Supporting Information

Metal-Free Arylalkylation of N-Aryl Acrylamides with AzobisisoalkylNitriles

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General Experimental Details:

All manipulations were carried out under argon using standard Schlenk techniques. All glassware was oven or flame dried immediately prior to use. All solvents were purified and dried according to standard methods prior to use, unless stated otherwise. All reagents were obtained from commercial sources and used without further purification. Thin-layer chromatography (TLC) was performed using 60 mesh silica gel plates visualized with short-wavelength UV light (254 nm). Silica gel 60 (230 -400 mesh) was used for column chromatography. 1H NMR spectra were obtained at 400 MHz and recorded relative to the tetramethylsilane signal (0 ppm) or residual protio-solvent. 13C NMR spectra were obtained at 100 MHz, and chemical shifts were recorded relative to the solvent resonance (CDCl3, 77.0 ppm). Data for 1H NMR are recorded as follows: chemical shift (δ, ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet or unresolved, br = broad singlet, coupling constant(s) in Hz, integration). Data for 13C NMR are reported in terms of chemical shift (δ, ppm). IR spectra were recorded on a Nicolet FT-IR spectrometer and only major peaks are reported in cm⁻¹. High resolution mass spectra were obtained using an Agilent 6210 Series TOF LC-MS equipped with electrospray ionization (ESI) probe operating in positive ion mode. Melting points were measured with SGW-4 micro melting point apparatus without further correction.
General Procedure for preparation of substrats
All of compounds in Table 2 were synthesized according to the literature, and the NMR spectroscopy were consisted with those data.\textsuperscript{1,2}

![Chemical reaction diagram](image)

General procedure of the reaction of 1 with AIBN.

An oven-dried 15 mL screw-capped vial containing 1 (0.2 mmol), AIBN (0.4 mmol), DTBP (0.3 mmol) were evacuated and purged with Ar gas three times. Then, DCE(2.00 mL) was added via syringe. The reaction mixture was stirred at 80 °C for 16 h. After cooling to room temperature, the solvent was evaporated and then the residue was purified on a silica gel column using petroleum ether /ethyl acetate (4/1) as eluent to give the desired product 2.

Kinetic isotopic effect (KIE) studies
Intermolecular KIE experiment: To a mixture of N-arylacrylamides 1a (0.1 mmol) and 1a-d5(0.1 mmol), AIBN (0.2 mmol) in DCE (2 mL) was added DTBP (0.3 mmol) at room temperature. The mixture in sealed tube was heated at 80 °C for 16 h and cooled down to room temperature. The excess solvent was removed under vacuum, and the residue subjected to silica gel chromatography. The product was analyzed by \textsuperscript{1}H-NMR (400 MHz) (Figure S1). The result was summarized:

![Reaction diagram](image)

1a:1a-d5=1:1

75\% yield, $k_{\text{H}}/k_{\text{D}}$=1.0
Figure S1: The $^1$H-NMR spectrum of 2a and 2a-$d^4$

The data of characterization

3-(1,3-dimethyl-2-oxindolin-3-yl)-2,2-dimethylpropanenitrile (2a)
White solid; m. p. 118 °C; $^1$H NMR (400 MHz, CDCl$_3$) δ 7.35 (m, 2H), 7.14 (t, J = 7.5 Hz, 1H), 6.93 (d, J = 7.7 Hz, 1H), 3.27 (s, 3H), 2.35 (d, J = 14.6 Hz, 1H), 2.19 (d, J = 14.6 Hz, 1H), 1.38 (s, 3H), 1.19 (s, 3H), 1.11 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 179.67, 143.16, 130.93, 128.65, 124.70, 123.97, 122.48, 108.52, 47.01, 46.56, 30.72, 29.70, 27.44, 26.65, 26.39; IR: max (thin film) (cm$^{-1}$)=3059, 2967, 2936, 2233, 1715, 1609, 1493, 1469, 1377, 1349, 1338, 1136, 1021, 774; HRMS (ESI-TOF) m/z: calcd for C$_{15}$H$_{18}$N$_2$NaO$: 265.1317$(M+Na)^{+}$, found: 265.1318.

