0$ Hz, 1H), 7.49 (s, 5H), 2.59 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 158.33, 140.95, 138.27, 134.53, 132.78, 130.93, 129.42, 128.73, 128.22, 127.58, 126.75, 126.17, 125.64, 14.56; ESI-HRMS m/z calcd for C$_{16}$H$_{13}$NCl [M+H]$^+$ 254.0731, found 254.0734.

4-methyl-1-(p-tolyl)isoquinoline 6h Yield: 70%. Brown solid. m.p. 51-54 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.20 (s, 1H), 7.99 (d, $J = 8.5$ Hz, 1H), 7.91 (d, $J = 8.5$ Hz, 1H), 7.70 (dd, $J = 8.2$, 7.1 Hz, 1H), 7.48 (dd, $J = 8.2$, 7.2 Hz, 1H), 7.36 (d, $J = 7.6$ Hz, 2H), 7.26 (d, $J = 7.8$ Hz, 2H), 2.56 (s, 3H), 2.36 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 159.29, 140.22, 138.56, 136.25, 136.00, 130.31, 129.49, 128.65, 127.79, 127.28, 126.97, 126.17, 123.28, 19.97, 14.63; ESI-HRMS m/z calcd for C$_{17}$H$_{16}$N [M+H]$^+$ 234.1277, found 234.1280.

1-(4-ethylphenyl)-4-methylisoquinoline 6i Yield: 71%. Brown solid. m.p. 38-40 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.19 (s, 1H), 7.98 (d, $J = 8.5$ Hz, 1H), 7.91 (d, $J = 8.5$ Hz, 1H), 7.69 (dd, $J = 8.2$, 7.1 Hz, 1H), 7.47 (dd, $J = 8.2$, 7.2 Hz, 1H), 7.39 (d, $J = 7.5$ Hz, 2H), 7.28 (d, $J = 7.8$ Hz, 2H), 2.69 – 2.63 (m, 2H), 2.55 (s, 3H), 1.23 – 1.19 (m, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 159.32, 144.98, 140.23, 136.27, 136.25, 130.31, 129.60, 127.81, 127.50, 127.28, 126.98, 126.18, 123.28, 28.30, 14.74, 14.64; ESI-HRMS m/z calcd for C$_{18}$H$_{18}$N [M+H]$^+$ 248.1435, found 248.1435.
1-(4-isopropylphenyl)-4-methylisoquinoline 6j Yield: 70%. Brown oil. $^1$H NMR (400 MHz, CD$_3$OD) $\delta$ 8.21 (s, 1H), 8.01 (d, $J = 8.5$ Hz, 1H), 7.94 (d, $J = 8.5$ Hz, 1H), 7.72 (t, $J = 7.7$ Hz, 1H), 7.49 (t, $J = 7.7$ Hz, 1H), 7.42 (d, $J = 7.9$ Hz, 2H), 7.33 (d, $J = 7.8$ Hz, 2H), 2.93 (hept, $J = 6.7$ Hz, 1H), 2.58 (s, 3H), 1.24 (d, $J = 6.9$ Hz, 6H); $^{13}$C NMR (100 MHz, CD$_3$OD) $\delta$ 159.29, 149.53, 140.25, 136.42, 136.24, 130.30, 129.62, 127.83, 127.27, 126.98, 126.17, 126.07, 123.28, 33.89, 23.03, 14.65; ESI-HRMS m/z calcd for C$_{19}$H$_{20}$N [M+H]$^+$ 262.1590, found 262.1595.

1-(4-methoxyphenyl)-4-methylisoquinoline 6k Yield: 75%. Brown solid. m.p. 100-102 °C. $^1$H NMR (400 MHz, CD$_3$OD) $\delta$ 8.18 (s, 1H), 7.95 (dd, $J = 12.6$, 8.6 Hz, 2H), 7.68 (t, $J = 7.6$ Hz, 1H), 7.47 (t, $J = 7.7$ Hz, 1H), 7.41 (d, $J = 8.4$ Hz, 2H), 6.99 (d, $J = 8.5$ Hz, 2H), 3.78 (s, 3H), 2.54 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) $\delta$ 160.33, 159.00, 140.21, 136.30, 131.14, 130.91, 130.27, 127.82, 127.05, 126.94, 126.20, 123.28, 113.45, 54.46, 14.62; ESI-HRMS m/z calcd for C$_{17}$H$_{16}$O$_2$N [M+H]$^+$ 250.1226, found 250.1228.

