Supporting Information

Ruthenium-Catalyzed Aerobic Oxidative Coupling of Alkynes with 2-Aryl-Substituted Indoles and Pyrroles

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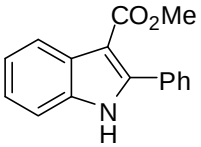
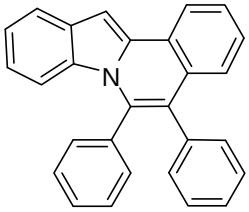
General Remarks

The following starting materials were synthesized according to previously described methods: **1b**,[1] **1c**,[1] **1e**,[1] **1i**–**1l**,[1] **2b**–**2e**,[2] **2f**,[3] **2i**,[4] **1d**,[5] **1g**,[6] **1m**,[7, 8] **1h**,[9] **4e**,[10] and **4a**–**4d**.[11, 12] Other chemicals were obtained from commercial sources, and were used without further purification. *t*AmOH was used as supplied by Merck. Yields refer to isolated compounds, estimated to be >95 % pure as determined by ^{1}H-NMR and GC. TLC: Macherey-Nagel, TLC plates Alugram® Sil G/UV254. Detection under UV light at 254 nm. Chromatography: Separations were carried out on Merck Silica 60 (0.040–0.063 mm, 70–230 mesh ASTM). All IR spectra were taken on a Bruker FT-IR Alpha device. MS: EI-MS: Finnigan MAT 95, 70 eV, DCI-MS: Finnigan MAT 95, 200 eV, reactant gas NH_3; ESI-MS: Finnigan LCQ. High resolution mass spectrometry (HRMS): APEX IV 7T FTICR, Bruker Daltonic. M. p.: Stuart® Melting Point Apparatus SMP3, values are uncorrected. NMR (^{1}H, ^{13}C, ^{19}F) spectra were recorded at 300 (^{1}H), 75.5 {^{13}C, APT (Attached Proton Test)} and 283 MHz (^{19}F), respectively, on Varian Unity-300 and AMX 300 instruments for $CDCl_3$ solutions if not otherwise specified, chemical shifts (δ) are given in ppm.

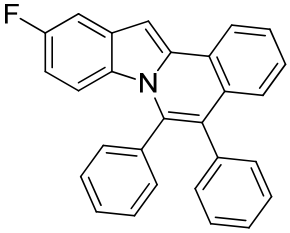


Methyl 2-phenyl-1*H*-indole-3-carboxylate (1f): A solution of MeMgI in Et_2O (3M, 3.3 mL, 10.0 mmol) was added dropwise at ambient temperature to a suspension of 2-phenylindole (**1a**) (0.97 g, 5.0 mmol) in Et_2O (3.0 mL). After 30 min, $ClCO_2Me$ (0.95 g, 10.0 mmol) was added dropwise at 0 °C, and the reaction mixture was stirred for 30 min at ambient temperature. Thereafter, H_2O (10.0 mL) was added to the reaction mixture, and the product was extracted with EtOAc (3 × 20 mL). The combined organic phase was washed with brine (15.0 mL) and dried over Na_2SO_4. After removal of the solvents *in vacuo*, the crude product was purified by column chromatography on silica gel (*n*-hexane/EtOAc: 1/1) to yield **1f** (0.63 g, 50%) as a colorless solid. M. p. = 153−154 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.71 (br s, 1H), 8.25−8.19 (m, 1H), 7.66−7.61 (m, 2H), 7.44−7.24 (m, 6 H), 3.82 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 165.8 (C_q), 144.6 (C_q), 135.1 (C_q), 131.9 (C_q), 129.5 (CH), 129.1 (CH), 128.1 (CH), 127.5 (C_q), 123.2 (CH), 122.1 (CH), 122.1 (CH), 111.0 (CH), 104.4 (C_q), 50.8 (CH_3). IR (neat): 3295, 1662, 1550, 1485, 1446, 1336, 1279, 1129, 1025, 695 cm^{-1}. MS (EI) *m/z* (relative intensity) 251 (50) [M^+], 220 (100), 165 (25). HRMS (EI) *m/z* calcd for $C_{16}H_{13}NO_2$ [M^+] 251.0946, found 251.0943.

Representative Procedure for Ruthenium-Catalyzed Aerobic Coupling of Azoles with Alkynes: The mixture of 2-phenylindole (**1a**) (96.5 mg, 0.50 mmol), diphenylacetylene (**2a**) (178 mg, 1.00 mmol), $[RuCl_2(p\text{-cymene})]_2$ (15.3 mg, 5.0 mol%) and $Cu(OAc)_2 \cdot H_2O$ (10 mg, 10.0 mol%) in *t*AmOH (2 mL) was stirred at 100 °C under air for 22 h. At ambient temperature, the reaction mixture was diluted with H_2O (75 mL) and extracted with EtOAc (3 x 75 mL). The combined organic phase was washed with brine (50 mL) and dried over anhydrous Na_2SO_4. After filtration and evaporation of the solvents under reduced pressure, the crude product was purified by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) to yield **3aa** as a colorless solid (151 mg, 82%).

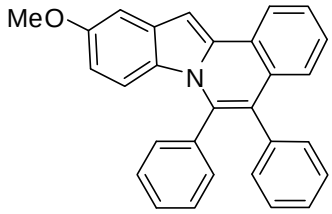


5,6-Diphenylindolo[2,1-a]isoquinoline (3aa): M. p. = 205−206 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.31 (d, J = 6.7 Hz, 1H), 7.80 (d, J = 8.0 Hz, 1H), 7.51 (ddd, J = 7.7, 7.2, 1.3 Hz, 1H), 7.42 (s, 1H), 7.38−7.14 (m, 13H), 6.82 (ddd, J = 7.8, 7.0, 1.3 Hz, 1H), 6.01 (d, J = 8.7 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 136.7 (C_q), 136.0 (C_q), 135.9 (C_q), 135.3 (C_q), 132.7 (C_q), 131.8 (CH), 130.8 (CH), 130.2 (C_q), 129.7 (C_q), 128.7 (CH), 128.6 (CH), 127.8 (CH), 127.3 (CH), 127.0 (CH), 126.7 (CH), 126.2 (CH), 125.4 (C_q), 123.3 (CH), 121.6 (CH), 121.4 (C_q), 120.2 (CH), 120.1 (CH), 114.6 (CH), 94.2 (CH). IR (neat): 1543, 1484, 1443, 1377, 1338, 1245, 1030, 756, 736, 696 cm^{-1}. MS (EI) *m/z* (relative intensity) 369 (100) [M^+], 291 (13). HRMS (EI) *m/z* calcd for $C_{28}H_{19}NO$ [M^+] 369.1517, found 369.1518. The spectral data were in accordance with those reported in the literature.[13]

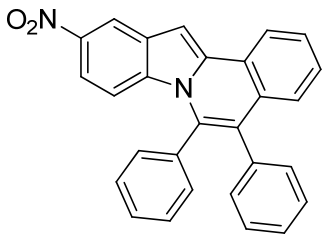


10-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3ba): The representative procedure was followed using 5-fluoro-2-phenyl-1*H*-indole (**1b**) (106 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 50/1) yielded **3ba** (102 mg, 54%) as a yellow solid. M. p. = 227−228 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.26 (d, J = 7.8 Hz, 1H), 7.49 (ddd, J = 7.8, 7.8, 1.2 Hz,

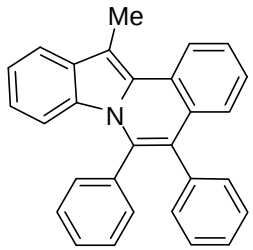
1H), 7.39−7.11 (m, 14H), 6.52 (ddd, J = 9.2, 9.1, 2.6 Hz. 1H), 5.86 (dd, J = 9.4, 4.6 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 158.6 (C_q, J_{C-F} = 238 Hz), 137.4 (C_q), 136.5 (C_q), 135.7 (C_q), 135.0 (C_q), 131.7 (CH), 130.8 (CH), 130.3 (C_q, J_{C-F} = 10 Hz), 130.2 (C_q), 129.4 (C_q), 128.8 (CH), 128.7 (CH), 127.8 (CH), 127.6 (CH), 127.1 (CH), 126.8 (CH), 126.2 (CH), 124.9 (C_q), 123.4 (CH), 121.6 (C_q), 115.6 (CH, J_{C-F} = 9 Hz), 108.5 (CH, J_{C-F} = 26 Hz), 104.3 (CH, J_{C-F} = 23 Hz), 94.0 (CH, J_{C-F} = 4 Hz). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −(121.7 – 121.8) (m). IR (neat): 3054, 1610, 1539, 1485, 1441, 1117, 855, 787, 753, 696 cm^{-1}. MS (EI) *m/z* (relative intensity) 387 (100) [M^+], 309 (30). HRMS (ESI) *m/z* calcd for $C_{28}H_{18}FN$ [M^+] 387.1423, found 387.1422.



10-Methoxy-5,6-diphenylindolo[2,1-a]isoquinoline (3ca): The representative procedure was followed using 5-methoxy-2-phenyl-1*H*-indole (**1c**) (112 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded **3ca** as a colorless solid (85 mg, 43%). M. p. = 210−211 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.29 (d, J = 8.1 Hz, 1H), 7.50 (dd, J = 7.5, 7.1 Hz, 1H), 7.39−7.14 (m, 14H), 6.48 (dd, J = 9.4, 2.7 Hz, 1H), 5.87 (d, J = 9.4 Hz, 1H), 3.86 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 155.1 (C_q), 136.7 (C_q), 136.5 (C_q), 135.8 (C_q), 135.2 (C_q), 131.8 (CH), 130.8 (CH), 130.5 (C_q), 130.1 (C_q), 128.7 (CH), 128.6 (CH), 127.9 (C_q), 127.8 (CH), 127.2 (CH), 126.9 (CH), 126.7 (CH), 126.1 (CH), 125.1 (C_q), 123.2 (CH), 121.0 (C_q), 115.4 (CH), 110.5 (CH), 100.9 (CH), 93.8 (CH), 55.5 (CH_3). IR (neat): 2948, 1613, 1487, 1445, 1336, 1218, 1126, 948, 842, 695 cm^{-1}. MS (EI) *m/z* (relative intensity) 399 (100) [M^+], 356 (53), 278 (12). HRMS (EI) *m/z* calcd for $C_{29}H_{21}NO$ [M^+] 399.1623, found 399.1612. The spectral data were in accordance with those reported in the literature.[13]

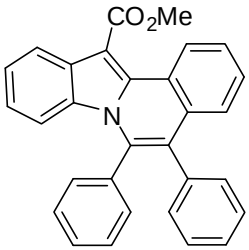


10-Nitro-5,6-diphenylindolo[2,1-a]isoquinoline (3da): The representative procedure was followed using 5-nitro-2-phenyl-1*H*-indole (**1d**) (119 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 25/1) yielded **3da** (141 mg, 71%) as a yellow solid. M. p. = 281−282 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.66 (s, 1H), 8.28 (d, J = 7.8 Hz, 1H), 7.63 (dd, J = 9.4, 2.3 Hz, 1H), 7.58−7.45 (m, 2H), 7.44−7.30 (m, 4H), 7.30−7.08 (m, 8H), 5.96 (d, J = 9.4 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 142.5 (C_q), 138.8 (CH), 135.9 (C_q), 135.3 (C_q), 134.9 (C_q), 134.5 (CH), 131.4 (CH), 130.7 (C_q), 130.2 (CH), 129.2 (CH), 128.9 (CH), 128.8 (CH), 128.4 (CH), 128.0 (CH), 127.7 (CH), 127.1 (CH), 126.6 (C_q), 124.7 (C_q), 123.6 (CH), 123.6 (C_q), 116.7 (C_q), 114.8 (C_q), 114.6 (CH), 95.9 (CH). IR (neat): 3060, 1600, 1545, 1505, 1487, 1336, 1073, 759, 731, 696 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 414 (100) [M^+], 384 (27), 368 (30), 291 (13). HRMS (ESI) *m*/*z* calcd for $C_{28}H_{18}N_2O_2$ [M^+] 414.1368, found 414.1384.

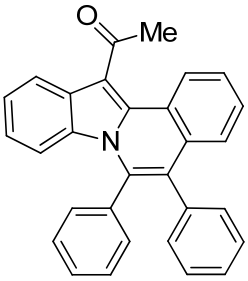


12-Methyl-5,6-diphenylindolo[2,1-a]isoquinoline (3ea): The representative procedure was followed using 3-methyl-2-phenyl-1*H*-indole (**1e**) (104 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded **3ea** as a colorless solid (89 mg, 47%). M. p. = 179−180 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.55 (d, J = 8.3 Hz, 1H), 7.84 (d, J = 8.1 Hz, 1H), 7.55 (ddd, J = 7.6, 7.2, 1.2 Hz, 1H), 7.39−7.16 (m, 13H), 6.86 (ddd, J = 7.8, 6.8, 1.3 Hz, 1H), 6.01 (d, J = 8.7 Hz, 1H), 2.97 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 137.0 (C_q), 136.1 (C_q), 135.7 (C_q), 131.9 (CH), 131.3 (C_q), 131.2 (C_q), 130.9 (C_q), 130.8 (CH), 130.3 (C_q), 128.6 (CH), 128.5 (CH), 127.8 (CH), 127.3 (C_q), 126.6 (CH), 126.6 (CH), 126.4 (CH), 125.9 (CH), 124.4 (CH), 121.0 (CH), 120.9 (C_q), 120.4 (CH), 117.9 (CH), 114.5 (CH), 105.2 (C_q), 12.0 (CH_3). IR (neat): 3052, 3028, 1596, 1474, 1443, 1375, 1336, 1319,

1161, 1025, 776, 752, 735, 698 cm^{-1}. MS (EI) *m/z* (relative intensity) 383 (100) [M^+], 304 (13). HRMS (EI) *m/z* calcd for $C_{29}H_{21}N$ [M^+] 383.1674, found 383.1673.

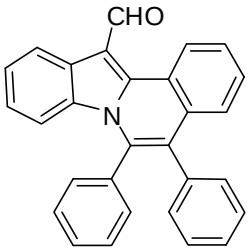


Methyl 5,6-diphenylindolo[2,1-a]isoquinoline-12-carboxylate (3fa): The representative procedure was followed using methyl 2-phenyl-1*H*-indole-3-carboxylate (**1f**) (126 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 10/1) yielded **3fa** as a colorless solid (181 mg, 85%). M. p. = 181−182 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 9.33 (d, *J* = 8.0 Hz, 1H), 8.26 (d, *J* = 8.3 Hz, 1H), 7.59 (t, *J* = 7.7 Hz, 1H), 7.47 (t, *J* = 7.6 Hz, 1H), 7.37−7.14 (m, 12H), 6.84 (t, *J* = 7.9 Hz, 1H), 6.03 (d, *J* = 8.8 Hz, 1H), 4.13 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 167.4 (C_q), 138.3 (C_q), 136.2 (C_q), 135.4 (C_q), 135.0 (C_q), 132.3 (C_q), 131.9 (C_q), 131.5 (CH), 130.8 (CH), 129.1 (C_q), 129.0 (CH), 128.9 (CH), 128.6 (CH), 127.9 (CH), 127.7 (CH), 126.9 (CH), 126.8 (CH), 126.0 (CH), 124.7 (C_q), 124.0 (C_q), 123.3 (CH), 121.3 (CH), 121.1 (CH), 115.0 (CH), 101.5 (C_q), 51.5 (CH_3). IR (neat): 2946, 1693, 1519, 1488, 1447, 1364, 1251, 1153, 1028 cm^{-1}. MS (EI) *m/z* (relative intensity) 427 (100) [M^+], 396 (27), 369 (25). HRMS (EI) *m/z* calcd for $C_{30}H_{21}NO_2$ [M^+] 427.1572, found 427.1571.

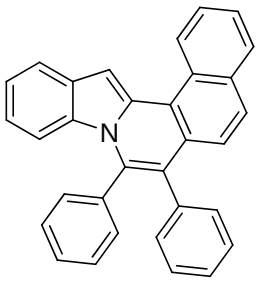


1-(5,6-Diphenylindolo[2,1-a]isoquinolin-12-yl)ethanone (3ga): The representative procedure was followed using 1-(2-phenyl-1*H*-indol-3-yl)ethanone (**1g**) (118 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 10/1) yielded **3ga** as a yellow solid (165 mg, 80%). M. p. = 207−209 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.56 (dd, *J* = 8.3, 1.1 Hz, 1H), 8.09 (d, *J* = 8.0 Hz, 1H), 7.56 (ddd, *J* = 8.4, 7.6, 1.4 Hz, 1H), 7.46 (ddd, *J* = 8.2, 7.2, 1.4 Hz, 1H), 7.41−7.15 (m, 12H), 6.86 (ddd, *J* = 8.6, 7.0, 1.3 Hz, 1H), 6.04 (d, *J* = 8.8 Hz, 1H), 2.86

(s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 198.9 (C_q), 136.3 (C_q), 136.1 (C_q), 135.6 (C_q), 134.8 (C_q), 132.3 (C_q), 131.9 (C_q), 131.5 (CH), 130.8 (CH), 129.0 (CH), 128.9 (CH), 128.7 (CH), 128.4 (C_q), 127.9 (CH), 127.4 (CH), 127.1 (CH), 126.9 (CH), 126.2 (CH), 124.2 (C_q), 124.0 (C_q), 123.4 (CH), 121.5 (CH), 119.9 (CH), 115.1 (CH), 112.7 (C_q), 32.1 (CH_3). IR (neat): 3056, 1634, 1519, 1474, 1368, 1155, 1110, 939, 771, 698 cm^{-1}. MS (EI) *m/z* (relative intensity) 411 (78) [M^+], 396 (100), 367 (9), 291 (10). HRMS (EI) *m/z* calcd for $C_{30}H_{21}NO$ [M^+] 411.1623, found 411.1624.

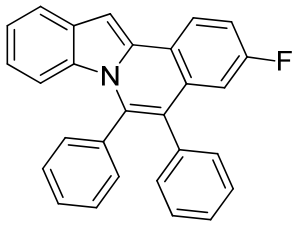


5,6-Diphenylindolo[2,1-a]isoquinoline-12-carbaldehyde (3ha): The representative procedure was followed using 2-phenyl-1*H*-indole-3-carbaldehyde (**1h**) (111 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc/CH_2Cl_2: 10/1/1) yielded **3ha** as a colorless solid (122 mg, 62%). M. p. = 283−285 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 10.98 (s, 1H), 9.15 (d, *J* = 8.1 Hz, 1H), 8.65 (d, *J* = 8.1 Hz, 1H), 7.68 (t, *J* = 7.7 Hz, 1H), 7.57 (t, *J* = 7.7 Hz, 1H), 7.43−7.15 (m, 12H), 6.91 (t, *J* = 7.9 Hz, 1H), 6.02 (d, *J* = 8.8 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 184.6 (CH), 141.0 (C_q), 135.9 (C_q), 135.7 (C_q), 134.5 (C_q), 133.1 (C_q), 132.5 (C_q), 131.3 (CH), 130.7 (CH), 129.9 (CH), 129.3 (C_q), 129.2 (CH), 128.8 (CH), 128.0 (CH), 127.9 (CH), 127.7 (CH), 127.2 (CH), 126.6 (CH), 125.5 (C_q), 124.6 (CH), 124.4 (C_q), 122.5 (CH), 120.7 (CH), 115.1 (CH), 111.1 (C_q). IR (neat): 1621, 1516, 1479, 1446, 1382, 1303, 1209, 1136, 1062, 1032, 732, 698, 579 cm^{-1}. MS (EI) *m/z* (relative intensity) 397 (100) [M^+], 367 (9), 291 (10). HRMS (EI) *m/z* calcd for $C_{29}H_{19}NO$ [M^+] 397.1467, found 397.1480.