3-(1-benzyl-3-methyl-2-oxindolin-3-yl)-2,2-dimethylpropanenitrile (2b)
Clear oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.38-7.31 (m, 5H), 7.30-7.24 (m, 2H), 7.11 (t, d= 7.8 Hz, 1H), 6.87 (d, J = 7.8 Hz, 1H), 5.16 (d, J = 15.5 Hz, 1H), 4.76 (d, J = 15.5 Hz, 1H), 2.39 (d, J = 14.6 Hz, 1H), 2.26 (d, J = 14.7 Hz, 1H), 1.43 (s, 3H), 1.23 (s, 3H), 1.06 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.75, 142.30, 135.77, 130.87, 128.77, 128.52, 127.69, 127.61, 124.88, 124.17, 122.48, 109.51, 47.05, 46.24, 44.10, 30.80, 29.77, 28.12, 26.36; IR: max (thin film) (cm$^{-1}$) = 2975, 2926, 1708, 1612, 1489, 1468, 1453, 1380, 1357, 1177, 756; HRMS (ESI-TOF) m/z: calc'd for C$_{21}$H$_{23}$N$_2$NaO$^+$: 341.1630(M+Na)$^+$, found: 341.1633.

![Image of 3-(1-ethyl-3-methyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2e)](image)

3-(1-ethyl-3-methyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2e)

Yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.36 (m, 2H), 7.13 (t, J = 7.5 Hz, 1H), 6.95 (d, J = 7.8 Hz, 1H), 3.82 (m, 2H), 2.35 (d, J = 14.7 Hz, 1H), 2.23 (d, J = 14.7 Hz, 1H), 1.36 (s, 3H), 1.31 (t, J = 7.2 Hz, 4H), 1.24 (s, 3H), 1.09 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.27, 142.16, 131.07, 128.55, 125.06, 124.22, 122.27, 108.60, 46.96, 46.16, 34.83, 30.85, 29.83, 27.91, 26.09, 12.29; IR: max (thin film) (cm$^{-1}$) = 2976, 2932, 1711, 1612, 1489, 1468, 1377, 1359, 1216, 1130, 766; HRMS (ESI-TOF) m/z: calc'd for C$_{16}$H$_{20}$N$_2$NaO$^+$: 279.1473(M+Na)$^+$, found: 279.1475.

![Image of 3-(1-butyl-3-methyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2f)](image)

3-(1-butyl-3-methyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2f)

Yellow oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.33 (m, 2H), 7.11 (t, J = 7.5 Hz, 1H), 6.93 (d, J = 7.8 Hz, 1H), 3.74 (m, 2H), 2.33 (d, J = 14.7 Hz, 1H), 2.22 (d, J = 14.6 Hz, 1H), 1.68 (m, 2H), 1.44 (m, 2H), 1.36 (s, 3H), 1.23 (s, 3H), 1.08 (s, 3H), 0.98 (t, J = 7.3 Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.59, 142.58, 131.03, 128.52, 124.96, 124.19, 122.25, 108.75, 46.96, 46.13, 40.03, 30.83, 29.82, 29.25, 28.00, 26.13, 20.29, 13.75; IR: max (thin film) (cm$^{-1}$) = 2964, 2931, 2973, 2234, 1712, 1611, 1488, 1468, 1359, 1199, 755; HRMS (ESI-TOF) m/z: calc'd for C$_{16}$H$_{24}$N$_2$NaO$^+$: 284.1889(M+Na)$^+$, found: 284.1890.