1-(4-fluorophenyl)-4-methylisoquinoline 6l Yield: 67%. Brown solid. m.p. 140-142 °C. $^1$H NMR (400 MHz, CD$_3$OD) $\delta$ 8.24 (s, 1H), 8.03 (d, $J = 8.5$ Hz, 1H), 7.90 (d, $J = 8.5$ Hz, 1H), 7.74 (t, $J = 7.6$ Hz, 1H), 7.53 (dd, $J = 8.4$, 5.6 Hz, 3H), 7.21 (t, $J = 8.7$ Hz, 2H), 2.59 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) $\delta$ 164.38, 161.92, 158.12, 140.31, 136.28, 135.14, 135.11, 131.63, 131.55, 130.45, 127.73, 127.47, 127.23, 126.10, 123.42, 115.02, 114.80, 14.62; ESI-HRMS m/z calcd for C$_{16}$H$_{13}$NF [M+H]$^+$ 238.1027, found 238.1028.
1-(4-chlorophenyl)-4-methylisoquinoline 6m Yield: 65%. Brown solid. m.p. 97-99 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.25 (s, 1H), 8.04 (d, $J = 8.5$ Hz, 1H), 7.89 (d, $J = 8.5$ Hz, 1H), 7.75 (t, $J = 7.7$ Hz, 1H), 7.56 – 7.46 (m, 5H), 2.60 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 157.83, 140.40, 137.49, 136.24, 134.58, 131.12, 130.46, 128.23, 127.89, 127.30, 127.29, 125.94, 123.43, 14.65; ESI-HRMS m/z calcd for C$_{16}$H$_{13}$Cl[M+H]$^+$ 254.0731, found 254.0734.

4-methyl-1-(4-(trifluoromethyl)phenyl)isoquinoline 6n Yield: 63%. Brown solid. m.p. 123-126 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.29 (s, 1H), 8.07 (d, $J = 8.4$ Hz, 1H), 7.88 (d, $J = 8.5$ Hz, 1H), 7.82 – 7.74 (m, 3H), 7.71 (d, $J = 8.1$ Hz, 2H), 7.56 (dd, $J = 8.1, 7.2$ Hz, 1H), 2.62 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 157.58, 142.80, 140.54, 136.26, 130.59, 130.28, 128.36, 127.51, 127.13, 125.92, 125.06, 125.02, 124.99, 124.95, 123.54, 14.66; ESI-HRMS m/z calcd for C$_{17}$H$_{13}$NF$_3$[M+H]$^+$ 288.0995, found 288.0998.

4-(4-methylisoquinolin-1-yl)benzonitrile 6o Yield: 62%. Brown solid. m.p. 139-141 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.31 (s, 1H), 8.08 (d, $J = 8.5$ Hz, 1H), 7.91 – 7.81 (m, 3H), 7.78 (t, $J = 7.6$ Hz, 1H), 7.71 (d, $J = 8.0$ Hz, 2H), 7.57 (t, $J = 7.6$ Hz, 1H), 2.62 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 157.13, 143.56, 140.68, 136.28, 132.00, 130.64, 130.58, 128.59, 127.60, 126.94, 125.77, 123.61, 118.09, 112.24, 14.68; ESI-HRMS m/z calcd for C$_{17}$H$_{13}$N$_2$[M+H]$^+$ 245.1073, found 245.1077.
4-methyl-1-(pyridin-3-yl)isoquinoline 6p. Yield: 62%. Brown solid. m.p. 76.79 °C. $^1$H NMR (400 MHz, CD$_3$OD) δ 8.73 (s, 1H), 8.65 (d, $J = 4.4$ Hz, 1H), 8.35 (s, 1H), 8.11 (d, $J = 8.5$ Hz, 1H), 8.08 – 8.01 (m, 1H), 7.91 (d, $J = 8.5$ Hz, 1H), 7.81 (t, $J = 7.7$ Hz, 1H), 7.67 – 7.53 (m, 2H), 2.65 (s, 3H); $^{13}$C NMR (100 MHz, CD$_3$OD) δ 155.40, 149.44, 148.83, 140.87, 138.07, 135.38, 130.90, 130.62, 128.47, 127.66, 126.76, 126.08, 123.63, 14.69; ESI-HRMS m/z calcd for C$_{15}$H$_{13}$N$_2$ [M+H]$^+$ 221.1073, found 221.1076.

Tert-butyl (2-(2-acetylphenyl)allyl)carbamate 3a. Yield: 85%. Brown oil. $^1$H NMR (400 MHz, Acetone) δ 7.62 (d, $J = 7.7$ Hz, 1H), 7.48 (dd, $J = 7.5$, 1.2 Hz, 1H), 7.41 (td, $J = 7.5$, 1.2 Hz, 1H), 7.32 (d, $J = 7.6$ Hz, 1H), 6.22 (s, 1H), 5.25 (d, $J = 1.5$ Hz, 1H), 4.90 (d, $J = 1.3$ Hz, 1H), 4.01 (d, $J = 6.1$ Hz, 2H), 2.51 (s, 3H), 1.37 (s, 9H); $^{13}$C NMR (100 MHz, Acetone) δ 202.09, 155.69, 147.95, 139.87, 139.75, 130.55, 129.51, 128.06, 127.47, 113.71, 76.81, 45.60, 29.19, 27.69; ESI-HRMS m/z calcd for C$_{16}$H$_{21}$O$_3$NNa [M+Na]$^+$ 298.1414, found 298.1417.
Experimental Procedures and Characterization Data:
Isoquinolines derivatives