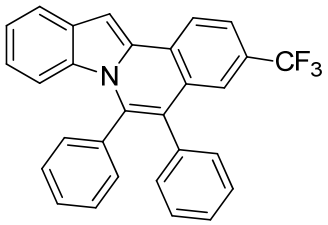


7, 8-Diphenylbenzo[h]indolo[2,1-a]isoquinoline (3ia): The representative procedure was followed using 2-(naphthalen-1-yl)-1*H*-indole (**1i**) (122 mg, 0.50 mmol) and

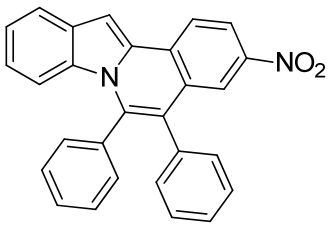
diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 5/1) yielded **3ia** (97 mg, 46%) as a yellow solid. M. p. = 215−217 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 9.40 (d, J = 8.6 Hz, 1H), 8.06 (s, 1H), 7.96 (dd, J = 9.0, 8.6 Hz, 2H), 7.84 (ddd, J = 7.6, 7.6, 1.2 Hz, 1H), 7.76 (d, J = 8.6 Hz, 1H), 7.66 (dd, J = 7.3, 7.3 Hz, 1H), 7.46−7.18 (m, 12H), 6.92 (ddd, 8.0, 7.8, 1.2 Hz, 1H), 6.17 (d, J = 8.7 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 137.2 (C_q), 136.6 (C_q), 135.6 (C_q), 134.9 (C_q), 132.8 (C_q), 132.0 (CH), 131.7 (C_q), 130.7 (CH), 130.2 (C_q), 129.5 (C_q), 129.5 (C_q), 128.9 (CH), 128.6 (CH), 128.6 (CH), 127.9 (CH), 127.9 (CH), 127.2 (CH), 126.8 (CH), 125.9 (CH), 125.7 (CH), 124.2 (CH), 122.1 (C_q), 122.0 (CH), 121.2 (C_q), 120.3 (CH), 120.2 (CH), 114.9 (CH), 99.3 (CH). IR (neat): 3057, 1588, 1543, 1467, 1360, 1210, 1017, 818, 730, 695 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 419 (100) [M^+], 341 (20). HRMS (ESI) *m*/*z* calcd for $C_{32}H_{21}N$ [M^+] 419.1674, found 419.1678. The spectral data were in accordance with those reported in the literature.[13]



3-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3ja): The representative procedure was followed using 2-(4-fluorophenyl)-1*H*-indole (**1j**) (106 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 10/1) yielded **3ja** (164 mg, 84%) as a yellow solid. M. p. = 178−179 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.26 (dd, J = 8.7, 5.5 Hz, 1H), 7.79 (d, J = 8.0 Hz, 1H), 7.40−7.28 (m, 6H), 7.28−7.11 (m, 7H), 6.87−6.76 (m, 2H), 6.00 (d, J = 8.7 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 162.0 (C_q, J_{C-F} = 246 Hz), 137.1 (C_q), 136.1 (C_q), 135.4 (C_q), 135.0 (C_q), 132.6 (C_q), 132.3 (C_q, J_{C-F} = 9 Hz), 131.6 (CH), 130.6 (CH), 129.7 (C_q), 128.8 (CH), 128.6 (CH), 128.0 (CH), 127.0 (CH), 125.4 (CH, J_{C-F} = 9 Hz), 121.9 (C_q), 121.9 (CH), 121.8 (CH), 120.8 (C_q, J_{C-F} = 3 Hz), 120.1 (CH), 115.2 (CH, J_{C-F} = 23 Hz), 114.6 (CH), 111.6 (CH, J_{C-F} = 23 Hz), 93.9 (CH). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −(112.6 − 112.7) (m). IR (neat): 3055, 1609, 1546, 1481, 1442, 1273, 775, 738, 724, 693 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 387 (100) [M^+], 309 (37). HRMS (ESI) *m*/*z* calcd for $C_{28}H_{18}FN$ [M^+] 387.1423, found 387.1412.

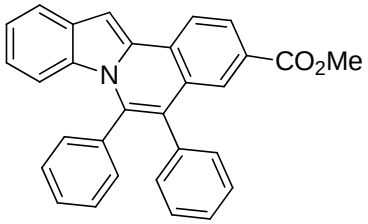


5,6-Diphenyl-3-(trifluoromethyl)indolo[2,1-a]isoquinoline (3ka): The representative procedure **A** was followed using 2-{4-(trifluoromethyl)phenyl}-1*H*-indole (**1k**) (131 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 5/1) yielded **3ka** (158 mg, 72%) as a yellow solid. M. p. = 225−226 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.38 (d, J = 8.4 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.71 (d, J = 8.4 Hz, 1H), 7.51 (s, 1H), 7.41−7.28 (m, 6H), 7.28−7.20 (m, 4H), 7.20−7.12 (m, 2H), 6.86 (ddd, J = 7.8, 7.8, 1.3 Hz, 1H), 6.00 (d, J = 8.8 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 137.3 (C_q), 135.7 (C_q), 134.8 (C_q), 134.6 (C_q), 132.9 (C_q), 131.7 (CH), 130.6 (CH), 130.1 (C_q), 129.5 (C_q), 129.3 (C_q, $J_{C–F}$ = 22 Hz), 128.9 (CH), 128.1 (CH), 127.9 (C_q), 127.2 (CH), 124.1 (C_q, $J_{C–F}$ = 273 Hz), 123.8 (CH), 123.2 (CH, $J_{C–F}$ = 19 Hz), 123.2 (CH, $J_{C–F}$ = 11 Hz), 123.2 (CH, $J_{C–F}$ = 4 Hz), 122.0 (CH), 121.0 (CH), 120.9 (C_q), 120.6 (CH), 114.7 (CH), 96.0 (CH). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −62.3 (s). IR (neat): 3062, 1618, 1544, 1485, 1345, 1272, 1017, 977, 744, 695 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 437 (100) [M^+], 359 (11). HRMS (ESI) *m*/*z* calcd for $C_{29}H_{18}F_3N$ [M^+] 437.1391, found 437.1380.



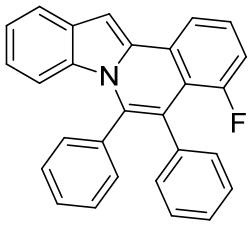
3-Nitro-5,6-diphenylindolo[2,1-a]isoquinoline (3la): The representative procedure was followed using 2-(4-nitrophenyl)-1*H*-indole (**1l**) (119 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 7/1) yielded **3la** (92 mg, 44%) as a yellow solid. M. p. = 224−225 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.38 (d, J = 8.2 Hz, 1H), 7.83 (d, J = 7.8 Hz, 1H), 7.71 (d, J = 8.2 Hz, 1H), 7.51 (s, 1H), 7.45−7.08 (m, 12H), 6.87 (dd, J = 8.2, 7.4 Hz, 1H), 6.01 (d, J = 8.8 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 137.3 (C_q), 135.7 (C_q), 134.9 (C_q), 134.7 (C_q), 132.9 (C_q), 131.7 (CH), 130.6 (CH), 130.2 (C_q), 129.5 (C_q), 128.9 (CH), 128.7 (CH), 128.1 (CH), 127.9 (C_q), 127.2 (CH), 125.9 (C_q), 123.8 (CH), 123.2 (CH), 123.1 (CH), 122.0 (CH), 121.0 (CH), 120.9 (C_q), 120.6 (CH), 114.7 (CH), 96.0 (CH). IR (neat): 3061, 3032,

1618, 1597, 1544, 1485, 1444, 1169, 825, 658 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 414 (100) [M^+], 384 (27), 368 (30). HRMS (ESI) *m*/*z* calcd for $C_{28}H_{18}N_2O_2$ [M^+] 414.1368, found 414.1368.

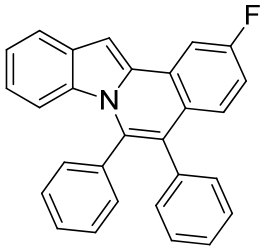


Methyl 5,6-diphenylindolo[2,1-a]isoquinoline-3-carboxylate (3ma): The representative procedure was followed using methyl 4-(1*H*-indol-2-yl)benzoate (**1m**) (126 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 2/1) yielded **3ma** (122 mg, 57%) as a yellow solid. M. p. = 256−257 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.33 (d, *J* = 8.3 Hz, 1H), 8.13 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.86 (s, 1H), 7.82 (d, *J* = 8.0 Hz, 1H), 7.51 (s, 1H), 7.39−7.28 (m, 5H), 7.27−7.15 (m, 6H), 6.86 (dd, *J* = 7.8, 7.7 Hz, 1H), 6.00 (d, *J* = 8.7 Hz, 1H), 3.86 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 166.8 (C_q), 136.7 (C_q), 135.9 (C_q), 135.0 (C_q), 134.9 (C_q), 133.0 (C_q), 131.7 (CH), 130.7 (CH), 129.9 (C_q), 129.5 (C_q), 128.9 (C_q), 128.8 (CH), 128.6 (CH), 128.5 (C_q), 128.0 (CH), 127.8 (CH), 127.5 (CH), 127.0 (CH), 123.2 (CH), 121.9 (CH), 121.3 (C_q), 120.9 (CH), 120.6 (CH), 114.7 (CH), 96.3 (CH), 52.1 (CH_3). IR (neat): 3025, 1708, 1604, 1544, 1484, 1441, 1422, 762, 738, 701 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 427 (100) [M^+], 367 (9), 291 (10). HRMS (ESI) *m*/*z* calcd for $C_{30}H_{21}NO_2$ [M^+] 427.1572, found 427.1578. The spectral data were in accordance with those reported in the literature.[13]

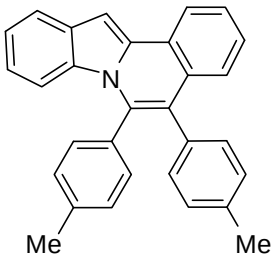
4-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3oa') and 2-Fluoro-5,6-diphenyl-indolo[2,1-a]isoquinoline (3oa''): The representative procedure was followed using 2-(3-fluorophenyl)-1*H*-indole (**1o**) (106 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 10/1) yielded **3oa'** (78 mg, 40%) as yellow solid and **3oa''** (17 mg, 9%) as yellow solid.



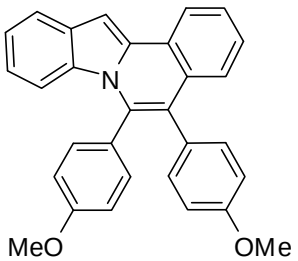
4-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3oa'): M. p. = 211−212 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.8 Hz, 1H), 7.83 (d, J = 7.8 Hz, 1H), 7.52−7.10 (m, 13H), 7.05 (dd, J = 12.4, 7.8 Hz, 1H), 6.88 (dd, J = 7.8, 7.8 Hz, 1H), 5.96 (d, J = 8.8 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 159.1 (C_q, $J_{C–F}$ = 254 Hz), 138.7 (C_q, $J_{C–F}$ = 3 Hz), 137.5 (C_q), 134.9 (C_q, $J_{C–F}$ = 3 Hz), 134.8 (C_q), 132.8 (C_q), 131.0 (CH), 130.9 (CH), 129.6 (C_q), 128.7 (CH), 128.5 (CH), 128.0 (CH, $J_{C–F}$ = 9 Hz), 127.7 (C_q, $J_{C–F}$ = 4 Hz), 127.1 (CH), 126.3 (CH), 121.9 (CH), 120.6 (CH), 120.4 (CH), 119.4 (CH, $J_{C–F}$ = 4 Hz), 118.6 (C_q, $J_{C–F}$ = 9 Hz), 117.0 (C_q, $J_{C–F}$ = 3 Hz), 114.7 (CH), 114.4 (CH, $J_{C–F}$ = 22 Hz), 96.1 (CH). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −(107.8 − 108.9) (m). IR (neat): 3056, 1608, 1539, 1487, 1461, 1440, 1230, 773, 739, 693 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 387 (100) [M^+], 309 (13). HRMS (ESI) *m*/*z* calcd for $C_{28}H_{18}FN$ [M^+] 387.1423, found 387.1411.



2-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3oa''): M. p. = 226−227 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 7.93 (dd, J = 9.7, 2.6 Hz, 1H), 7.81 (d, J = 8.0 Hz, 1H), 7.43−7.27 (m, 6H), 7.27−7.09 (m, 7H), 7.05 (ddd, J = 8.8, 8.6, 2.6 Hz, 1H), 6.84 (ddd, J = 8.0, 7.7, 1.3 Hz, 1H), 6.01 (d, J = 8.8 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 161.8 (C_q, $J_{C–F}$ = 247 Hz), 136.7 (C_q), 136.7 (C_q), 135.3 (C_q), 135.3 (C_q), 133.0 (C_q), 131.8 (CH), 131.0 (CH), 129.6 (C_q), 129 (CH), 128.6 (CH), 128.5 (CH, $J_{C–F}$ = 9 Hz), 127.9 (CH), 127.2 (C_q, $J_{C–F}$ = 9 Hz), 126.9 (CH), 126.8 (C_q, $J_{C–F}$ = 2 Hz), 121.9 (CH), 121.0 (C_q), 120.6 (CH), 120.5 (CH), 115.3 (CH, $J_{C–F}$ = 23 Hz), 114.7 (CH), 108.7 (CH, $J_{C–F}$ = 23 Hz), 96.1 (CH). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −(113.7 − 113.8) (m). IR (neat): 3061, 1608, 1542, 1487, 1340, 1167, 956, 732, 694, 651 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 387 (100) [M^+], 309 (9). HRMS (ESI) *m*/*z* calcd for $C_{28}H_{18}FN$ [M^+] 387.1423, found 387.1419.

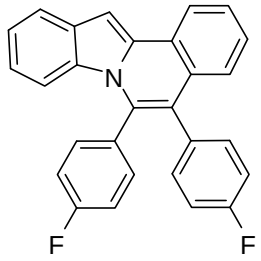


5,6-Di-(*p*-tolyl)indolo[2,1-a]isoquinoline (3ab): The representative procedure was followed using 2-phenyl-1*H*-indole (**1a**) (48.3 mg, 0.25 mmol) and 1,2-di-(*p*-tolyl)ethyne (**2b**) (103 mg, 0.50 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 30/1) yielded **3ab** as a colorless solid (96 mg, 97%). M. p. = 216−218 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.32 (d, J = 8.0 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.52 (dd, J = 7.5, 7.5 Hz, 1H), 7.44 (s, 1H), 7.37 (ddd, J = 7.6, 7.2, 1.0 Hz, 1H), 7.28−7.17 (m, 6H), 7.11 (s, 4H), 6.89 (ddd, J = 7.8, 7.1, 1.0 Hz, 1H), 6.09 (d, J = 8.7 Hz, 1H), 2.43 (s, 3H), 2.36 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 138.3 (C_q), 136.1 (C_q), 136.0 (C_q), 135.9 (C_q), 133.7 (C_q), 132.7 (C_q), 132.4 (C_q), 131.6 (CH), 130.6 (CH), 130.5 (CH), 129.6 (C_q), 129.3 (C_q), 128.5 (CH), 127.2 (CH), 126.8 (CH), 126.1 (CH), 125.3 (C_q), 123.2 (CH), 121.5 (CH), 121.3 (C_q), 120.1 (CH), 119.9 (CH), 114.7 (CH), 94.0 (CH), 21.5 (CH_3), 21.2 (CH_3). IR (neat): 3021, 2918, 1506, 1445, 1377, 1338, 1108, 1020, 788, 758 cm^{-1}. MS (EI) *m/z* (relative intensity) 397 (100) [M^+], 381 (9), 305 (7), 291 (6), 182 (7). HRMS (EI) *m/z* calcd for $C_{30}H_{23}N$ [M^+] 397.1830, found 397.1831. The spectral data were in accordance with those reported in the literature.[13]

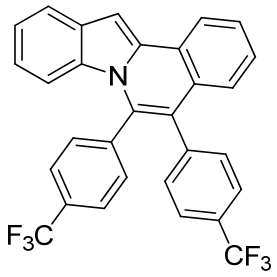


5,6-Di-(4-methoxyphenyl)indolo[2,1-a]isoquinoline (3ac): The representative procedure was followed using 2-phenyl-1*H*-indole (**1a**) (48.3 mg, 0.25 mmol) and 1,2-bis(4-methoxyphenyl)ethyne (**2c**) (119 mg, 0.50 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded **3ac** as a colorless solid (54 mg, 50%). M. p. = 271−273 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.29 (d, J = 8.0 Hz, 1H), 7.79 (d, J = 8.0 Hz, 1H), 7.50 (ddd, J = 7.3, 7.2, 1.3 Hz, 1H), 7.40 (d, J = 0.8 Hz, 1H), 7.34 (ddd, J = 7.6, 7.2, 1.3 Hz, 1H), 7.25−7.14 (m, 4H), 7.08 (d, J = 8.8 Hz, 2H), 6.91−6.84 (m, 3H), 6.79 (d, J = 8.8 Hz, 2H), 6.10 (d, J = 8.7 Hz, 1H), 3.85 (s, 3H), 3.80 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 159.5 (C_q), 158.1 (C_q), 136.1 (C_q), 136.0 (C_q), 132.8 (C_q), 132.7 (CH), 131.9

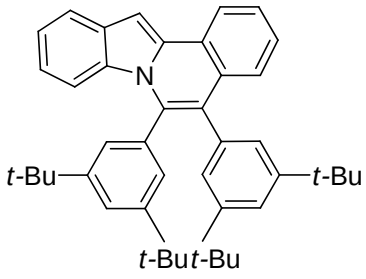
(CH), 130.6 (C_q), 129.6 (C_q), 129.1 (C_q), 127.9 (C_q), 127.2 (CH), 126.9 (CH), 126.1 (CH), 125.3 (C_q), 123.2 (CH), 121.5 (CH), 121.3 (C_q), 120.1 (CH), 120.0 (CH), 114.7 (CH), 114.0 (CH), 113.3 (CH), 94.0 (CH), 55.2 (CH_3), 55.1 (CH_3). IR (neat): 2956, 1606, 1505, 1444, 1376, 1290, 1242, 1108, 827, 758 cm^{-1}. MS (EI) *m/z* (relative intensity) 429 (100) [M^+], 414 (11), 383 (10), 354 (10), 342 (7), 214 (13). HRMS (EI) *m/z* calcd for $C_{30}H_{23}NO_2$ [M^+] 429.1729, found 429.1727. The spectral data were in accordance with those reported in the literature.[13]



5,6-Di-(4-fluorophenyl)indolo[2,1-a]isoquinoline (3ad): The representative procedure was followed using 2-phenyl-1*H*-indole (**1a**) (48.3 mg, 0.25 mmol) and 1,2-bis(4-fluorophenyl)ethyne (**2d**) (107 mg, 0.50 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 30/1) yielded **3ad** as a colorless solid (80 mg, 79%). M. p. = 231−233 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.30 (d, J = 8.1 Hz, 1H), 7.82 (d, J = 7.7 Hz, 1H), 7.53 (dd, J = 7.5, 7.5 Hz, 1H), 7.42 (s, 1H), 7.37 (dd, J = 7.5, 7.5 Hz, 1H), 7.30−7.21 (m, 3H), 7.16−7.03 (m, 5H), 7.01−6.93 (m, 2H), 6.89 (dd, J = 7.8, 7.2 Hz, 1H), 6.06 (d, J = 8.8 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 162.5 (C_q, J_{C-F} = 249 Hz), 161.7 (C_q, J_{C-F} = 247 Hz), 136.1 (C_q), 135.8 (C_q), 135.2 (C_q), 133.2 (CH, J_{C-F} = 8 Hz), 132.6 (CH, J_{C-F} = 8 Hz), 132.4 (C_q, J_{C-F} = 4 Hz), 131.2 (C_q, J_{C-F} = 4 Hz), 129.9 (C_q), 129.7 (C_q), 127.4 (CH), 127.3 (CH), 126.0 (CH), 125.4 (C_q), 123.3 (CH), 121.8 (CH), 120.8 (C_q), 120.4 (CH), 120.3 (CH, J_{C-F} = 4 Hz), 116.0 (CH, J = 22 Hz), 115.0 (CH, J = 22 Hz), 114.3 (CH), 94.5 (CH). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −111.5 (s), −115.0 (s). IR (neat): 1599, 1501, 1445, 1379, 1337, 1218, 1093, 739 cm^{-1}. MS (EI) *m/z* (relative intensity) 405 (100) [M^+], 309 (13), 191 (5). HRMS (EI) *m/z* calcd for $C_{28}H_{17}F_2N$ [M^+] 405.1329, found 405.1332.