![Image of 2,2-dimethyl-3-(1,3,5-trimethyl-2-oxoindolin-3-yl)propanenitrile (2g)](image)

2,2-dimethyl-3-(1,3,5-trimethyl-2-oxoindolin-3-yl)propanenitrile (2g)

White solid; m. p. 98 °C; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.16-7.14 (m, 2H), 6.81 (d, J = 7.7 Hz,
1H), 3.23 (d, J = 11.4 Hz, 3H), 2.38 (s, 3H), 2.33 (d, J = 14.6 Hz, 1H), 2.17 (d, J = 14.6 Hz, 1H), 1.36 (s, 3H), 1.19 (s, 3H), 1.09 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.63, 140.73, 132.03, 130.88, 128.77, 125.59, 124.09, 108.18, 47.03, 46.48, 30.76, 29.74, 27.47, 26.47, 26.41, 21.18; IR max (thin film) (cm$^{-1}$) = 2969, 2941, 2234, 1710, 1610, 1493, 1469, 1377, 1349, 1338, 1136, 1019, 775; HRMS (ESI-TOF) m/z: calcd for C$_{18}$H$_{26}$N$_2$NaO$^+$: 279.1473(M+Na)$^+$, found: 279.1475.

3-(5-(tert-butyl)-1,3-dimethyl-2-oxindolin-3-yl)-2,2-dimethylpropanenitrile (2h)
White solid; m. p. 102 °C; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.37 (m, 2H), 6.86 (d, J = 8.7 Hz, 1H), 3.25 (s, 3H), 2.36 (d, J = 14.6 Hz, 1H), 2.20 (d, J = 14.6 Hz, 1H), 1.38 (s, 3H), 1.35 (s, 9H), 1.18 (s, 3H), 1.08 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.90, 145.64, 140.67, 130.45, 125.10, 124.10, 122.10, 107.88, 47.19, 46.50, 34.57, 31.52, 30.77, 29.67, 27.54, 26.45, 26.40; IR max (thin film) (cm$^{-1}$) = 2967, 2923, 1705, 1620, 1499, 1451, 1366, 1242, 1110, 1051, 888; HRMS (ESI-TOF) m/z: calcd for C$_{19}$H$_{28}$N$_2$NaO$^+$: 321.1943(M+Na)$^+$, found: 321.1945.

3-(5-methoxy-1,3-dimethyl-2-oxindolin-3-yl)-2,2-dimethylpropanenitrile (2i)
White solid; m. p. 99 °C; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.97 (d, J = 2.1 Hz, 1H), 6.89 (dd, J = 8.4, 2.2 Hz, 1H), 6.83 (d, J = 8.5 Hz, 1H), 3.84 (s, 3H), 3.24 (s, 3H), 2.33 (d, J = 114.6 Hz, 1H), 2.17 (d, J = 14.6 Hz, 1H), 1.37 (s, 3H), 1.22 (s, 3H), 1.10 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.33, 155.95, 132.20, 124.12, 113.18, 112.22, 108.82, 55.97, 47.43, 46.42, 30.76, 29.79, 27.56, 26.48, 2638; IR max (thin film) (cm$^{-1}$) = 2955, 2921, 1705, 1597, 1494, 1463, 1434, 1291, 1210, 1123, 1041, 807; HRMS (ESI-TOF) m/z: calcd for C$_{16}$H$_{20}$N$_2$O$_2$$: 295.1422(M+Na)$^+$, found: 295.1425.

3-(5-ethoxy-1,3-dimethyl-2-oxindolin-3-yl)-2,2-dimethylpropanenitrile (2j)
White solid; m. p. 128 °C; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.96 (d, J = 2.0 Hz, 1H), 6.88 (dd, J = 8.5, 1.9 Hz, 1H), 6.81 (d, J = 8.4 Hz, 1H), 4.04 (m, 2H), 3.23 (s, 3H), 2.34 (d, J = 14.6 Hz, 1H), 2.15 (d, J = 14.6 Hz, 1H), 1.42 (t, J = 7.0 Hz, 3H), 1.36 (s, 3H), 1.20 (s, 3H), 1.11 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.33, 155.30, 136.59, 132.22, 124.09, 114.04, 112.77, 108.84, 64.31, 47.42, 46.48, 30.75, 29.73, 27.54, 26.57, 26.46, 14.93; IR max (thin film) (cm$^{-1}$) = 2975, 2920, 2849, 1705,
1605, 1492, 1474, 1459, 1471, 1360, 1341, 1245, 1125, 1113, 801; HRMS (ESI-TOF) m/z: calcd
for C_{17}H_{22}N_{2}NaO_{5}^+: 309.1579(M+Na)^+, found: 309.1583.