General procedure for the synthesis of 1-phenyl-4-(bromomethyl)isoquinoline (7):

A solution of 6a (220 mg, 1 mmol), NBS (196 mg, 1.1 mmol) and AIBN (17 mg, 0.1 mmol) in benzene (10 mL) was reflux under argon for 1h. After cooled to room temperature, the solvent was removed in vacuo. The residue was dissolved in EtOAc (15 mL), washed with brine, dried over Na$_2$SO$_4$, filtered and concentrated in vacuo. The crude residue was purified by flash column chromatography over silica gel (eluting with CH$_2$Cl$_2$/EtOA=100:1) to provide the desired product (253 mg, 85% yield) as yellow solid. m.p. 225-227°C. $^1$H NMR (400 MHz, Acetone) δ 8.75 (s, 1H), 8.33 (d, $J$ = 8.5 Hz, 1H), 8.16 (d, $J$ = 8.5 Hz, 1H), 7.97 – 7.89 (m, 1H), 7.74 – 7.67 (m, 3H), 7.62 – 7.52 (m, 3H), 5.22 (s, 2H); $^{13}$C NMR (100 MHz, Acetone) δ161.68, 142.88, 139.55, 134.57, 130.48, 130.03, 128.68, 128.19, 127.95, 127.63, 126.78, 126.40, 123.67, 28.78; ESI-MS m/z calcd for C$_{16}$H$_{13}$NBr [M+H]$^+$ 298.0226, found 298.0236.

General procedure for the synthesis of 1-phenyl-4-(hydroxymethyl)isoquinoline (8):

A solution of 7 (230 mg, 0.77 mmol), CH$_3$COOH (70 mg, 1.2 mmol) and Et$_3$N (155 mg, 1.5 mmol) in CH$_3$CN (10 mL) was heated at 60°C for 30 min. Then solvent was removed in vacuo and the residue was dissolved in MeOH (10 mL) followed by NaOH (616 mg, 15.4 mmol) added. The mixture was reflux for 1 h, then cooled to room temperature. After MeOH was removed in vacuo, the residue was washed with saturated aqueous NH$_4$Cl solution and brine, dried over Na$_2$SO$_4$, filtered and concentrated in vacuo. The crude residue was purified by flash column chromatography over silica gel (eluting with CH$_2$Cl$_2$/MeOH=100:1 to 30:1) to provide the desired product (127 mg, 70%) as yellow solid. m.p. 105-108°C. $^1$H NMR (400 MHz, Acetone) δ 8.60 (s, 1H), 8.29 (d, $J$ = 8.5 Hz, 1H), 8.10 (d, $J$ = 8.5 Hz, 1H), 7.83 – 7.79 (m, 1H), 7.71 – 7.66 (m, 2H), 7.66 – 7.60 (m, 1H), 7.60 – 7.49 (m, 3H), 5.14 (s, 2H); $^{13}$C NMR (100 MHz, Acetone) δ160.25, 140.89, 139.96, 135.14, 129.99, 129.92, 129.63, 128.35, 128.11, 127.49, 126.95, 126.08, 123.89, 60.10;
ESI-HRMS m/z calcld for C_{16}H_{14}ON [M+H]^+ 236.1070, found 236.1072.

**General procedure for the synthesis of 1-phenylisoquinoline-4-carbaldehyde (9):**

![Chemical structure of 9](image)

To a solution of 8 (100 mg, 0.43 mmol) in CH_2Cl_2 (5 mL) was added MnO_2 (740 mg, 8.5 mmol). The mixture was stirred at room temperature for 6 h, then filtered through diatomite and the filtrate was concentrated in vacuo to afford 9 (90 mg, 90%) as white solid. m.p. 149-151 °C. ^1H NMR (400 MHz, Acetone) δ 10.49 (s, 1H), 9.31 (d, J = 8.6 Hz, 1H), 9.12 (s, 1H), 8.22 (d, J = 8.5 Hz, 1H), 8.06 – 7.92 (m, 1H), 7.82 – 7.73 (m, 3H), 7.65 – 7.58 (m, 3H); ^13C NMR (100 MHz, Acetone) δ 193.04, 166.02, 152.19, 139.15, 133.41, 132.84, 130.18, 129.38, 128.31, 128.23, 128.18, 126.12, 124.29, 123.6;

ESI-HRMS m/z calcld for C_{16}H_{14}ON [M+H]^+ 234.0913, found 234.0915.

**Reference**

$^1$H and $^{13}$C NMR Spectra
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