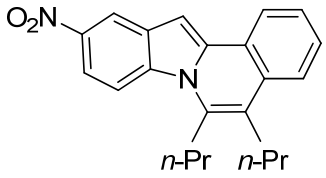


5,6-Bis{4-(trifluoromethyl)phenyl}indolo[2,1-a]isoquinoline (3ae): The representative procedure was followed using 2-phenyl-1*H*-indole (**1a**) (97.0 mg, 0.50 mmol) and 1,2-bis{4-(trifluoromethyl)phenyl}ethyne (**2e**) (314 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 10/1) yielded **3ae** (137 mg, 54%) as a yellow solid. M. p. = 287−288 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.32 (d, J = 7.8 Hz, 1H), 7.82 (d, J =7.8 Hz, 1H), 7.64 (d, J = 7.8 Hz, 2H), 7.59−7.48 (m, 3H), 7.48−7.33 (m, 4H), 7.33−7.18 (m, 3H), 7.05 (d, J = 7.8 Hz, 1H), 6.88 (dd, J = 7.8, 7.8 Hz, 1H), 5.95 (d, J = 8.6 Hz, 1H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 140.2 (C_q), 138.5 (C_q), 135.7 (C_q), 134.5 (C_q), 132.5 (C_q), 132.1 (CH), 131.2 (C_q, J_{C-F} = 33 Hz), 131.2 (CH), 129.8 (C_q), 129.7 (C_q, J_{C-F} = 33 Hz), 129.2 (C_q), 127.8 (CH, J_{C-F} = 11 Hz), 125.9 (CH), 125.8 (CH, J_{C-F} = 4 Hz), 125.6 (C_q), 125.1 (CH, J_{C-F} = 11 Hz), 125.1 (CH, J_{C-F} = 4 Hz), 124.0 (C_q, J_{C-F} = 272 Hz). 123.7 (C_q, J_{C-F} = 272 Hz), 123.5 (CH), 122.1 (CH), 120.7 (CH), 120.7 (C_q), 120.6 (CH), 114.0 (CH), 94.9 (CH). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −62.6 (s), −62.7 (s). IR (neat): 3065, 1612, 1576, 1545, 1446, 1322, 1171, 1105, 1066, 759 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 505 (100) [M^+], 435 (10), 359 (15), 291 (10). HRMS (ESI) *m*/*z* calcd for $C_{30}H_{17}F_6N$ [M^+] 505.1265, found 505.1269. The spectral data were in accordance with those reported in the literature.[13]

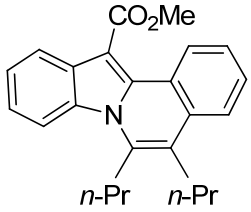


5,6-Bis(3,5-di-*tert*-butylphenyl)indolo[2,1-a]isoquinoline (3af): The representative procedure was followed using 2-phenyl-1*H*-indole (**1a**) (48.3 mg, 0.25 mmol) and 1,2-bis(3,5-di-*tert*-butylphenyl)ethyne (**2f**) (201 mg, 0.50 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 50/1) yielded **3af** as a colorless solid (110 mg, 74%). M. p. = 283−284 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.30 (d, J = 8.0 Hz, 1H), 7.77 (d, J = 8.0 Hz, 1H), 7.49 (ddd, J = 7.7, 6.4, 2.2 Hz, 1H), 7.42−7.32 (m, 4H), 7.21−7.14 (m, 2H), 7.08 (s, 1H), 7.07 (s, 1H), 6.97 (s, 1H), 6.96 (s, 1H), 6.78 (ddd, J = 7.8, 7.0, 1.3 Hz,

1H), 6.10 (d, J = 8.7 Hz, 1H), 1.18 (s, 18H), 1.16 (s, 18H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 150.9 (C_q), 149.9 (C_q), 136.9 (C_q), 136.0 (C_q), 135.7 (C_q), 134.3 (C_q), 132.7 (C_q), 130.2 (C_q), 129.6 (C_q), 126.7 (CH), 126.3 (CH), 126.1 (2 CH), 125.4 (C_q), 125.1 (2 CH), 123.3 (CH), 121.9 (C_q), 121.7 (CH), 121.4 (CH), 119.9 (CH), 119.6 (CH), 115.3 (CH), 93.9 (CH), 34.7 (C_q), 34.6 (C_q), 31.5 (CH_3), 31.3 (CH_3). IR (neat): 2957, 1593, 1542, 1446, 1361, 1247, 901, 859, 790, 739 cm^{-1}. MS (EI) *m/z* (relative intensity) 593 (100) [M$^+$], 521 (9), 289 (7). HRMS (EI) *m/z* calcd for $C_{44}H_{51}N$ [M$^+$] 593.4021, found 593.4036.

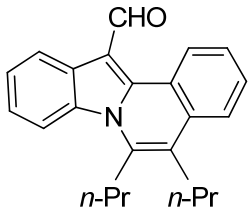


10-Nitro-5,6-dipropylindolo[2,1-a]isoquinoline (3dg): The representative procedure was followed using 5-nitro-2-phenyl-1*H*-indole (**1d**) (119 mg, 0.50 mmol), 4-octyne (**2g**) (110 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded **3dg** as an orange solid (78 mg, 45%). M. p. = 172−173 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.67 (d, J = 2.4 Hz, 1H), 8.17 (dd, J = 7.7, 1.6 Hz, 1H), 8.08 (dd, J = 9.6, 2.5 Hz, 1H), 7.90 (d, J = 9.4 Hz, 1H), 7.72 (d, J = 7.9 Hz, 1H), 7.54 (ddd, J = 7.5, 7.3, 1.6 Hz, 1H), 7.48 (ddd, J = 7.4, 7.1, 1.3 Hz, 1H), 7.36 (s, 1H), 3.27 (t, J = 8.2 Hz, 2H), 2.87 (t, J = 8.2 Hz, 2H), 1.86 (m, 2H), 1.68 (m, 2H), 1.23 (t, J = 7.5 Hz, 3H), 1.14 (t, J = 7.5 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 142.1 (C_q), 138.9 (C_q), 135.6 (C_q), 134.1 (C_q), 128.9 (C_q), 128.7 (C_q), 128.5 (CH), 126.8 (CH), 124.6 (C_q), 123.9 (CH), 123.6 (CH), 118.8 (C_q), 116.9 (CH), 115.0 (CH), 114.6 (CH), 95.7 (CH), 31.3 (CH_2), 29.8 (CH_2), 23.6 (CH_2), 21.5 (CH_2), 14.5 (CH_3), 13.8 (CH_3). IR (neat): 2951, 1503, 1455, 1385, 1325, 1199, 1079, 741 cm^{-1}. MS (EI) *m/z* (relative intensity) 346 (100) [M$^+$], 317 (65), 271 (28), 241 (36). HRMS (EI) *m/z* calcd for $C_{22}H_{22}N_2O_2$ [M$^+$] 346.1681, found 346.1683.

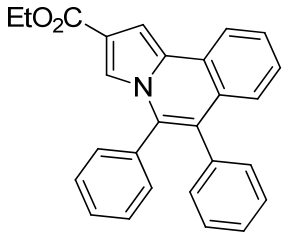


Methyl 5,6-dipropylindolo[2,1-a]isoquinoline-12-carboxylate (3fg): The representative procedure was followed using methyl 2-phenyl-1*H*-indole-3-carboxylate (**1f**) (63.0 mg, 0.25 mmol), 4-octyne (**2g**) (55.0 mg, 0.50 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%).

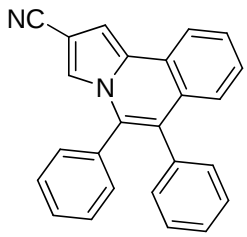
After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded **3fg** as a yellow solid (78 mg, 87%). M. p. = 122−123 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 9.01 (d, J = 8.4 Hz, 1H), 8.34 (d, J = 8.2 Hz, 1H), 7.96 (d, J = 8.6 Hz, 1H), 7.80 (d, J = 8.3 Hz, 1H), 7.60 (dd, J = 7.2, 7.2 Hz, 1H), 7.51 (dd, J = 7.6, 7.6 Hz, 1H), 7.44 (dd, J = 7.6, 7.6 Hz, 1H), 7.34 (dd, J = 7.8, 7.8 Hz, 1H), 4.09 (s, 3H), 3.36 (m, 2H), 2.93 (m, 2H), 1.92 (m, 2H), 1.69 (m, 2H), 1.23 (t, J = 7.3 Hz, 3H), 1.13 (t, J = 7.3 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 167.4 (C_q), 138.7 (C_q), 136.1 (C_q), 131.7 (C_q), 130.6 (C_q), 129.3 (C_q), 129.1 (CH), 128.1 (CH), 125.7 (CH), 123.7 (C_q), 123.1 (CH), 122.9 (CH), 121.8 (CH), 121.3 (CH), 119.6 (C_q), 114.9 (CH), 100.8 (C_q), 51.4 (CH_3), 31.6 (CH_2), 29.8 (CH_2), 23.5 (CH_2), 21.9 (CH_2), 14.5 (CH_3), 13.8 (CH_3). IR (neat): 2952, 1684, 1516, 1432, 1242, 1196, 1115, 731 cm^{-1}. MS (EI) *m/z* (relative intensity) 359 (15) [M$^+$], 236 (32), 217 (40), 186 (30), 131 (40), 69 (100). HRMS (EI) *m/z* calcd for $C_{24}H_{25}NO_2$ [M$^+$] 359.1885, found 359.1873.



5,6-Dipropylindolo[2,1-a]isoquinoline-12-carbaldehyde (3hg): The representative procedure was followed using 2-phenyl-1*H*-indole-3-carbaldehyde (**1h**) (111 mg, 0.5 mmol), 4-octyne (**2g**) (110 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 10/1) yielded **3hg** as a yellow solid (123 mg, 75%). M. p. = 158−159 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 10.76 (s, 1H), 8.75 (dd, J = 7.4, 6.8 Hz, 2H), 7.91 (d, J = 8.6 Hz, 1H), 7.84 (d, J = 8.3 Hz, 1H), 7.67 (ddd, J = 7.6, 7.1, 1.3 Hz, 1H), 7.56 (ddd, J = 7.6, 7.1, 1.3 Hz, 1H), 7.48 (ddd, J = 7.5, 6.9, 0.9 Hz, 1H), 7.37 (ddd, J = 7.8, 7.0, 1.4 Hz, 1H), 3.33 (m, 2H), 2.92 (m, 2H), 1.89 (m, 2H), 1.68 (m, 2H), 1.23 (t, J = 7.3 Hz, 3H), 1.14 (t, J = 7.3 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 184.7 (CH), 141.9 (C_q), 136.7 (C_q), 132.5 (C_q), 131.2 (C_q), 130.0 (CH), 129.2 (C_q), 128.3 (CH), 126.8 (CH), 124.5 (CH), 123.9 (C_q), 123.4 (CH), 123.0 (CH), 121.3 (CH), 120.6 (C_q), 115.0 (CH), 110.7 (C_q), 31.5 (CH_2), 29.8 (CH_2), 23.5 (CH_2), 21.8 (CH_2), 14.5 (CH_3), 13.7 (CH_3). IR (neat): 2868, 1623, 1469, 1383, 1331, 1236, 1173, 1131, 1078, 1045, 736 cm^{-1}. MS (EI) *m/z* (relative intensity) 329 (100) [M$^+$], 300 (75), 272 (30), 256 (30), 241 (25). HRMS (EI) *m/z* calcd for $C_{23}H_{23}NO$ [M$^+$] 329.1780, found 329.1788.

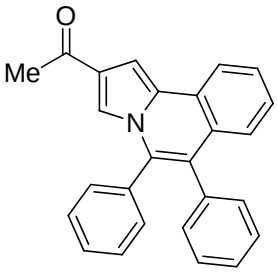


Ethyl 5,6-diphenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5aa): The representative procedure was followed using ethyl 5-phenyl-1*H*-pyrrole-3-carboxylate (**4a**) (108 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 5/1) yielded **5aa** (182 mg, 93%) as a yellow solid. M. p. = 200−201°C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.15 (d, J = 8.0 Hz, 1H), 7.54−7.37 (m, 2H), 7.42 (d, J = 1.6 Hz, 1H), 7.36−7.19 (m, 10H), 7.19−7.11 (m, 2H), 4.33 (q, J = 7.1 Hz, 2H), 1.37 (t, J = 7.1 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 165.1 (C_q), 136.2 (C_q), 133.8 (C_q), 133.3 (C_q), 131.3 (CH), 130.8 (C_q), 130.5 (CH), 128.7 (CH), 128.7 (CH), 128.4 (C_q), 127.9 (CH), 127.7 (CH), 127.1 (CH), 126.6 (CH), 126.2 (CH), 125.7 (C_q), 124.6 (C_q), 122.1 (CH), 118.7 (CH), 118.3 (C_q), 101.3 (CH), 60.1 (CH_2), 14.5 (CH_3). IR (neat): 2979, 1702, 1513, 1454, 1418, 1235, 1207, 1144, 749, 700 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 391 (100) [M^+], 318 (90). HRMS (ESI) *m*/*z* calcd for $C_{27}H_{21}NO_2$ [M^+] 391.1572, found 391.1580.

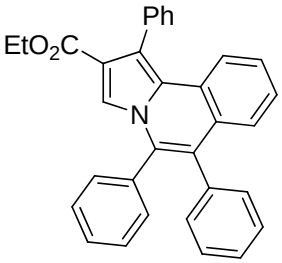


5,6-Diphenylpyrrolo[2,1-a]isoquinoline-2-carbonitrile (5ba): The representative procedure was followed using 5-phenyl-1*H*-pyrrole-3-carbonitrile (**4b**) (84.0 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 10/1) yielded **5ba** (70 mg, 40%) as a white solid. M. p. = 228−229 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.11 (d, J = 8.0 Hz, 1H), 7.55 (ddd, J = 7.6, 7.4, 1.3 Hz, 1H), 7.40−7.30 (m, 4H), 7.30−7.21 (m, 8H), 7.21−7.10 (m, 2H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 135.7 (C_q), 133.2 (C_q), 132.7 (C_q), 131.1 (CH), 130.9 (C_q), 130.3 (CH), 129.1 (CH), 128.9 (CH), 128.5 (C_q), 128.0 (CH), 128.0 (CH), 127.3 (CH), 127.0 (CH), 126.8 (CH), 125.3 (C_q), 124.7 (C_q), 122.2 (CH), 120.7 (CH), 116.5 (C_q), 103.0 (CH), 95.5 (C_q). IR (neat): 3132, 2227, 1598, 1513, 1487, 1389, 1131, 800, 754, 697 cm^{-1}. MS (EI)

m/*z* (relative intensity) 344 (100) [M^+], 266 (10). HRMS (ESI) *m*/*z* calcd for $C_{25}H_{16}N_2$ [M^+] 344.1313, found 344.1324.

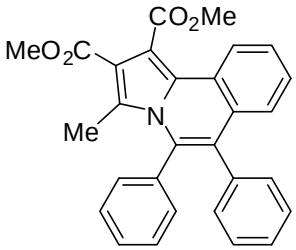


1-(5,6-Diphenylpyrrolo[2,1-a]isoquinolin-2-yl)ethanone (5ca): The representative procedure was followed using 1-(5-phenyl-1*H*-pyrrol-3-yl)ethanone (**4c**) (93.0 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 10/1) yielded **5ca** (137 mg, 76%) as a white solid. M. p. = 206 °C (dec.). ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.15 (d. J = 8.2 Hz, 1H), 7.56−7.42 (m, 2H), 7.39−7.10 (m, 13H), 2.49 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 194.6 (C_q), 136.1 (C_q), 133.8 (C_q), 133.2 (C_q), 131.3 (C_q), 131.2 (CH), 130.4 (CH), 128.8 (CH), 128.8 (CH), 128.5 (C_q), 128.0 (CH), 127.8 (CH), 127.1 (CH), 127.0 (C_q), 126.7 (CH), 126.4 (CH), 125.8 (C_q), 125.0 (C_q), 122.1 (CH), 118.2 (CH), 100.3 (CH), 27.5 (CH_3). IR (neat): 3023, 1651, 1511, 1458, 1241, 1143, 799, 773, 700, 644 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 361 (100) [M^+], 346 (27), 318 (30). HRMS (ESI) *m*/*z* calcd for $C_{26}H_{19}NO$ [M^+] 361.1467, found 361.1456.

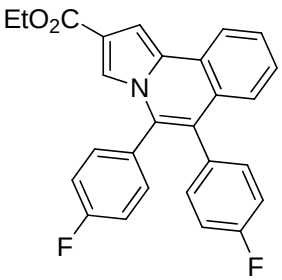


Ethyl 1,5,6-triphenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5da): The representative procedure was followed using ethyl 4,5-diphenyl-1*H*-pyrrole-3-carboxylate (**4d**) (146 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 10/1) yielded **5da** (176 mg, 75%) as a white solid. M. p. = 243−244 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 7.57−7.42 (m, 7H), 7.41−7.29 (m, 5H), 7.29−7.06 (m, 8H), 4.08 (q, J = 7.0 Hz, 2H), 1.04 (t, J = 7.0 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 164.8 (C_q), 136.8 (C_q), 136.4 (C_q), 133.6 (C_q), 133.3 (C_q), 131.3 (CH), 130.6 (CH), 130.5 (CH), 129.1 (C_q), 128.8 (CH), 128.8 (CH), 128.4 (CH), 127.9

(CH), 127.2 (CH), 127.1 (CH), 127.0 (CH), 126.7 (C_q), 126.6 (CH), 126.4 (C_q), 125.7 (CH), 124.7 (C_q), 122.7 (CH), 119.9 (C_q), 118.9 (CH), 117.6 (C_q), 59.6 (CH_2), 13.9 (CH_3). IR (neat): 3049, 1713, 1601, 1514, 1456, 1206, 1137, 776, 761, 699 cm^{-1}. MS (EI) *m/z* (relative intensity) 467 (100) [M^+], 394 (30). HRMS (ESI) *m/z* calcd for $C_{33}H_{25}NO_2$ [M^+] 467.1885, found 467.1872.

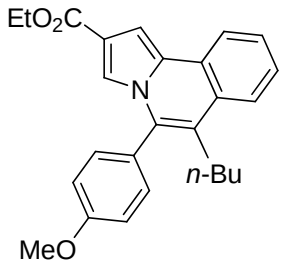


Dimethyl 3-methyl-5,6-diphenylpyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5ea): The representative procedure was followed using dimethyl 2-methyl-5-phenyl-1*H*-pyrrole- 3,4-dicarboxylate (**4e**) (137 mg, 0.50 mmol) and diphenylacetylene (**2a**) (178 mg, 1.00 mmol). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 3/1) yielded **5ea** as a yellow solid (157 mg, 70%). M. p. 186−187 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.56 (d, *J* = 8.0 Hz, 1H), 7.47 (ddd, *J* = 7.7, 7.1, 1.4 Hz, 1H), 7.29 (ddd, *J* = 7.7, 7.1, 1.2 Hz, 1H), 7.25−7.15 (m, 8H), 7.10−7.03 (m, 3H), 4.05 (s, 3H), 3.85 (s, 3H), 1.93 (s, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 168.8 (C_q), 165.5 (C_q), 136.4 (C_q), 134.9 (C_q), 134.2 (C_q), 131.3 (CH), 131.2 (CH), 130.6 (C_q), 129.0 (C_q), 128.4 (CH), 127.9 (C_q), 127.9 (CH), 127.8 (CH), 127.5 (CH), 127.2 (C_q), 126.9 (CH), 126.9 (CH), 126.7 (CH), 124.8 (C_q), 122.9 (CH), 116.4 (C_q), 109.6 (C_q), 52.7 (CH_3), 51.7 (CH_3), 14.4 (CH_3). IR (neat): 2950, 1722, 1702, 1443, 1365, 1294, 1199, 1151, 1021, 701 cm^{-1}. MS (EI) *m/z* (relative intensity) 449 (83) [M^+], 416 (100), 358 (16), 331 (48). HRMS (EI) *m/z* calcd for $C_{29}H_{23}NO_4$ [M^+] 449.1627, found 449.1636.

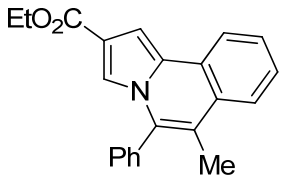


Ethyl 5,6-di(4-fluorophenyl)pyrrolo[2,1-a]isoquinoline-2-carboxylate (5ad): The representative procedure was followed using ethyl 5-phenyl-1*H*-pyrrole-3-carboxylate (**4a**) (108 mg, 0.50 mmol) and 1,2-bis(4-fluorophenyl)ethyne (**2d**) (206 mg, 1.00 mmol). After 22

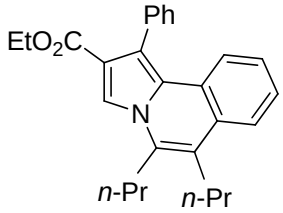
h, purification by column chromatography on silica gel (*n*-hexane/CH_2Cl_2: 10/1) yielded **5ad** (116 mg, 54%) as a yellow solid. M. p. = 240−241°C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.14 (d, J = 8.0 Hz, 1H), 7.56-7.41 (m, 2H), 7.41−6.84 (m, 11H); 4.34 (q, J = 7.1 Hz, 2H), 1.37 (t, J = 7.1 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 164.9 (C_q), 162.6 (C_q, J_{C-F} = 250 Hz), 161.9 (C_q, J_{C-F} = 247 Hz), 133.0 (C_q), 132.9 (CH, J_{C-F} = 8 Hz), 132.4 (CH, J_{C-F} = 8 Hz), 132.0 (C_q, J_{C-F} = 4 Hz), 130.8 (C_q), 129.2 (C_q, J_{C-F} = 4 Hz), 128.1 (C_q), 128.0 (CH), 126.4 (CH), 126.4 (CH), 125.8 (C_q), 124.0 (C_q), 122.2 (CH), 118.6 (C_q), 118.4 (CH), 116.2 (CH, J_{C-F} = 22 Hz), 115.2 (CH, J_{C-F} = 22 Hz), 101.6 (CH), 60.2 (CH_2), 14.4 (CH_3). ^{19}F-NMR (283 MHz, $CDCl_3$): δ = −(111.2 − 111.4) (m), −(114.3 − 114.5) (m). IR (neat): 3144, 2989, 1697, 1598, 1545, 1501, 1218, 816, 789, 756 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 427 (100) [M^+], 354 (60). HRMS (ESI) *m*/*z* calcd for $C_{27}H_{19}F_2NO_2$ [M^+] 427.1384, found 427.1379.