3-(1,3-dimethyl-2-oxo-5-(trifluoromethyl)indolin-3-yl)-2,2-dimethylpropanenitrile (2k)
White solid; m. p. 138°C; ^1H NMR (400 MHz, CDCl_3) δ 7.65 (d, J = 8.2 Hz, 1H), 7.56 (s, 1H),
7.01 (d, J = 8.2 Hz, 1H), 3.31 (s, 3H), 2.39 (d, J = 14.7 Hz, 1H), 2.19 (d, J = 14.7 Hz, 1H), 1.41 (s,
3H), 1.16 (s, 3H), 1.15 (s, 3H); ^13C NMR (100 MHz, CDCl_3) δ 179.47, 146.21, 131.65, 126.40 (q,
J = 3.9 Hz), 124.81 (q, J = 32.32 Hz), 124.34 (q, J = 271.69 Hz), 123.47, 123.00, 121.67 (q, J = 3.6
Hz), 108.32, 47.02, 46.62, 30.57, 29.54, 27.32, 27.28, 26.60; IR: max(thin film) (cm⁻¹)= 2968, 2933,
1710, 1608, 1489, 1470, 1375, 1350, 1344, 1135, 1021, 776; HRMS (ESI-TOF) m/z: calcd
for C_{16}H_{17}F_{3}N_2NaO^+: 333.1191(M+Na)^+, found: 333.1195.

3-(5-fluoro-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2l)
Yellow oil; ^1H NMR (400 MHz, CDCl_3) δ 7.09 (m, 3H), 6.85 (dd, J = 8.3, 4.1 Hz, 1H), 3.26 (s,
3H), 2.36 (d, J = 14.6 Hz, 1H), 2.14 (d, J = 14.6 Hz, 1H), 1.38 (s, 3H), 1.20 (s, 3H), 1.14 (s, 3H);
^13C NMR (100 MHz, CDCl_3) δ 179.21, 160.45 (d, J = 241.39 Hz), 139.15, 132.75, 123.72, 115.04
(d, J = 24.24 Hz), 112.86 (d, J = 25.25 Hz), 109.02 (d, J = 8.1 Hz), 47.45, 46.58, 30.65, 29.70,
27.33, 26.90, 26.52, 24.81, 19.42; IR: max(thin film) (cm⁻¹)= 2975, 2931, 1713, 1650, 1621, 1494,
1470, 1378, 1352, 1270, 1116, 812; HRMS (ESI-TOF) m/z: calcd for C_{15}H_{17}FN_2NaO^+: 283.1223(M+Na)^+, found: 283.1226.