Ethyl 6-butyl-5-(4-methoxyphenyl)pyrrolo[2,1-a]isoquinoline-2-carboxylate (5ai): The representative procedure was followed using ethyl 5-phenyl-1*H*-pyrrole-3-carboxylate (**4a**) (108 mg, 0.50 mmol), 1-(hex-1-yn-1-yl)-4-methoxybenzene (**2i**) (188 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/ EtOAc: 30/1) yielded **5ai** (160 mg, 80%, 8:1 mixture of regioisomers according to ^{1}H-NMR) as a yellow oil. Purification by a second column chromatography on silica gel (*n*-hexane/ EtOAc: 30/1) yielded the major regioisomer (95 mg, 47%) as a yellow oil. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.10 (d, J = 7.6 Hz, 1H), 7.76 (d, J = 7.8 Hz, 1H), 7.55−7.45 (m, 2H), 7.40 (s, 1H), 7.51 (d, J = 8.4 Hz, 2H), 7.20 (s, 1H), 7.10 (d, J = 8.4 Hz, 2H), 4.52 (q, J = 7.4 Hz, 2H), 3.92 (s, 3H), 2.60 (t, J = 8.0 Hz, 2H), 1.61−1.49 (m, 2H), 1.36 (t, J = 7.0 Hz, 3H), 1.29 (m, 2H), 0.85 (t, J = 7.4 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 165.1 (C_q), 160.0 (C_q), 152.8 (C_q), 131.2 (CH), 130.4 (C_q), 127.2 (CH), 127.1 (C_q), 126.2 (C_q), 126.2 (CH), 125.9 (C_q), 124.5 (CH), 122.6 (CH), 121.7 (C_q), 118.4 (CH), 117.6 (C_q), 114.8 (CH), 100.9 (CH), 60.0 (CH_2), 55.3 (CH_3), 32.5 (CH_2), 28.2 (CH_2), 22.9 (CH_2), 14.4 (CH_3), 13.7 (CH_3). IR (neat): 2955, 1705, 1607, 1508, 1454, 1289, 1241, 1173, 1025, 751 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 401 (100) [M^+], 358 (20), 285 (35). HRMS (ESI) *m*/*z* calcd for $C_{26}H_{27}NO_3$ [M^+] 401.1991, found 401.1989.

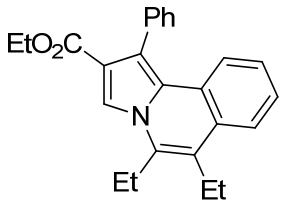


Ethyl 6-methyl-5-phenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5aj): The representative procedure was followed using ethyl 5-phenyl-1*H*-pyrrole-3-carboxylate (108 mg, 0.50 mmol) (**4a**), 1-phenyl-1-propyne (**2j**) (116 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/ EtOAc: 20/1) yielded **5aj** (120 mg, 73%, 5:1 mixture of regioisomers according to ^{1}H-NMR) as a yellow solid. Purification by a second column chromatography on silica gel (*n*-hexane/ EtOAc: 30/1) yielded the major regioisomer (41 mg, 25%) as a yellow oil. M. p. = 114−115 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.10 (d, J = 7.8 Hz, 1H), 7.76 (d, J = 7.8 Hz, 1H), 7.60−7.38 (m, 8H), 7.25 (d, J = 1.6 Hz, 1H), 4.51 (q, J = 7.1 Hz, 2H), 2.21 (s, 3H), 1.55 (t, J = 7.1 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 165.2 (C_q), 153.9 (C_q), 153.0 (C_q), 150.6 (C_q), 150.1 (CH), 129.6 (CH), 129.5 (CH), 128.1 (C_q), 127.6 (CH), 126.5 (CH), 125.9 (C_q), 124.2 (CH), 122.5 (CH), 118.5 (CH), 117.7 (C_q), 116.6 (C_q), 101.1 (CH), 60.0 (CH_2), 15.0 (CH_3), 14.4 (CH_3). IR (neat): 2974, 1695, 1544, 1516, 1454, 1240, 1178, 1019, 747, 703 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 329 (100) [M^+], 256 (55). HRMS (ESI) *m*/*z* calcd for $C_{22}H_{19}NO_2$ [M^+] 329.1416, found 329.1417.

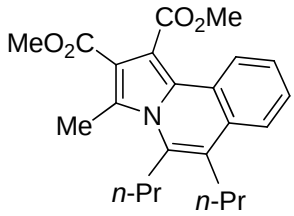


Ethyl 5,6-dimethyl-1-phenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5dg): The representative procedure was followed using ethyl 4,5-diphenyl-1*H*-pyrrole-3-carboxylate (**4d**) (72.8 mg, 0.25 mmol), 4-octyne (**2g**) (55.0 mg, 0.50 mmol) and $Cu(OAc)_2 \cdot H_2O$ (15.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded **5dg** (77 mg, 77%) as a yellow oil. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 7.97 (s, 1H), 7.69 (d, J = 8.2 Hz, 1H), 7.65−7.57 (m, 6H), 7.32 (ddd, J = 7.7, 7.7, 1.2 Hz, 1H), 7.09 (ddd, J = 7.7, 7.7, 1.2 Hz, 1H), 4.15 (q, J = 7.1 Hz, 2H), 3.02 (t, J = 8.0 Hz, 2H), 2.87 (t, J = 8.0 Hz, 2H), 1.92−1.77 (m, 2H), 1.75−1.61 (m, 2H), 1.22−1.01 (m, 9H). ^{13}C-

NMR (75.5 MHz, $CDCl_3$): δ = 166.0 (C_q), 157.2 (C_q), 152.5 (C_q), 150.6 (CH), 128.5 (CH), 127.7 (C_q), 127.0 (CH), 126.5 (C_q), 126.5 (C_q), 126.1 (CH), 125.7 (CH), 123.6 (CH), 123.1 (CH), 119.8 (C_q), 119.4 (C_q), 117.4 (C_q), 116.5 (CH), 59.6 (CH_2), 30.7 (CH_2), 30.0 (CH_2), 23.4 (CH_2), 20.3 (CH_2), 14.5 (CH_3), 14.3 (CH_3), 13.9 (CH_3). IR (neat): 2958, 1698, 1604, 1519, 1457, 1202, 1111, 758, 731, 698 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 399 (100) [M^+], 370 (45), 282 (35). HRMS (ESI) *m*/*z* calcd for $C_{27}H_{29}NO_2$ [M^+] 399.2198, found 399.2198.

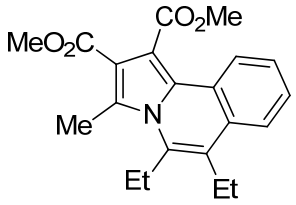


Ethyl 5,6-diethyl-1-phenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5dh): The representative procedure was followed using ethyl 2-methyl-4,5-diphenyl- 1*H*-pyrrole-3-carboxylate (**4d**) (72.8 mg, 0.25 mmol), 3-hexyne (**2h**) (55.0 mg, 0.50 mmol) and $Cu(OAc)_2 \cdot H_2O$ (15.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/ EtOAc: 20/1) yielded **5dh** (74 mg, 80%) as a white solid. M. p. = 141−142 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.01 (s, 1H), 7.73 (d, *J* = 8.4 Hz, 1H), 7.64−7.38 (m, 6H), 7.32 (ddd, *J* = 7.7, 7.6, 1.3 Hz, 1H), 7.09 (ddd, *J* = 7.7, 7.6, 1.2 Hz, 1H), 4.16 (q, *J* = 7.4 Hz, 2H), 3.09 (q, *J* = 7.6 Hz, 2H), 2.96 (q, *J* = 7.6 Hz, 2H), 1.45 (t, *J* = 7.6 Hz, 3H), 1.31 (t, *J* = 7.6 Hz, 3H), 1.11 (t, *J* = 7.4 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 166.0 (C_q), 157.3 (C_q), 155.4 (C_q), 150.7 (CH), 128.5 (CH), 127.6 (C_q), 127.0 (CH), 126.5 (C_q), 126.5 (C_q), 126.2 (CH), 125.8 (CH), 123.6 (CH), 123.3 (CH), 120.8 (C_q), 119.6 (C_q), 117.7 (C_q), 116.4 (CH), 59.6 (CH_2), 21.8 (CH_2), 20.8 (CH_2), 14.7 (CH_3), 14.0 (CH_3), 11.7 (CH_3). IR (neat): 2966, 1695, 1602, 1521, 1444, 1268, 1221, 1034, 757, 703 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 371 (100) [M^+], 298 (23), 282 (20). HRMS (ESI) *m*/*z* calcd for $C_{25}H_{25}NO_2$ [M^+] 371.1885, found 371.1887.

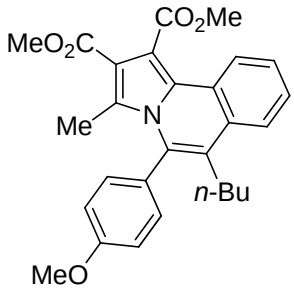


Dimethyl 3-methyl-5,6-di(*n*-propyl)pyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5eg): The representative procedure was followed using dimethyl 2-methyl-5-phenyl-1*H*-pyrrole-

3,4-dicarboxylate (**4e**) (137 mg, 0.50 mmol), 4-octyne (**2g**) (110 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/ EtOAc: 10/1) yielded **5eg** (141 mg, 74%) as a yellow oil. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.17 (d, J = 7.2 Hz, 1H), 7.67 (d, J = 7.0 Hz, 1H), 7.46−7.36 (m, 2H), 3.99 (s, 3H), 3.87 (s, 3H), 3.12 (t, J = 8.2 Hz, 2H), 2.97 (s, 3H), 2.79 (t, J = 8.2 Hz, 2H), 1.70−1.52 (m, 4H), 1.09 (t, J = 7.3 Hz, 3H), 1.02 (t, J = 7.3 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 169.0 (C_q), 165.7 (C_q), 154.7 (C_q), 128.8 (C_q), 128.4 (C_q), 127.9 (C_q), 126.9 (CH), 126.8 (CH), 124.7 (C_q), 123.6 (CH), 123.1 (CH), 122.2 (C_q), 116.4 (C_q), 109.2 (C_q), 52.5 (CH_3), 51.7 (CH_3), 50.5 (CH_2), 50.2 (CH_2), 25.4 (CH_2), 25.0 (CH_2), 14.8 (CH_3), 14.4 (CH_3), 13.4 (CH_3). IR (neat): 2954, 1708, 1526, 1455, 1438, 1199, 1158, 1091, 755, 730 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 381 (100) [M^+], 350 (30), 334 (42), 263 (28). HRMS (ESI) *m*/*z* calcd for $C_{23}H_{27}NO_4$ [M^+] 381.1940, found 381.1933.

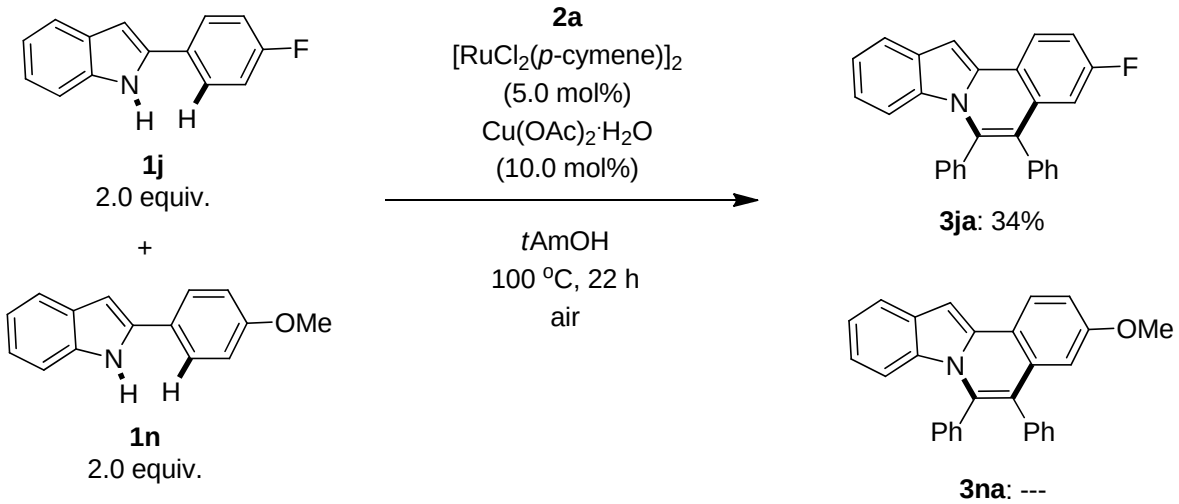


Dimethyl 5,6-diethyl-3-methylpyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5eh): The representative procedure was followed using dimethyl 2-methyl-5-phenyl-1*H*-pyrrole- 3,4-dicarboxylate (**4e**) (137 mg, 0.50 mmol), 3-hexyne (**2h**) (82.0 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30.0 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/ EtOAc: 10/1) yielded **5eh** (152 mg, 86%) as a yellow oil. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.17 (d, J = 6.8 Hz, 1H), 7.71 (d, J = 6.7 Hz, 1H), 7.46−7.34 (m, 2H), 3.99 (s, 3H), 3.88 (s, 3H), 3.21 (q, J = 7.4 Hz, 2H), 3.01 (s, 3H), 2.89 (q, J = 7.5 Hz, 2H), 1.25 (t, J = 7.5 Hz, 3H), 1.24 (t, J = 7.4 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 168.8 (C_q), 165.7 (C_q), 155.7 (C_q), 128.6 (C_q), 128.5 (C_q), 127.6 (C_q), 126.9 (CH), 126.8 (CH), 125.0 (C_q), 125.4 (CH), 125.4 (CH), 125.2 (C_q), 116.6 (C_q), 109.6 (C_q), 52.4 (CH_3), 51.6 (CH_3), 21.6 (CH_2), 20.9 (CH_2), 14.9 (CH_3), 14.4 (CH_3), 14.4 (CH_3). IR (neat): 2948, 1706, 1525, 1482, 1439, 1200, 1131, 1083, 784, 755 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 353 (80) [M^+], 322 (42), 306 (100), 235 (74). HRMS (ESI) *m*/*z* calcd for $C_{21}H_{23}NO_4$ [M^+] 353.1627, found 353.1636.



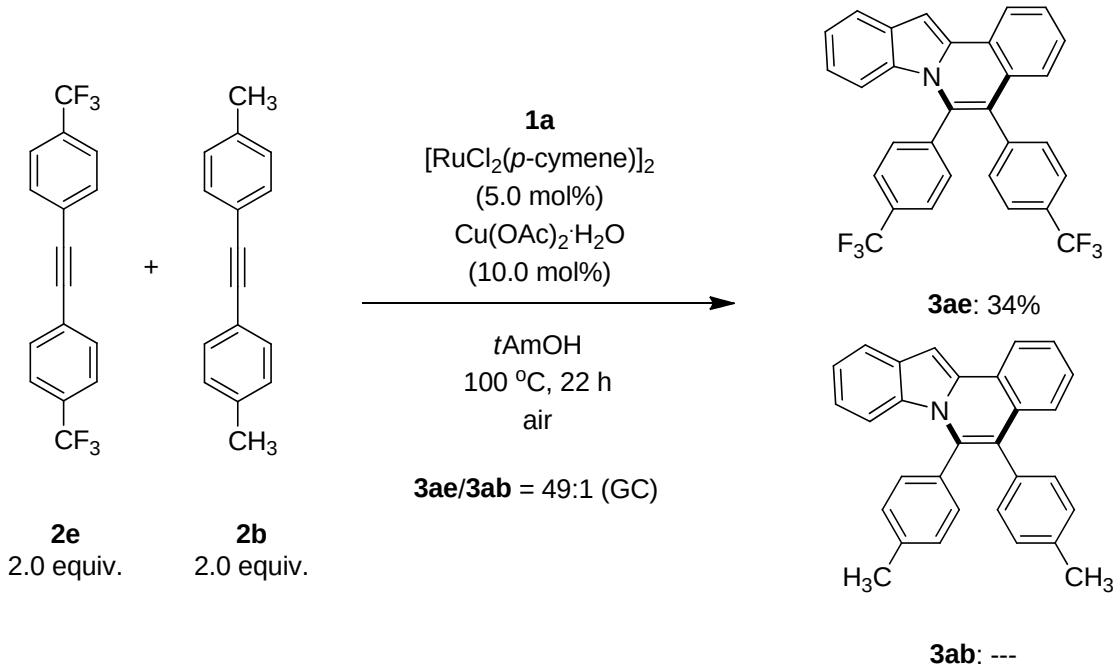
Dimethyl 6-(*n*-butyl)-5-(4-methoxyphenyl)-3-methylpyrrolo[2,1-a]isoquinoline-1,2-dicaboxylate (5ei): The representative procedure was followed using dimethyl 2-methyl-5-phenyl-1*H*-pyrrole-3,4-dicarboxylate (**4e**) (137 mg, 0.50 mmol), 1-(hex-1-yn-1-yl)-4-methoxybenzene (**2i**) (188 mg, 1.00 mmol) and $Cu(OAc)_2 \cdot H_2O$ (30 mg, 30.0 mol%). After 22 h, purification by column chromatography on silica gel (*n*-hexane/EtOAc: 10/1) yielded **5ei** (169 mg, 74%, 6:1 mixture of regioisomers according to ^{1}H-NMR) as a yellow oil. Purification by a second column chromatography on silica gel (*n*-hexane/EtOAc: 20/1) yielded the major regioisomer (146 mg, 64%) as a yellow solid. M. p. = 142−143 °C. ^{1}H-NMR (300 MHz, $CDCl_3$): δ = 8.31−8.24 (d, J = 7.1 Hz, 1H), 7.76−7.71 (d, J = 7.0 Hz, 1H), 7.50−7.45 (m, 2H), 7.27 (d, J = 10.8 Hz, 2H), 6.99 (d, J = 10.8 Hz, 2H), 4.00 (s, 3H), 3.90 (s, 3H), 3.82 (s, 3H), 2.49 (t, J = 8.2 Hz, 2H), 1.92 (s, 3H), 1.52−1.39 (m, 2H), 1.31−1.18 (m, 2H), 0.80 (t, J = 7.3 Hz, 3H). ^{13}C-NMR (75.5 MHz, $CDCl_3$): δ = 168.9 (C_q), 165.6 (C_q), 160.0 (C_q), 133.2 (C_q), 132.0 (CH), 130.1 (C_q), 127.6 (C_q), 127.5 (C_q), 127.4 (CH), 126.9 (CH), 125.3 (C_q), 124.1 (CH), 124.0 (C_q), 123.4 (CH), 115.9 (C_q), 113.6 (CH), 112.2 (C_q), 109.0 (C_q), 55.3 (CH_3), 52.5 (CH_3), 51.6 (CH_3), 32.3 (CH_2), 28.2 (CH_2), 22.9 (CH_2), 14.1 (CH_3), 13.6 (CH_3). IR (neat): 2954, 1705, 1604, 1525, 1509, 1438, 1240, 1171, 1021, 798 cm^{-1}. MS (EI) *m*/*z* (relative intensity) 459 (100) [M^+], 426 (70), 341 (60). HRMS (ESI) *m*/*z* calcd for $C_{28}H_{29}NO_5$ [M^+] 459.2046, found 459.2041.

Intermolecular Competition Experiment with Indoles 1j and 1n (Scheme 5a):



The mixture of 2-(4-fluorophenyl)-1*H*-indole (**1j**) (223 mg, 1.00 mmol), 2-(4-methoxyphenyl)-1*H*-indole (**1n)** (211 mg, 1.00 mmol), diphenylacetylene (**2a**) (89.0 mg, 0.50 mmol), $[RuCl_2(p\text{-cymene})]_2$ (15.3 mg, 5.0 mol%) and $Cu(OAc)_2 \cdot H_2O$ (10.0 mg, 10.0 mol%) in *t*AmOH (2 mL) was stirred at 100 °C under air for 22 h. At ambient temperature, the mixture was diluted with H_2O (75 mL) and extracted with EtOAc (3 x 75 mL). The combined organic phase was washed with brine (50 mL) and dried over anhydrous Na_2SO_4. After filtration and evaporation of the solvents under reduced pressure, the crude product was purified by column chromatography on silica gel (*n*-hexane/EtOAc: 50/1) to yield **3ja** as a yellow solid (66 mg, 34%).

Intermolecular Competition Experiment with Alkynes 2e and 2b (Scheme 5b):



2e
2.0 equiv.

2b
2.0 equiv.

The mixture of 2-phenylindole (**1a**) (48.0 mg, 0.25 mmol), 1,2-di-(*p*-tolyl)ethyne (**2e**) (103 mg, 0.50 mmol), 1,2-bis{4-(trifluoromethyl)phenyl}ethyne (**2b**) (157 mg, 0.50 mmol), $[RuCl_2(p\text{-cymene})]_2$ (7.7 mg, 5.0 mol%) and $Cu(OAc)_2 \cdot H_2O$ (5.0 mg, 10.0 mol%) in *t*AmOH (2 mL) was stirred at 100 °C under air for 22 h. At ambient temperature, the mixture was diluted with H_2O (75 mL) and extracted with EtOAc (3 x 75 mL). The combined organic phase was washed with brine (50 mL) and dried over anhydrous Na_2SO_4. After filtration and evaporation of the solvents under reduced pressure, the crude product was purified by column chromatography on silica gel (*n*-hexane/EtOAc: 50/1) to yield **3ae** as a yellow solid (43 mg, 34%).

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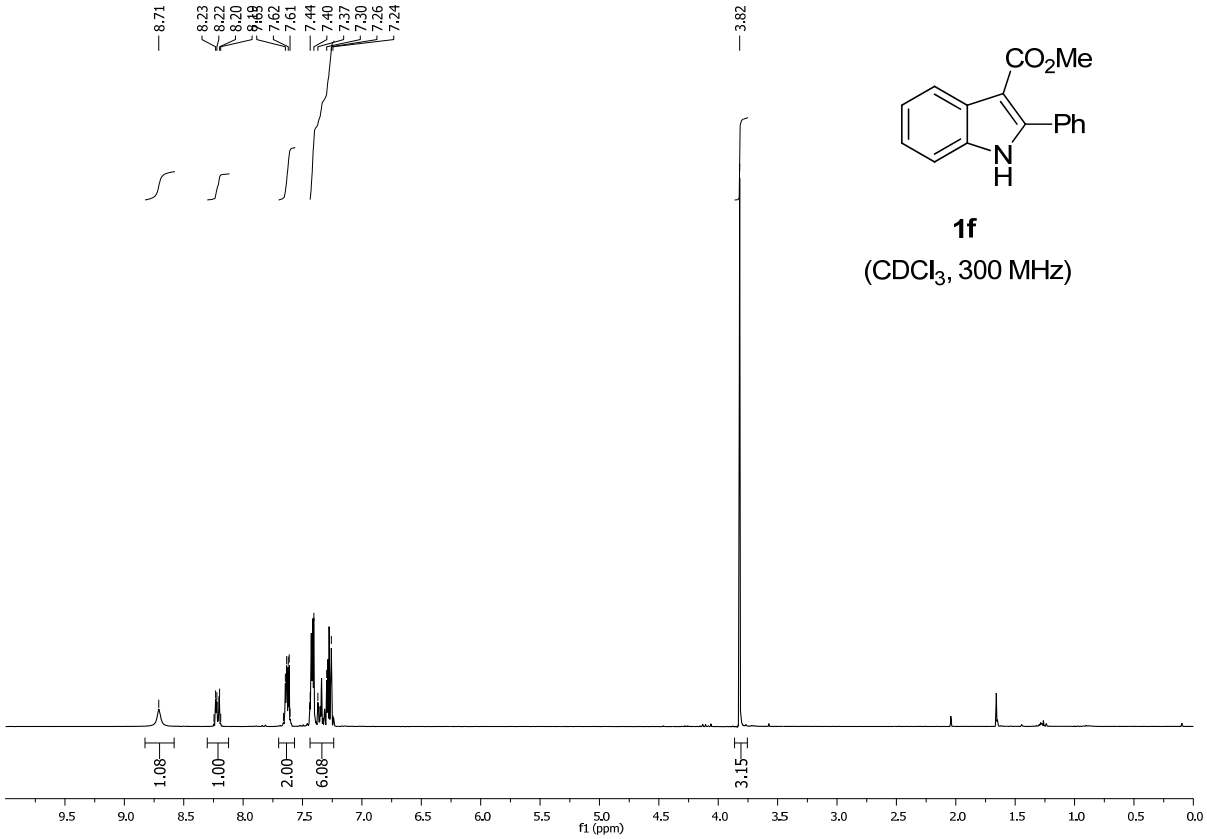
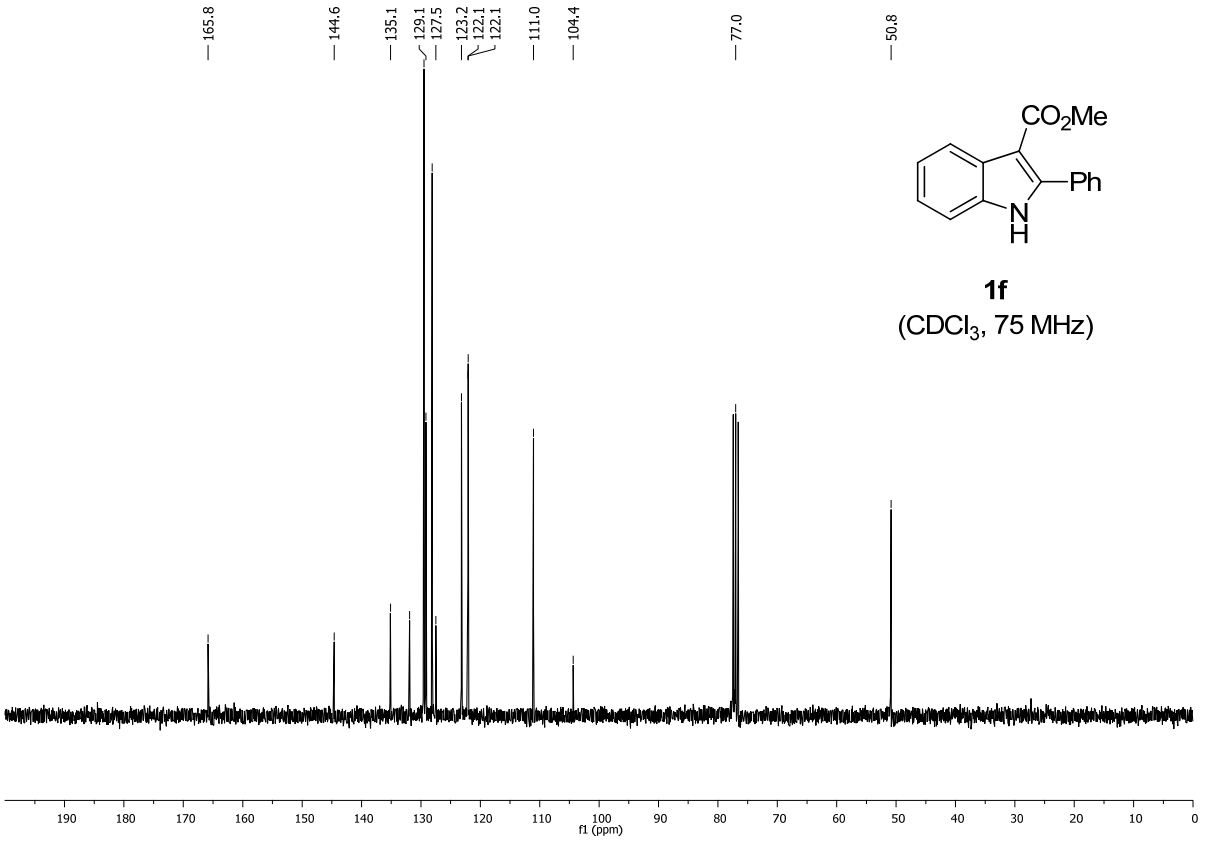
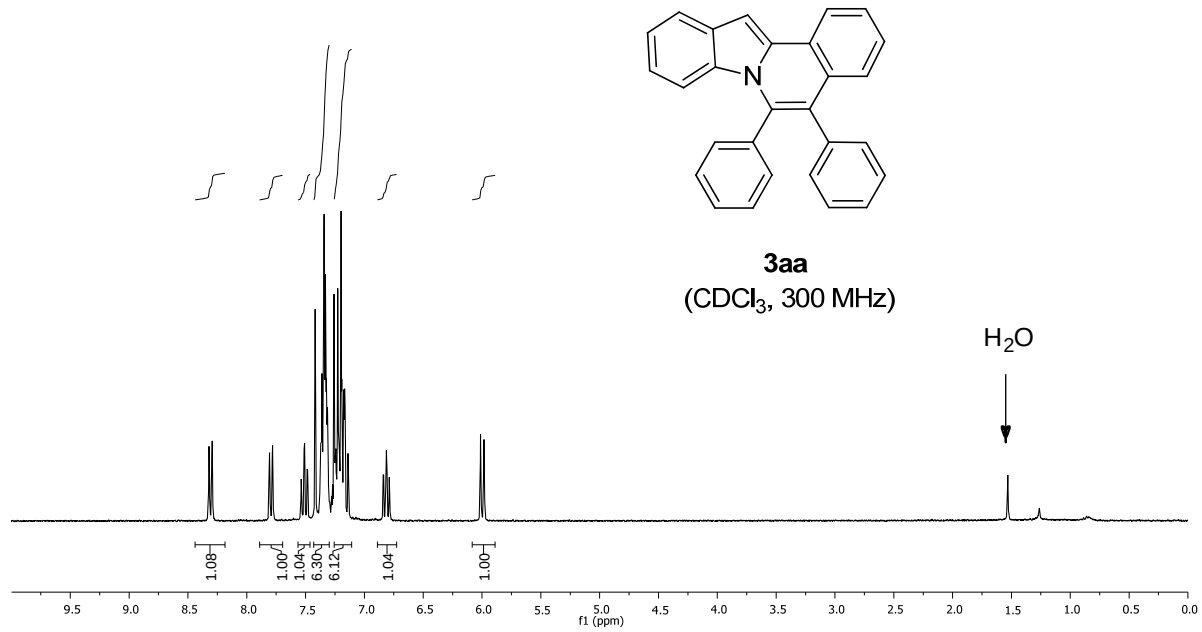
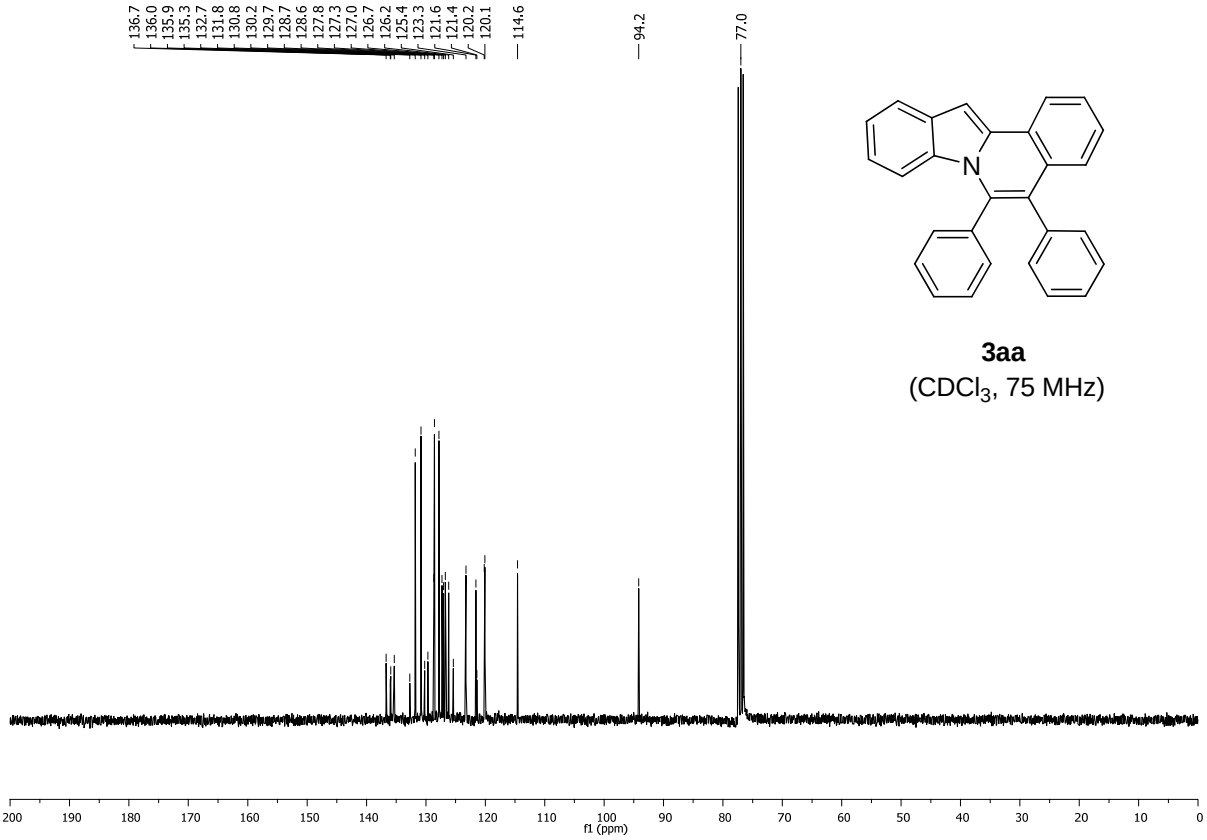
Methyl 2-phenyl-1*H*-indole-3-carboxylate (1f)



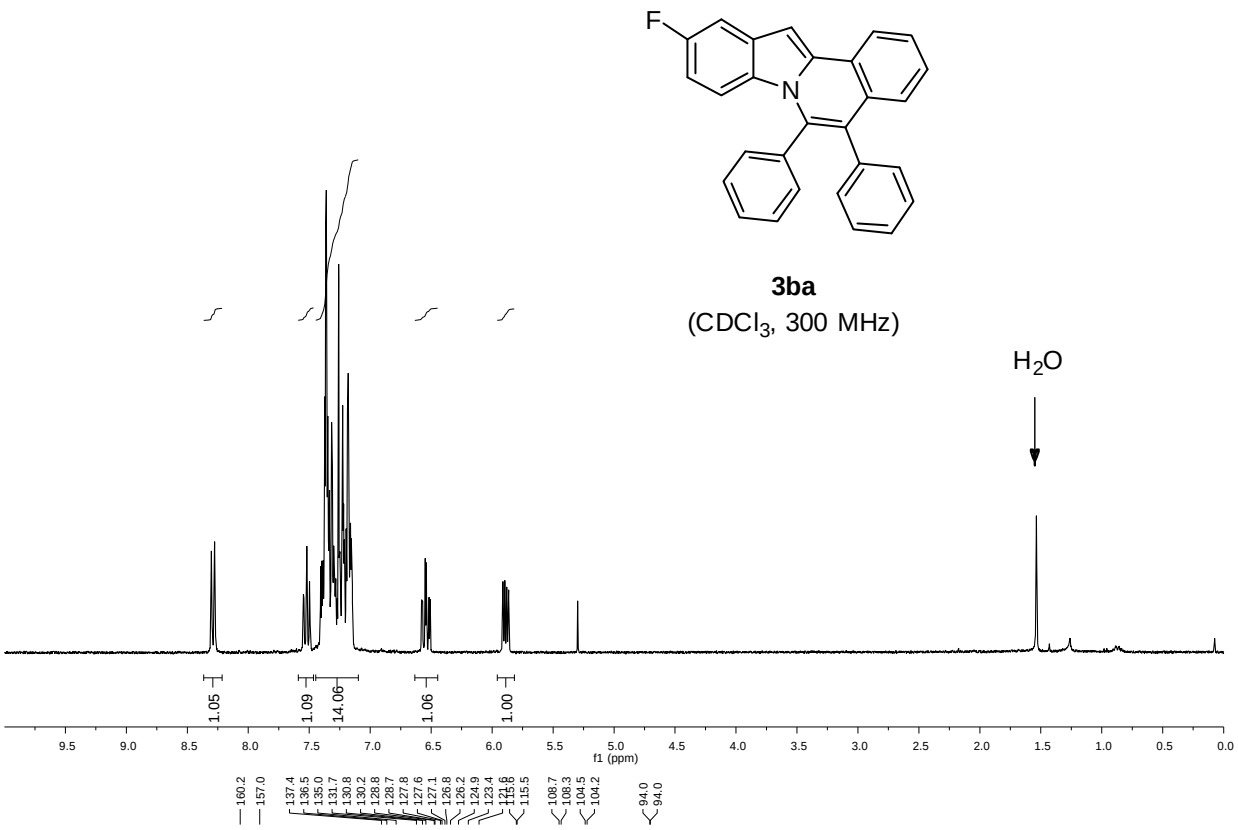


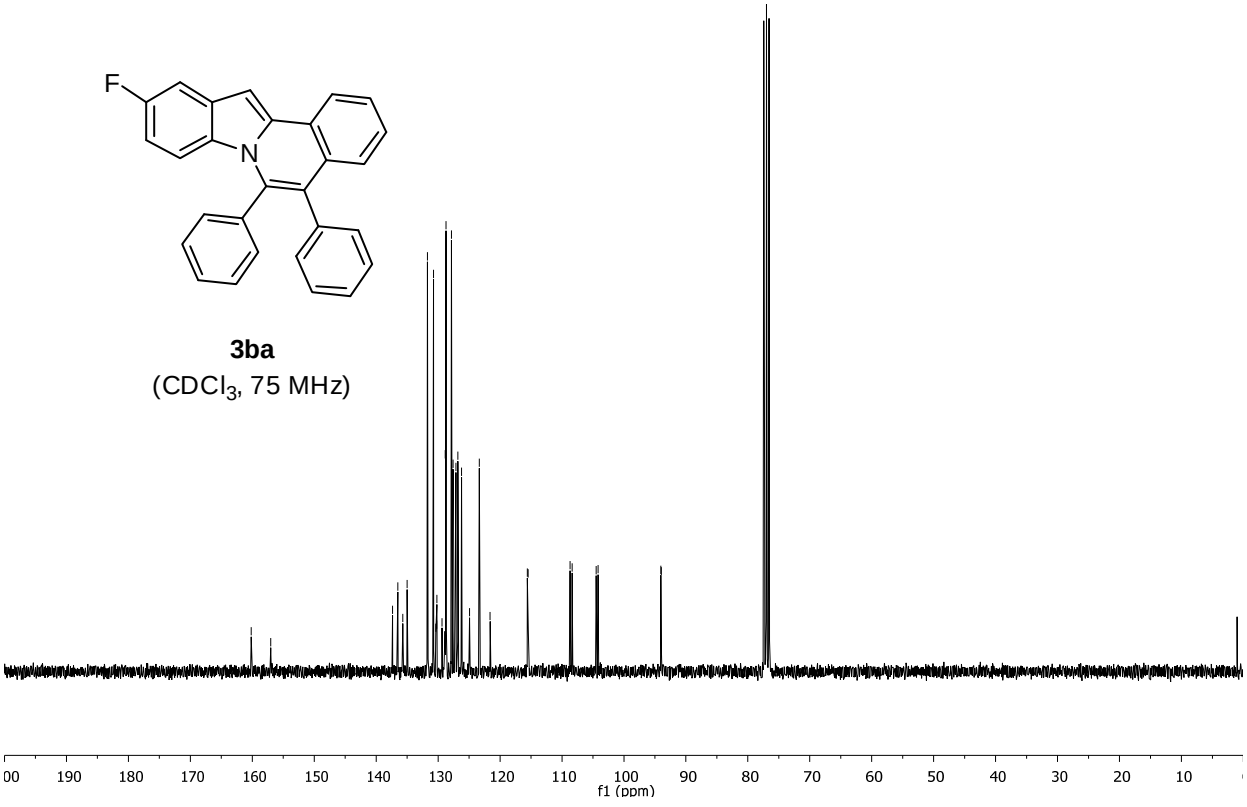
5,6-Diphenylindolo[2,1-a]isoquinoline (3aa)





10-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3ba)