3-(5-chloro-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2m)
White solid; m. p. 136°C; ^1H NMR (400 MHz, CDCl_3) δ 7.34 (dd, J = 8.2, 2.1 Hz, 1H), 7.31 (d, J =
1.9 Hz, 1H), 6.85 (d, J = 8.2 Hz, 1H), 3.26 (s, 3H), 2.36 (d, J = 14.6 Hz, 1H), 2.14 (d, J = 14.6 Hz,
1H), 1.38 (s, 3H), 1.19 (s, 3H), 1.14 (s, 3H); ^13C NMR (100 MHz, CDCl_3) δ 179.05, 141.79,
132.77, 128.57, 128.01, 125.06, 123.67, 109.46, 47.27, 46.58, 30.64, 29.65, 27.30, 27.10, 26.51;
IR: max(thin film) (cm⁻¹)= 2967, 2919, 2849, 1716, 1607, 1490, 1376, 844; HRMS (ESI-TOF) m/z:
calcd for C_{15}H_{17}ClN_2NaO^+: 299.0927(M+Na)^+, found: 299.0931.
3-(5-bromo-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2n)
White solid; m. p. 140 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.49 (dd, J = 8.3, 1.8 Hz, 1H), 7.44 (d, J = 1.8 Hz, 1H), 6.81 (d, J = 8.2 Hz, 1H), 3.25 (s, 3H), 2.36 (d, J = 14.6 Hz, 1H), 2.13 (d, J = 14.6 Hz, 1H), 1.38 (s, 3H), 1.19 (s, 3H), 1.15 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 142.28 (s), 133.17, 131.47, 127.80, 123.66, 115.24, 109.97, 47.24, 46.61, 30.64, 29.63, 27.32, 27.17, 26.51; IR max (thin film) (cm\(^{-1}\)) = 2975, 2920, 2849, 1705, 1605, 1492, 1474, 1360, 1341, 1245, 801; HRMS (ESI-TOF) m/z: calcd for C\(_{18}\)H\(_{17}\)BrN\(_2\)NaO\(^+\): 343.0422(M+Na)^+, found: 343.0423.

3-(5-iodo-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2o)
White solid; m. p. 139 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.68 (dd, J = 8.2, 1.7 Hz, 1H), 7.61 (d, J = 1.6 Hz, 1H), 6.72 (d, J = 8.2 Hz, 1H), 3.24 (s, 3H), 2.35 (d, J = 14.6 Hz, 1H), 2.12 (d, J = 14.6 Hz, 1H), 1.37 (s, 3H), 1.18 (s, 3H), 1.14 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 178.38, 143.10, 137.40, 133.48, 133.35, 123.65, 110.53, 47.06, 46.59, 29.59, 27.29, 27.19, 26.43; IR max (thin film) (cm\(^{-1}\)) = 2972, 2918, 2850, 1708, 1602, 1491, 1475, 1359, 1340, 1243, 805; HRMS (ESI-TOF) m/z: calcd for C\(_{18}\)H\(_{17}\)IN\(_2\)NaO\(^+\): 391.0283(M+Na)^+, found: 391.0284.

3-(7-bromo-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2p)
Yellow oil; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.46 (d, J = 7.6 Hz, 1H), 7.27 (d, J = 7.4 Hz, 1H), 6.98 (t, J = 7.8 Hz, 1H), 3.65 (s, 3H), 2.34 (d, J = 14.6 Hz, 1H), 2.18 (d, J = 14.6 Hz, 1H), 1.37 (s, 3H), 1.22 (s, 3H), 1.11 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 180.07, 140.48, 134.33, 133.95, 123.86, 123, 79, 123.66, 102.84, 46.73, 46.63, 30.65, 30.04, 29.86, 27.88, 26.36; IR max (thin film) (cm\(^{-1}\)) = 2975, 2927, 2233, 1721, 1606, 1461, 1366, 1331, 1251, 1061, 738; HRMS (ESI-TOF) m/z: calcd for C\(_{18}\)H\(_{17}\)BrN\(_2\)NaO\(^+\): 343.0422(M+Na)^+, found: 343.0423.
2,2-dimethyl-3-(1-methyl-2-oxo-2,4,5,6-tetrahydro-1H-pyrrolo[3,2,1-ij]quinolin-1-yl)propane nitrile (2q)

Clear oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.17 (d, J = 7.3 Hz, 1H), 7.10 (d, J = 7.6 Hz, 1H), 7.01 (t, J = 7.5 Hz, 1H), 3.76 (m, 2H), 2.83 (m, 2H), 2.35 (d, J = 14.6 Hz, 1H), 2.16 (d, J = 14.6 Hz, 1H), 2.04 (m, 2H), 1.38 (s, 3H), 1.20 (s, 3H), 1.14 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 178.51, 139.00, 129.48, 127.35, 124.05, 122.58, 121.87, 120.63, 48.35, 46.45, 39.03, 30.78, 29.64, 27.20, 26.87, 24.65, 21.10; IR: max (thin film) (cm$^{-1}$) = 2971, 2927, 2872, 1712, 1626, 1602, 1482, 1453, 1385, 1372. 1354, 1241, 1168, 751; HRMS (ESI-TOF) m/z: calcd for C$_{17}$H$_{20}$N$_2$NaO$^+$: 291.1473 (M+Na)$^+$, found: 291.1475.