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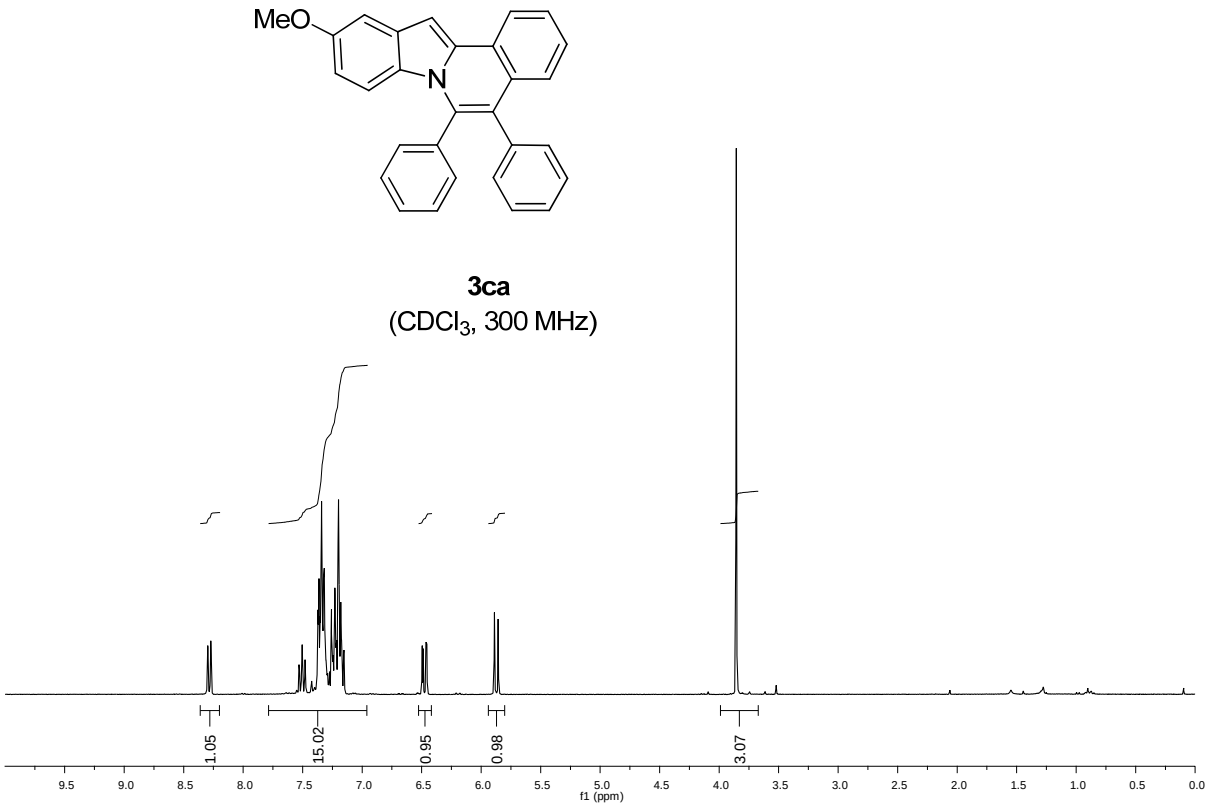
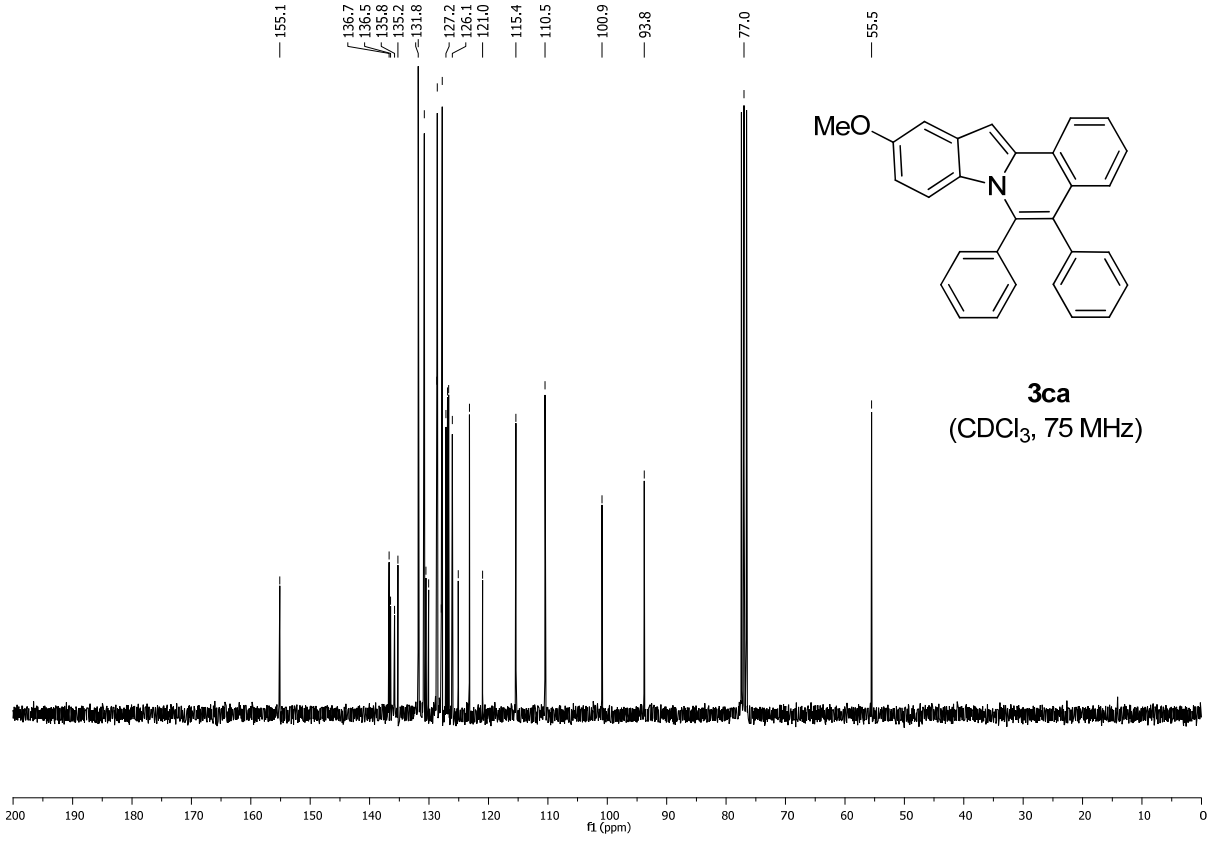
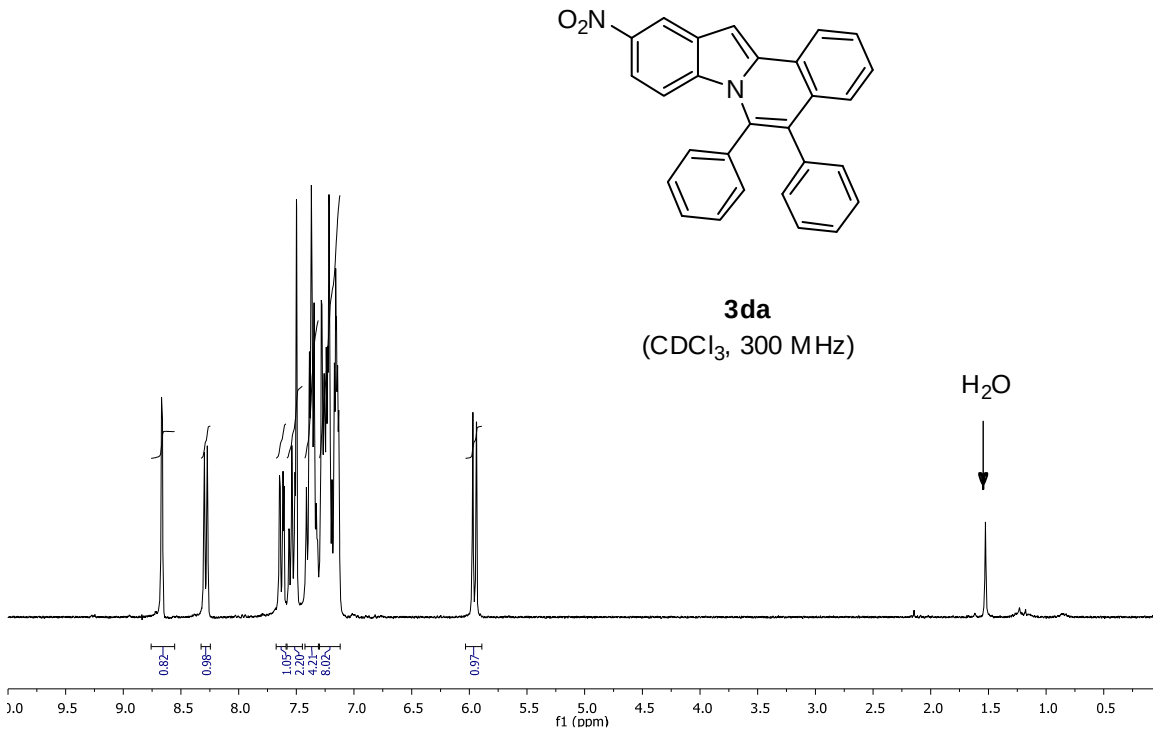
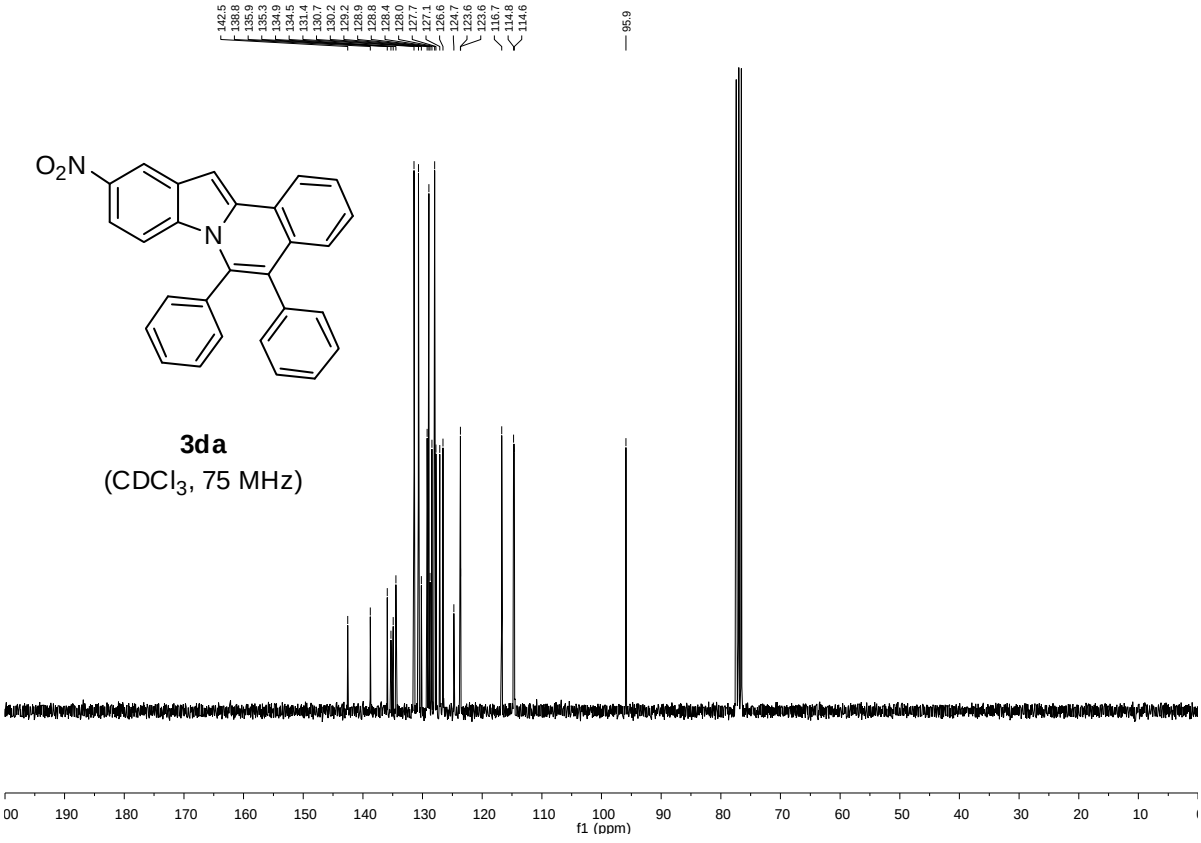


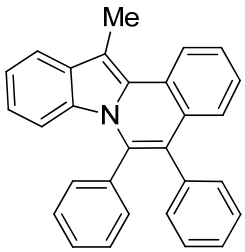


10-Nitro-5,6-diphenylindolo[2,1-a]isoquinoline (3da)



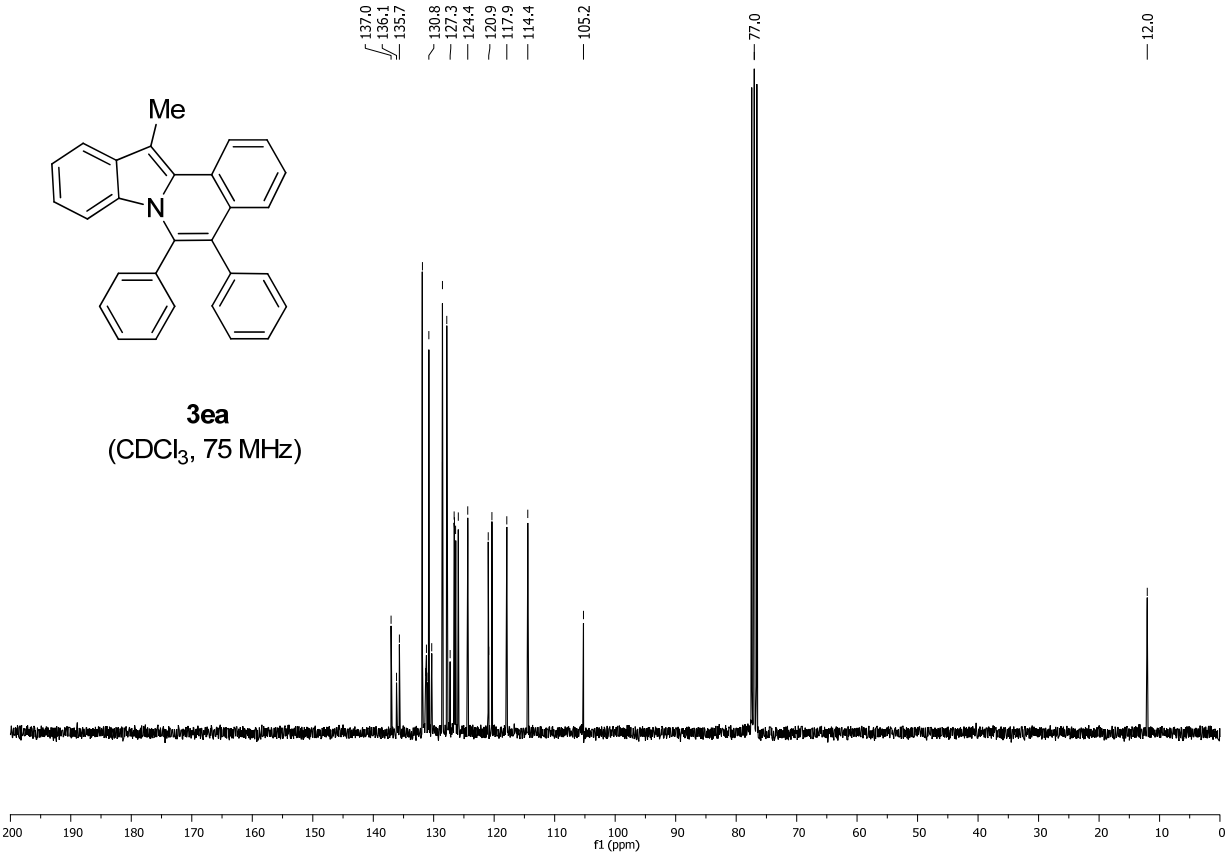


12-Methyl-5,6-diphenylindolo[2,1-a]isoquinoline (3ea)

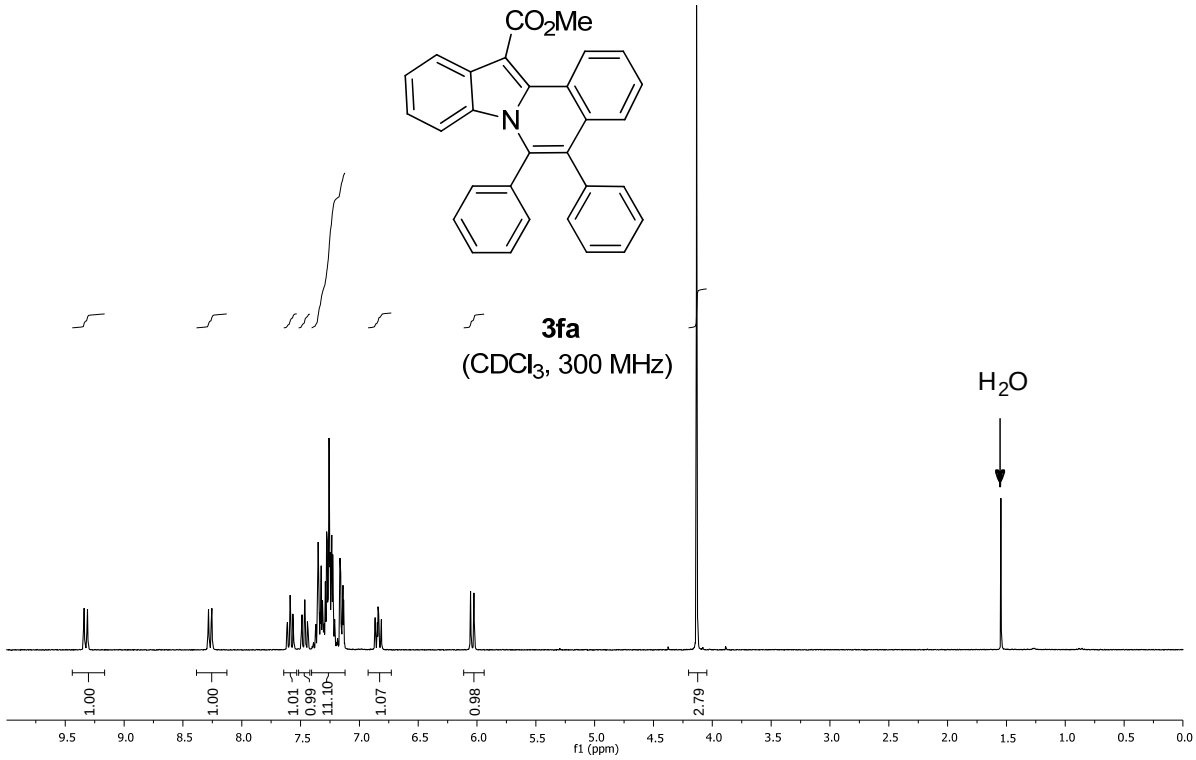


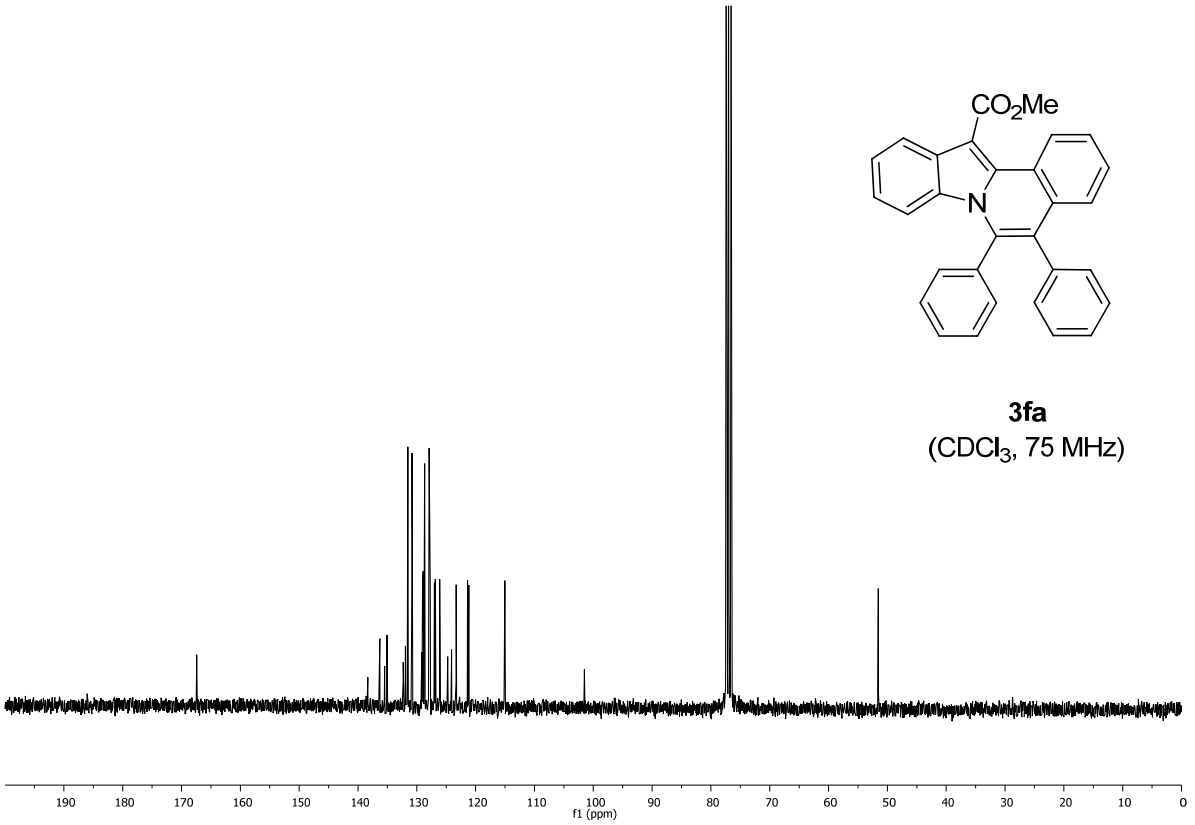
3ea
($CDCl_3$, 300 MHz)

3ea
($CDCl_3$, 75 MHz)

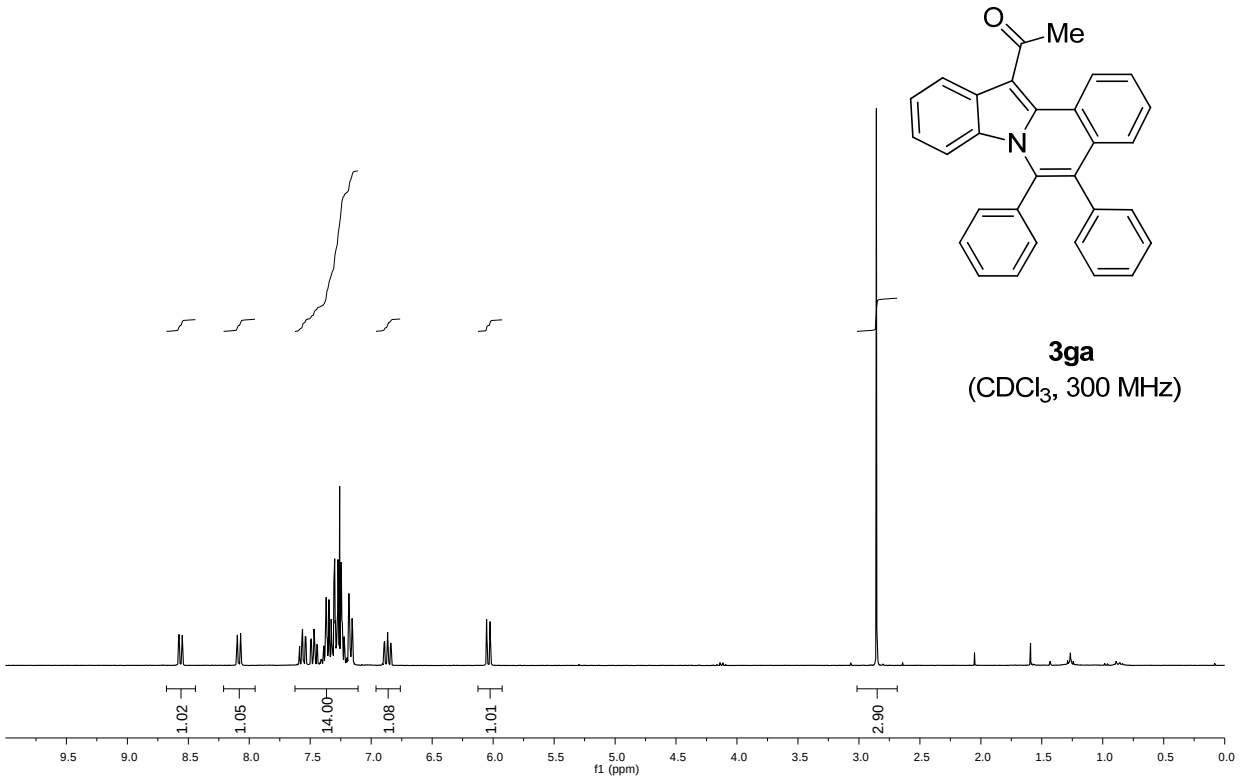


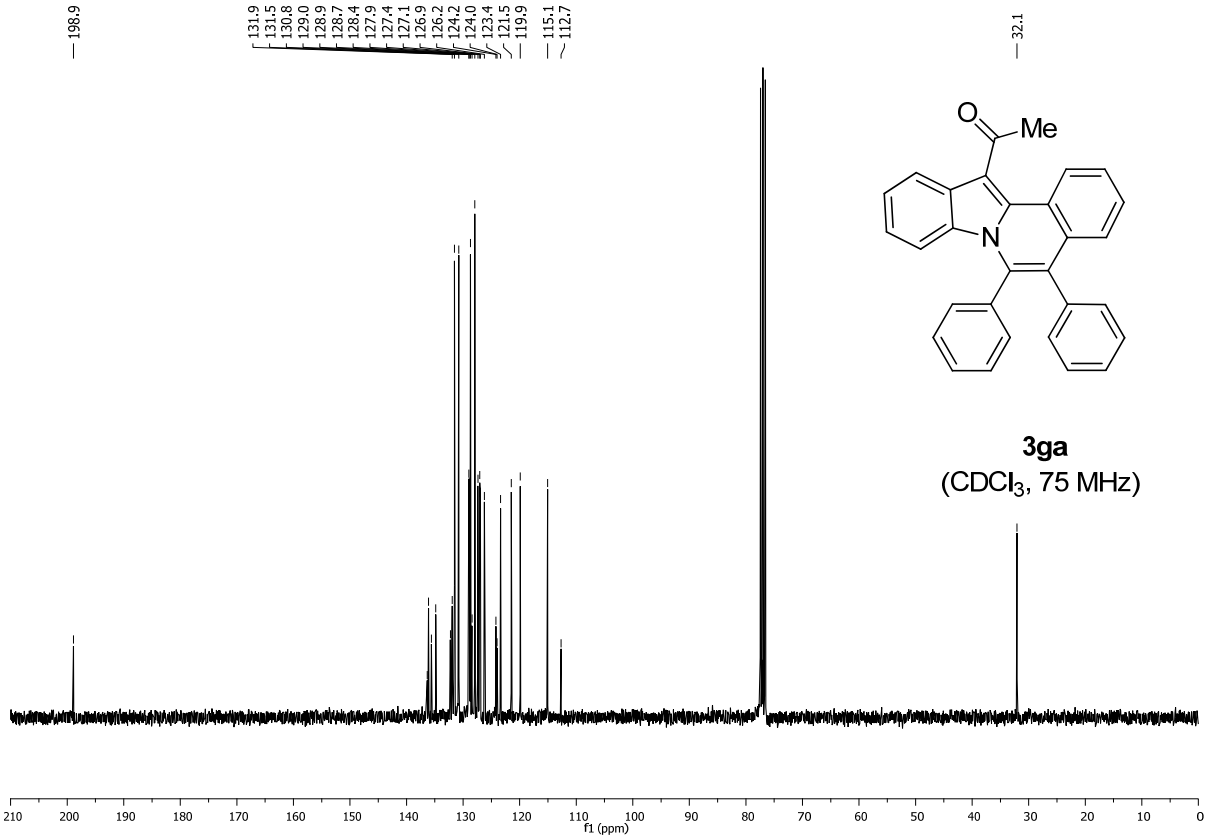
Methyl 5,6-diphenylindolo[2,1-a]isoquinoline-12-carboxylate (3fa)



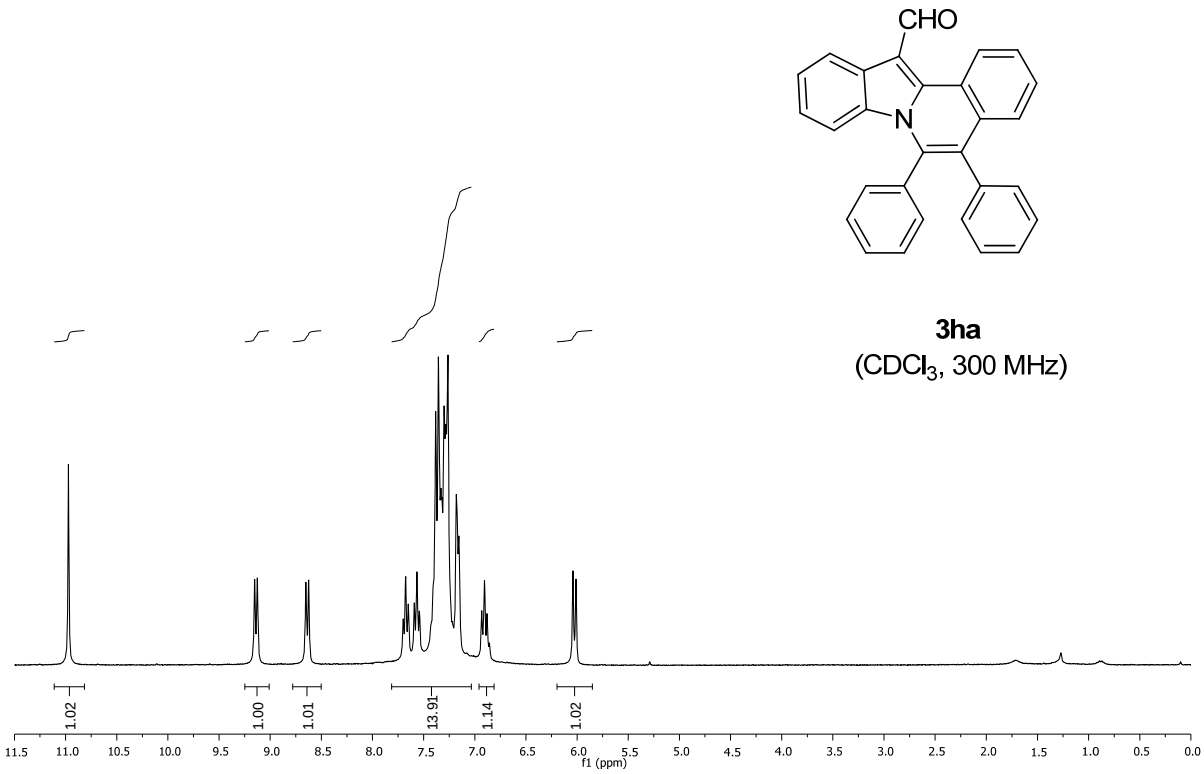


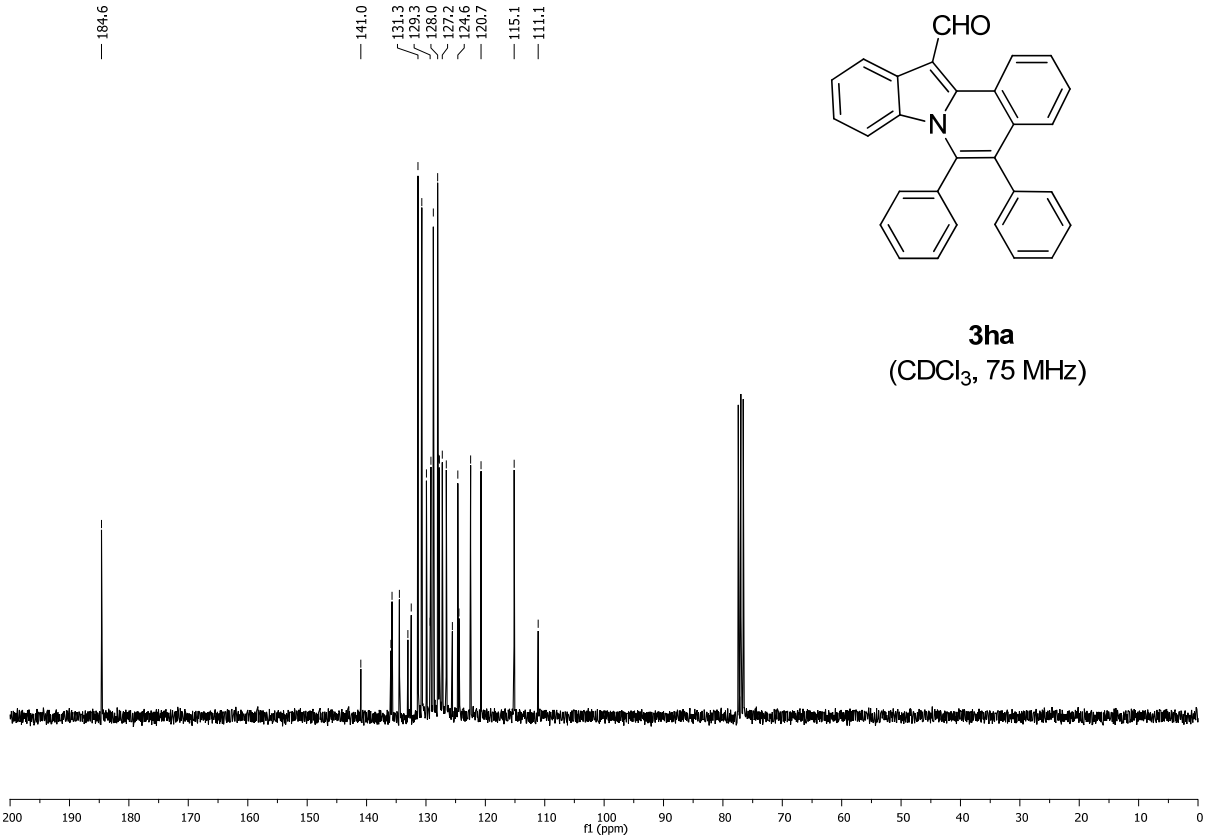
1-(5,6-Diphenylindolo[2,1-a]isoquinolin-12-yl)ethanone (3ga)



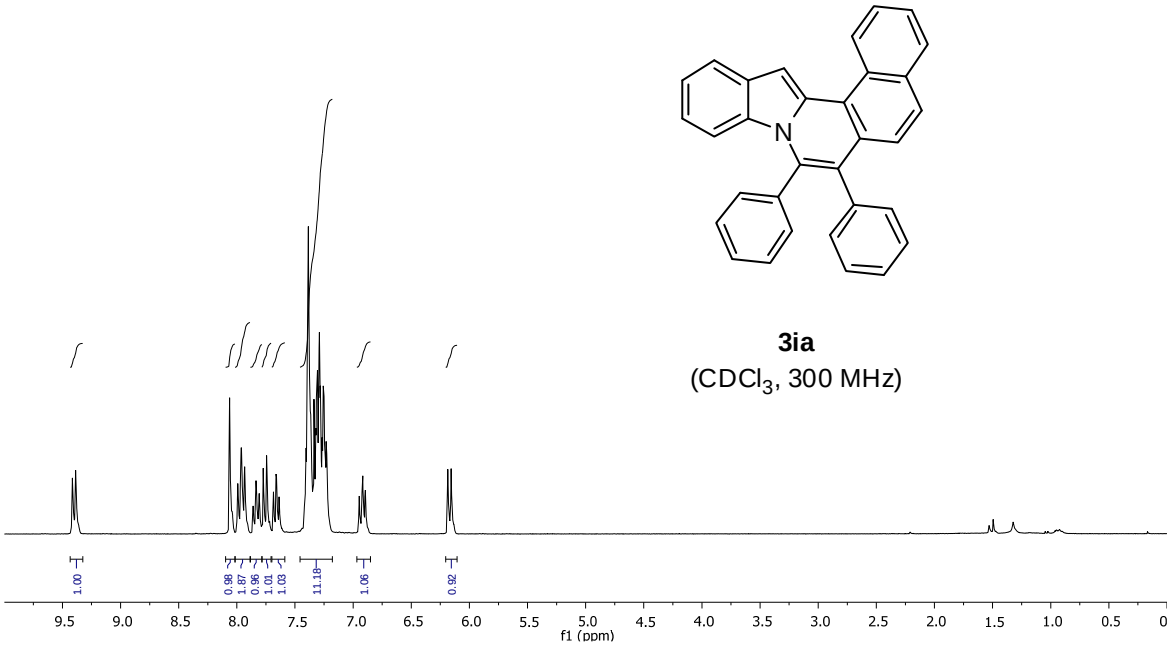


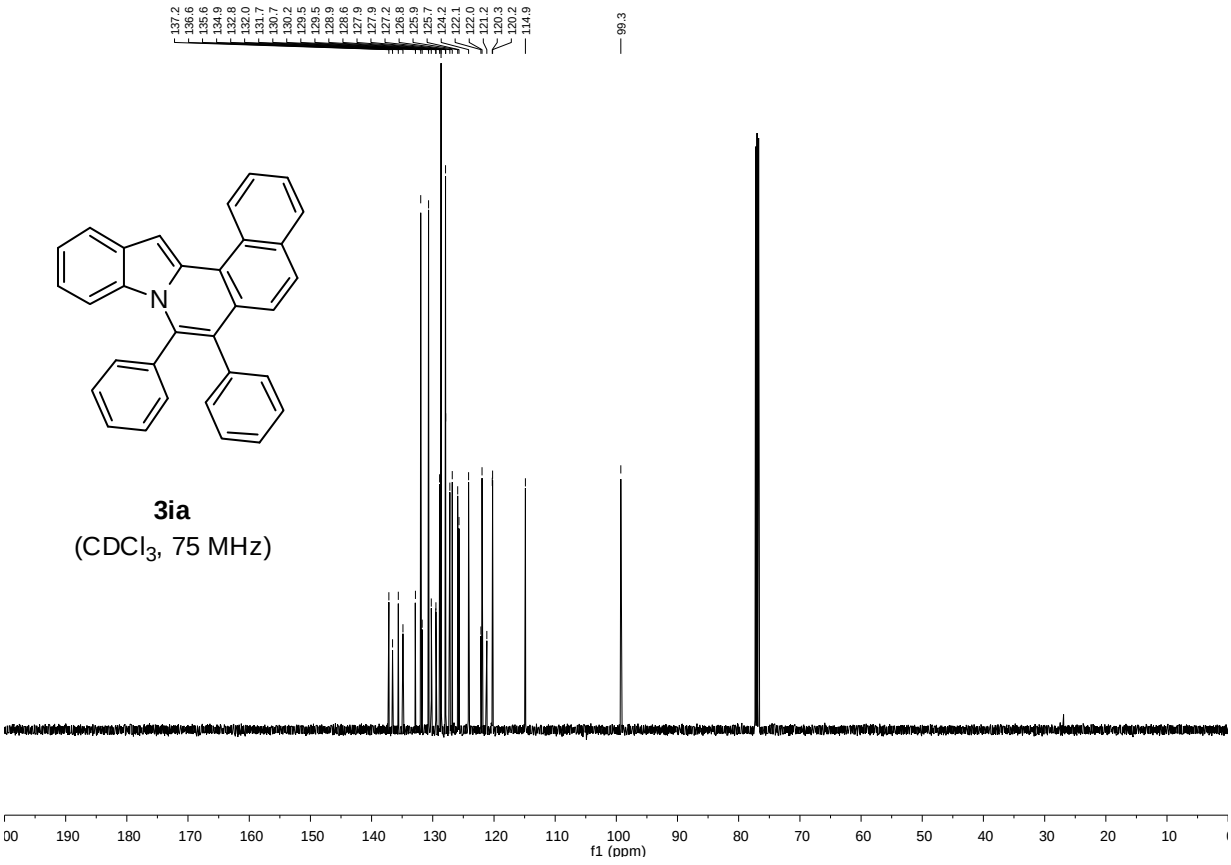
5,6-Diphenylindolo[2,1-a]isoquinoline-12-carbaldehyde (3ha)



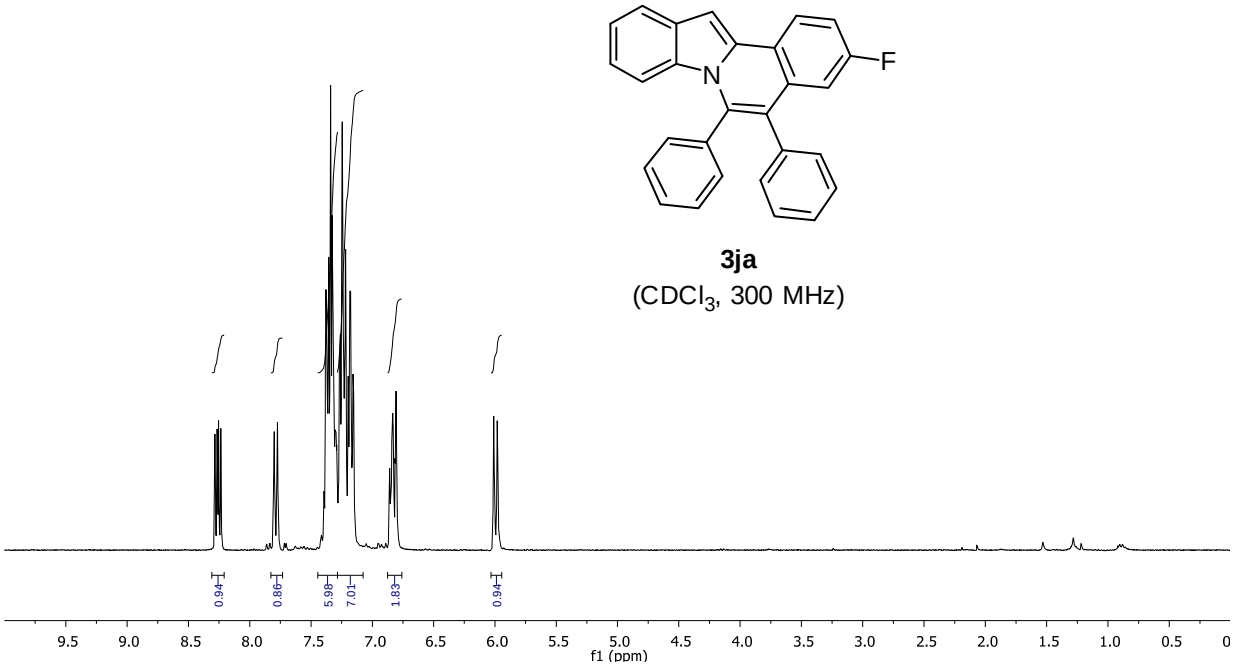


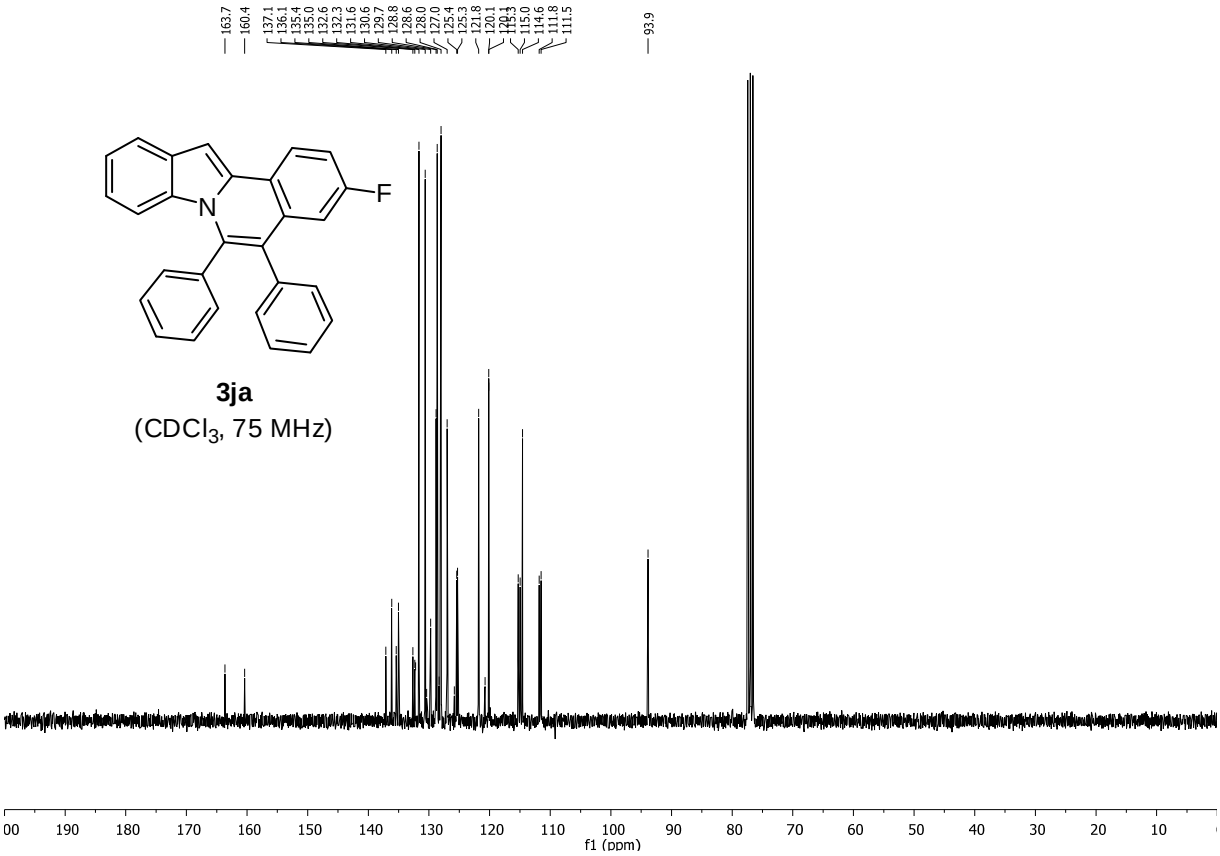
7, 8-Diphenylbenzo[h]indolo[2,1-a]isoquinoline (3ia)