3-(4-chloro-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2r)

Clear oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.30 (m, 1H), 7.05 (dd, J = 8.2, 0.6 Hz, 1H), 6.84 (d, J = 7.8 Hz, 1H), 3.26 (s, 3H), 2.61 (d, J = 14.5 Hz, 1H), 2.25 (d, J = 14.5 Hz, 1H), 1.52 (s, 3H), 1.21 (s, 3H), 1.17 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 178.81, 145.03, 132.01, 129.90, 127.79, 123.77, 123.24, 107.09, 48.30, 44.21, 30.73, 28.33, 27.88, 26.60, 23.69; IR: max (thin film) (cm$^{-1}$) = 2975, 2932, 2246, 1721, 1608, 1587, 1494, 1461, 1378, 1335, 1290, 1130, 1079, 780; HRMS (ESI-TOF) m/z: calcd for C$_{13}$H$_{17}$ClN$_2$NaO$^+$: 299.0927 (M+Na)$^+$, found: 299.0930.

3-(6-chloro-1,3-dimethyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2r')

Clear oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.26 (d, J = 7.9 Hz, 1H), 7.11 (dd, J = 7.9, 1.8 Hz, 1H), 6.93 (d, J = 1.7 Hz, 1H), 3.25 (s, 3H), 2.35 (d, J = 14.7 Hz, 1H), 2.18 (d, J = 14.7 Hz, 1H), 1.36 (s, 3H), 1.21 (s, 3H), 1.10 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 179.61, 144.36, 134.49, 129.19, 125.67, 123.92, 122.37, 109.33, 46.84, 46.40, 30.65, 29.76, 27.51, 26.56, 26.51; IR: max (thin film) (cm$^{-1}$) = 2975, 2932, 2246, 1721, 1608, 1587, 1494, 1461, 1378, 1335, 1290, 1130, 1079, 780; HRMS (ESI-TOF) m/z: calcd for C$_{13}$H$_{17}$ClN$_2$NaO$^+$: 299.0927 (M+Na)$^+$, found: 299.0929.
3-(3-benzyl-1-methyl-2-oxoindolin-3-yl)-2,2-dimethylpropanenitrile (2s)
White solid; m. p. 130°C; $^1$H NMR (400 MHz, CDCl$_3$) δ 7.37 (d, J = 7.4 Hz, 1H), 7.26 (d, J = 7.7 Hz, 1H), 7.15-7.02 (m, 4H), 6.75 (d, J = 7.4 Hz, 2H), 6.62 (d, J = 7.8 Hz, 1H), 3.06 (d, J = 12.5 Hz, 1H), 2.98 (d, J = 12.6 Hz, 1H), 2.94 (s, 3H), 2.49 (d, J = 14.6 Hz, 1H), 2.37 (d, J = 14.6 Hz, 1H), 1.27 (s, 3H), 1.11 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 178.18, 143.75, 134.25, 129.97, 128.76, 127.80, 127.39, 126.76, 125.98, 124.30, 121.95, 108.14, 53.08, 46.81, 45.06, 30.77, 30.04, 26.45, 25.93; IR: max (thin film) (cm$^{-1}$) = 2985, 2920, 2850, 1705, 1612, 1495, 1471, 1378, 1363, 1108, 1086, 752, 703; HRMS (ESI-TOF) m/z: calc for C$_{21}$H$_{22}$N$_2$O: 341.1630 (M+Na)$^+$, found: 341.1632.

2-((1,3-dimethyl-2-oxoindolin-3-yl)methyl)-2-methylbutanenitrile (3a)
White solid; m. p. 124°C; $^1$H NMR (400 MHz, CDCl$_3$) δ 7.39-7.30 (m, 2H), 7.14 (dd, J = 15.7, 7.8 Hz, 1H), 6.93 (d, J = 7.7 Hz, 1H), 3.27 (s, 3H), 2.45 (d, J = 14.6 Hz, 1H), 2.27 (q, J = 14.7 Hz, 1H), 2.07 (d, J = 14.6 Hz, 1H), 1.59-1.53 (m, 1H), 1.46-1.33 (m, 4H), 1.04-0.96 (m, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 180.04, 179.52, 143.36, 143.02, 131.47, 130.86, 128.63, 138.56, 124.92, 124.26, 123.28, 122.78, 122.57, 122.27, 108.60, 108.44, 46.94, 46.88, 45.40, 44.46, 35.64, 35.49, 35.30, 33.14, 27.84, 27.59, 26.42, 26.38, 25.82, 22.73, 9.12, 8.98; IR: max (thin film) (cm$^{-1}$) = 2986, 2927, 2235, 1710, 1609, 1494, 1470, 1361, 1349, 1338, 1136, 1021, 769; HRMS (ESI-TOF) m/z: calc for C$_{16}$H$_{20}$N$_2$O$^+$: 279.1473 (M+Na)$^+$, found: 279.1474.

2-methyl-2-((1,3,5-trimethyl-2-oxoindolin-3-yl)methyl)butanenitrile (3b)
Clear oil; $^1$H NMR (400 MHz, CDCl$_3$) δ 7.20 (s, 0.5H), 7.16-7.12 (m, 1.5H), 6.81 (d, J = 7.8 Hz, 1H), 3.24 (s, 3H), 2.43 (d, J = 14.66 Hz, 0.5H), 2.39 (s+s, 3H), 2.25 (q, J = 14.7 Hz, 1H), 2.04 (d, J = 14.6 Hz, 0.5H), 1.59-1.53 (m, 1H), 1.43-1.33 (m, 4H), 0.99 (m, 6H); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 180.02, 140.94, 140.58, 132.12, 131.79, 131.4, 130.79, 128.72, 125.86, 125.11, 123.43, 122.86, 108.27, 108.09,
2-methyl-2-((1-methyl-2-oxo-2,4,5,6-tetrahydro-1H-pyrrolo[3,2,1-ij]quinolin-1-yl)methyl)butane nitrile (3c)

Clear oil; ¹H NMR (400 MHz, CDCl₃) δ 7.22 (d, J = 7.3 Hz, 0.5H), 7.14-7.08 (m, 1.5H), 7.01 (m, 1H), 3.76 (m, 2H), 2.82 (m, 2H), 2.44 (d, J = 14.6 Hz, 0.5H), 2.25 (q, J = 14.7 Hz, 1H), 2.04 (m, 2.5H), 1.46-1.37 (m, 5H), 1.06-0.96 (m, 6H); ¹³C NMR (100 MHz, CDCl₃) δ 178.86, 178.34, 139.23, 138.83, 130.00, 129.43, 127.28, 123.38, 122.80, 122.01, 121.65, 120.76, 120.46, 53.43, 48.27, 48.21, 45.23, 44.33, 39.08, 38.96, 35.67, 35.56, 35.22, 33.42, 27.61, 27.33, 25.85, 24.67, 24, 65, 22.84, 21.08, 9.12, 8.98; IR: max (thin film) (cm⁻¹) = 2970, 2928, 2871, 1715. 1627, 1603, 1485, 1455, 1386, 1377. 1355, 1243, 1177, 750; HRMS (ESI-TOF) m/z: calcd for C_{18}H_{22}N_{2}NaO⁺: 305.1630 (M+Na)⁺, found: 305.1632.

2-((1-butyl-3-methyl-2-oxindolin-3-yl)methyl)-2-methylbutanenitrile (3d)

Clear oil; ¹H NMR (400 MHz, CDCl₃) δ 7.35 (m, 2H), 7.13 (m, 1H), 6.93 (d, J = 7.8 Hz, 1H), 3.74 (m, 2H), 2.42 (d, J = 14.7 Hz, 1H), 2.28 (q, J = 14.7 Hz, 1H), 2.14 (d, J = 14.7 Hz, 1H), 1.71-1.61 (m, 3H), 1.47-1.40 (m, 3H), 1.36-1.32 (m, 4H), 0.98 (m, 8H); ¹³C NMR (100 MHz, CDCl₃) δ 179.89, 179.38, 142.72, 142.46, 131.52, 130.97, 128.44, 125.17, 124.55, 123.43, 123.00, 122.27, 122.04, 108.78, 108.65, 53.43, 46.82, 45.16, 44.16, 40.01, 35.61, 32.29, 29.36, 29.18, 28.26, 25.72, 22.55, 20.30, 13.76, 9.11, 9.00; IR: max (thin film) (cm⁻¹) = 2979, 2930, 1710, 1615, 1490, 1469, 1367, 1360, 1219, 1136, 759; HRMS (ESI-TOF) m/z: calcd for C_{19}H_{36}N_{2}NaO⁺: 321.1943 (M+Na)⁺, found: 321.1945.

2-((3-benzyl-1-methyl-2-oxindolin-3-yl)methyl)-2-methylbutanenitrile (3e)
Clear oil; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.45 (d, $J = 7.2$ Hz, 0.5H), 7.34 (d, $J = 7.2$ Hz, 0.5H), 7.30-7.25 (m, 1H), 7.18-7.03 (m, 4H), 6.78-6.73 (m, 2H), 6.65-6.61 (m, 1H), 3.10-3.06 (m, 1H), 3.01-2.99 (m, 1H), 2.97 (s, 1.33H), 2.94 (s, 1.53H), 2.60 (d, $J = 14.5$ Hz, 1H), 2.49 (d, $J = 14.7$ Hz, 1H), 2.40 (d, $J = 14.7$ Hz, 1H), 2.28 (d, $J = 14.6$ Hz, 1H), 1.39 (m, 1H), 1.22 (m, 1H), 1.14 (s, 1H), 1.03 (m, 5H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 178.49, 178.01, 143.95, 143.65, 134.27, 130.02, 129.93, 128.74, 128.68, 128.30, 127.76, 127.38, 127.36, 126.76, 126.16, 125.56, 123.61, 123.05, 122.05, 121.74, 108.24, 108.04, 52.99, 47.17, 46.95, 44.15, 43.10, 35.72, 35.64, 35.54, 32.85, 26.11, 25.94, 22.78, 9.24, 9.07; IR: max(thin film) (cm$^{-1}$) = 2981, 2918, 2847, 1708, 1613, 1450, 1477, 1371, 1364, 1106, 1090, 749, 710; HRMS (ESI-TOF) m/z: calcld for C$_{25}$H$_{34}$N$_2$NaO: 355.1781(M+Na)$^+$, found: 355.1784.

Reference:

NMR spectra of compounds

$^1$H-2a
$^{13}\text{C}-2\text{a}$

$^1\text{H}-2\text{b}$
$^{13}$C-2e

$^1$H-2f
$^{13}$C-2f

$^1$H-2g
$^{13}$C-2g

$^1$H-2h
$^{13}$C-2h

$^1$H-2i
$^{12}$C-2i

$^{1}$H-2j
$^{13}$C-2m

$^1$H-2m
$^{13}\text{C-2m}$

$^{1}\text{H-2n}$
$^{12}$C-20

$^1$H-2p
$^{13}$C-$2p$

$^1$H-$2q$
$^{13}$C-2q

$^1$H-2r
$^{13}$C-2r'

The mixture of 2r+2r'
$^{1}H-2s$

$^{13}C-2s$