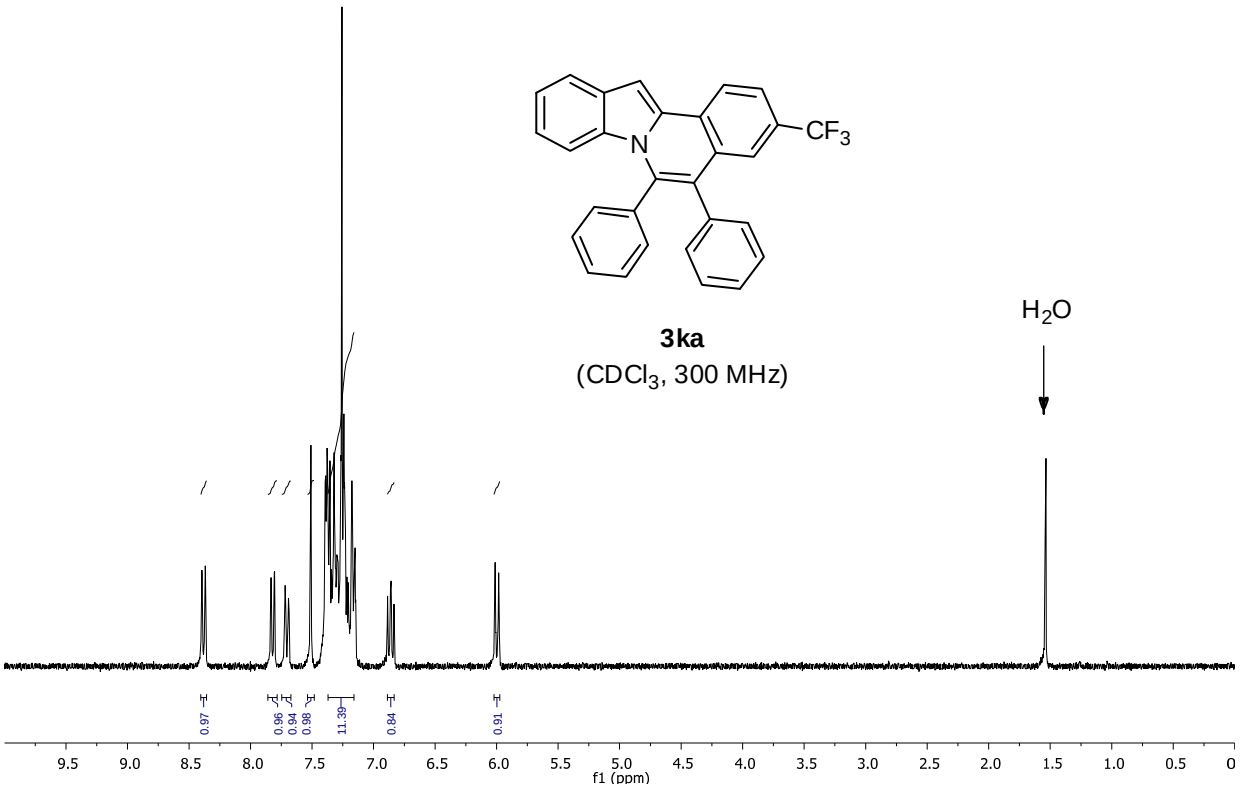


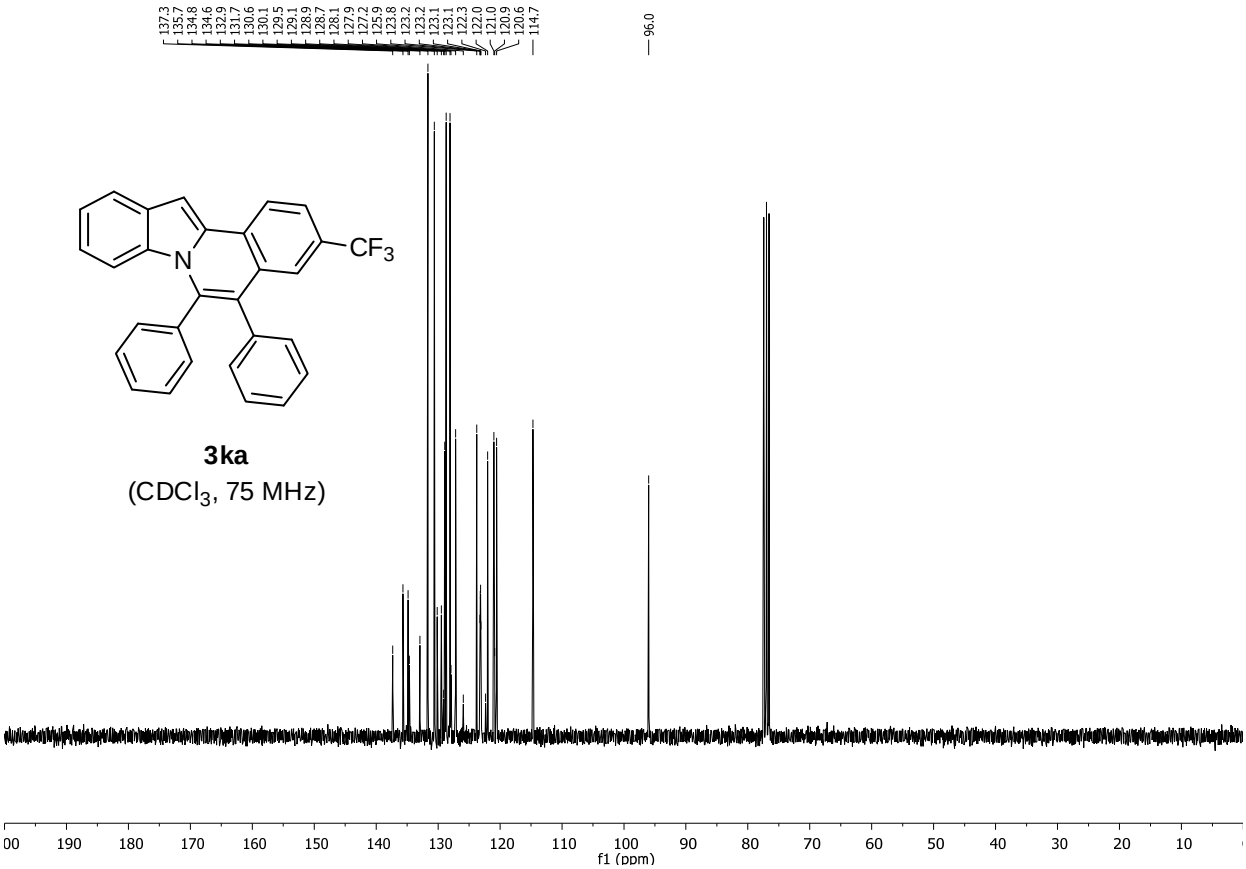
10-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3ja)



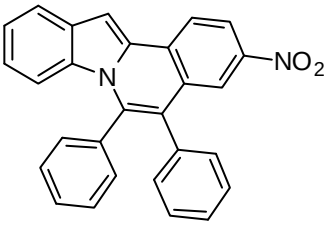


5,6-Diphenyl-3-(trifluoromethyl)indolo[2,1-a]isoquinoline (3ka)

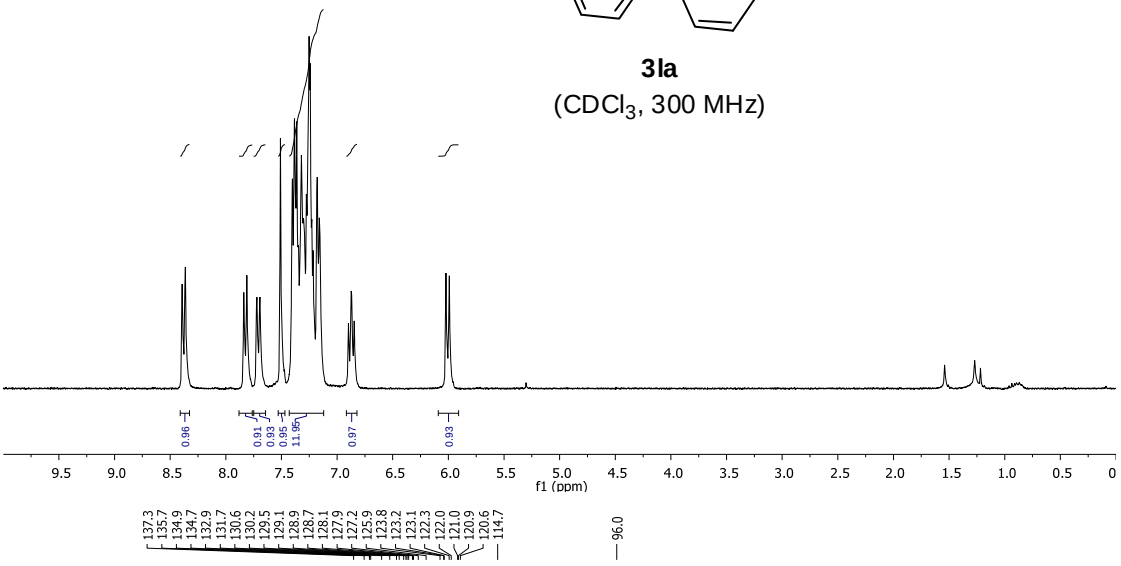


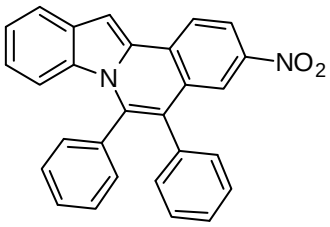


3-Nitro-5,6-diphenylindolo[2,1-a]isoquinoline (3la)



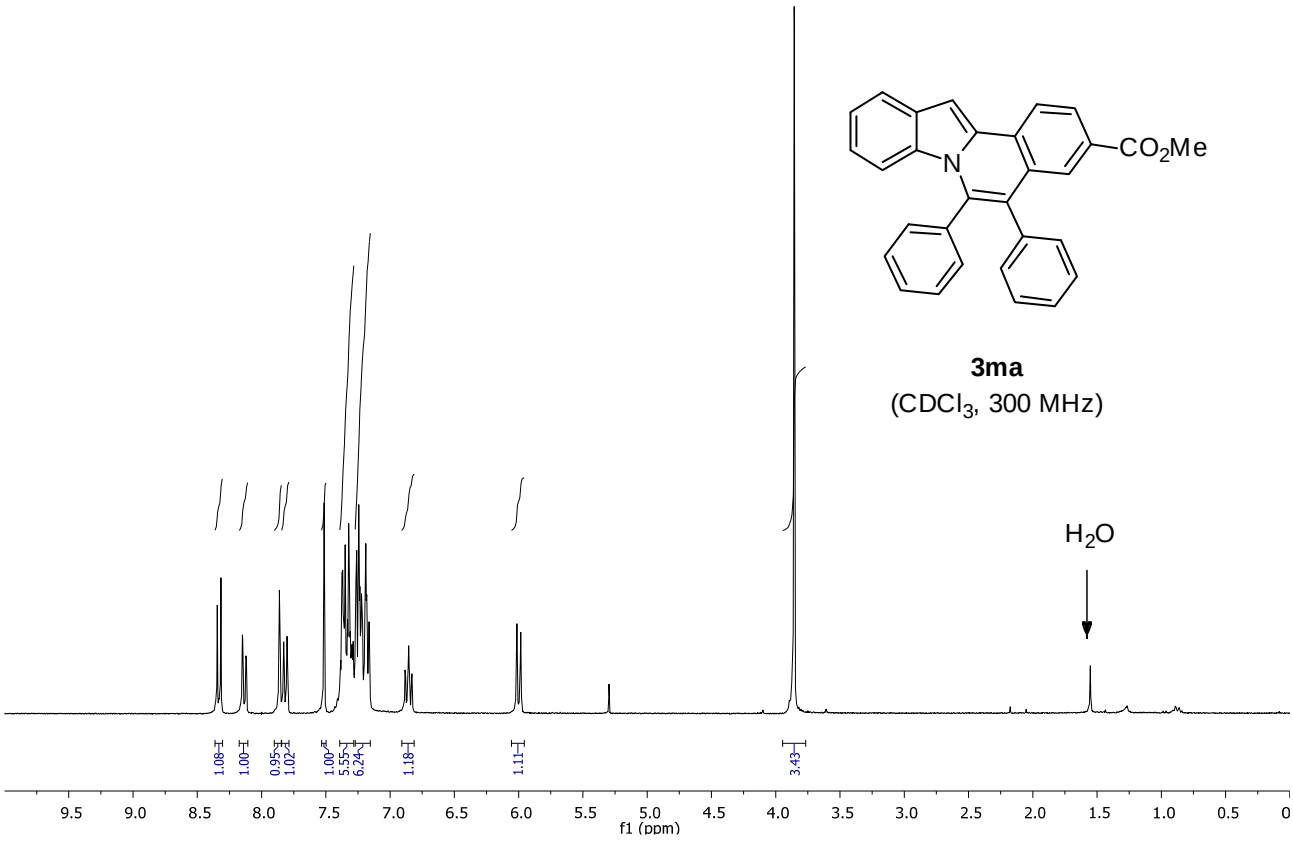
3la
($CDCl_3$, 300 MHz)

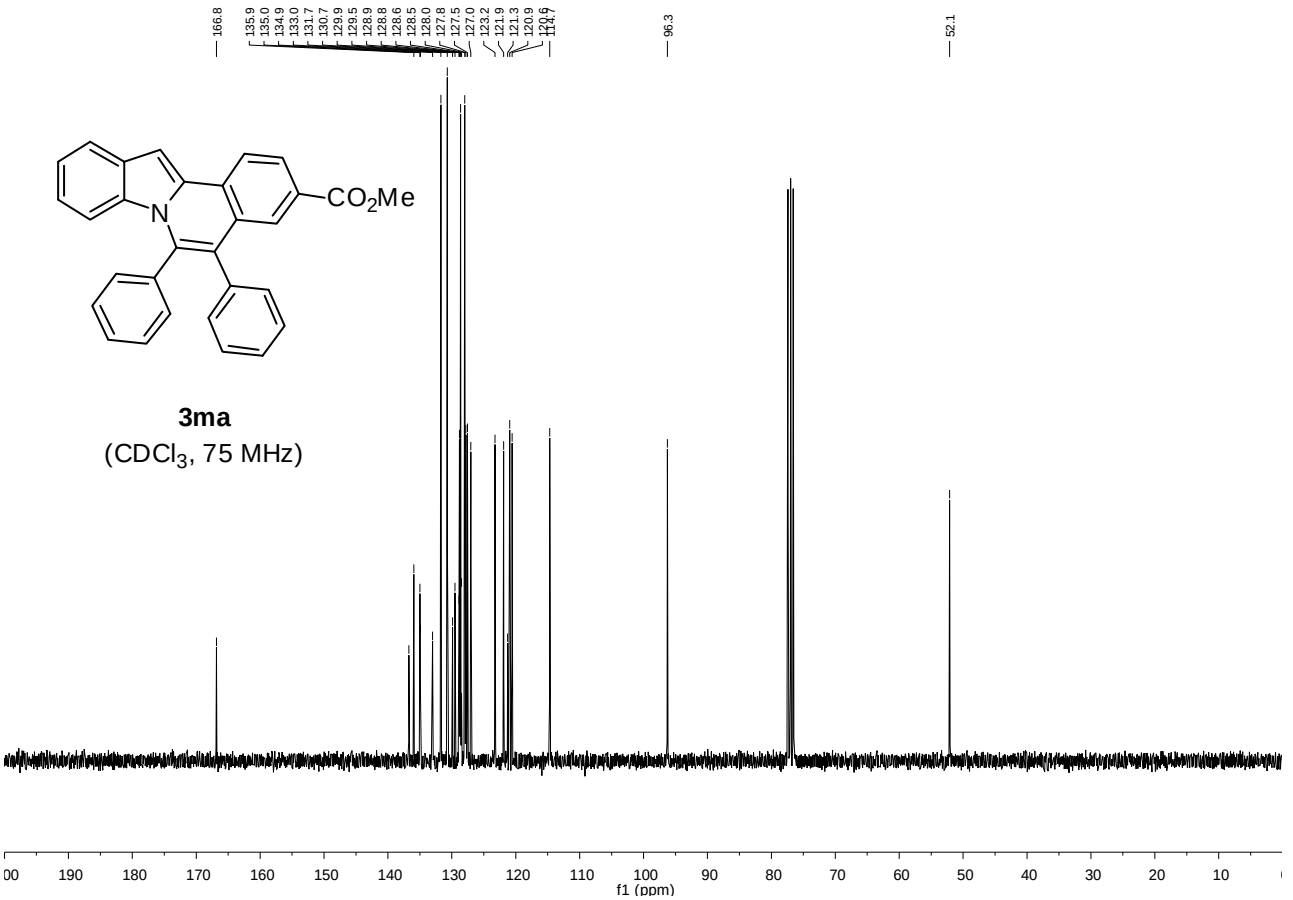




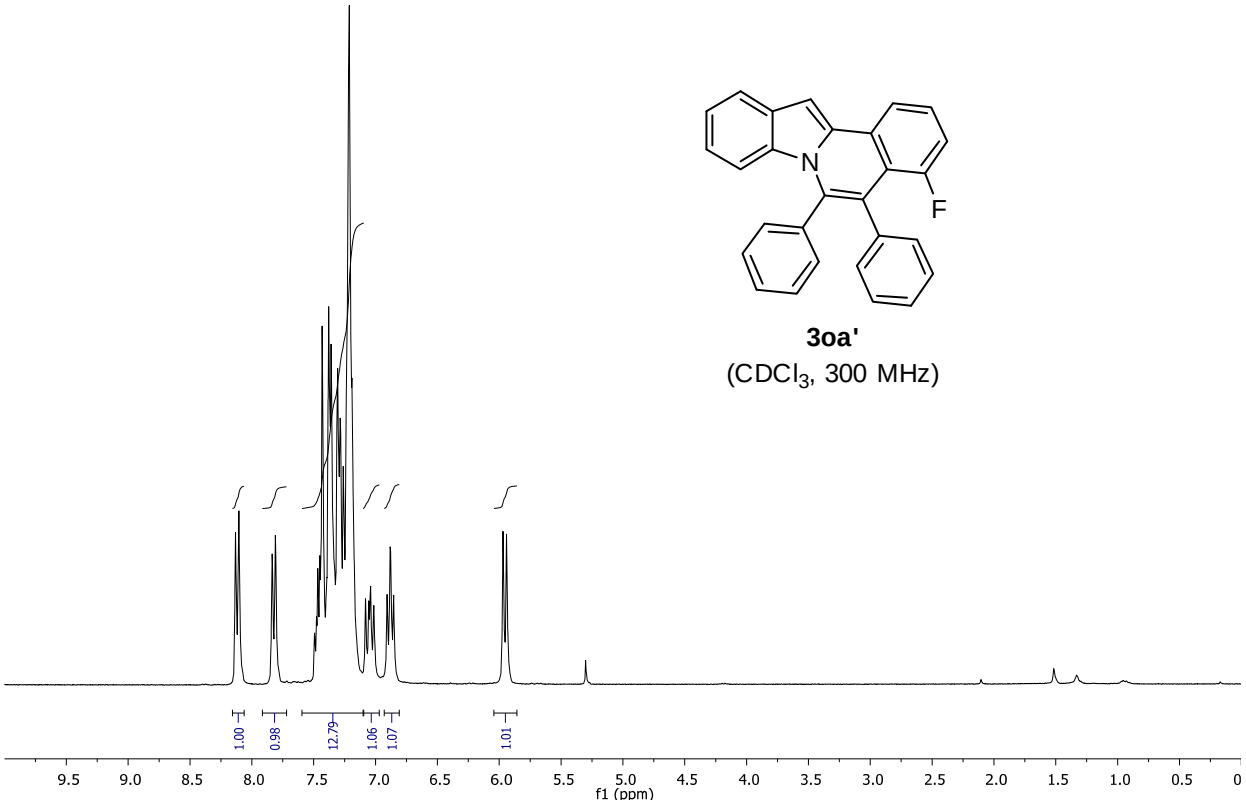
3la
($CDCl_3$, 75 MHz)

Methyl 5,6-diphenylindolo[2,1-a]isoquinoline-3-carboxylate (3ma)



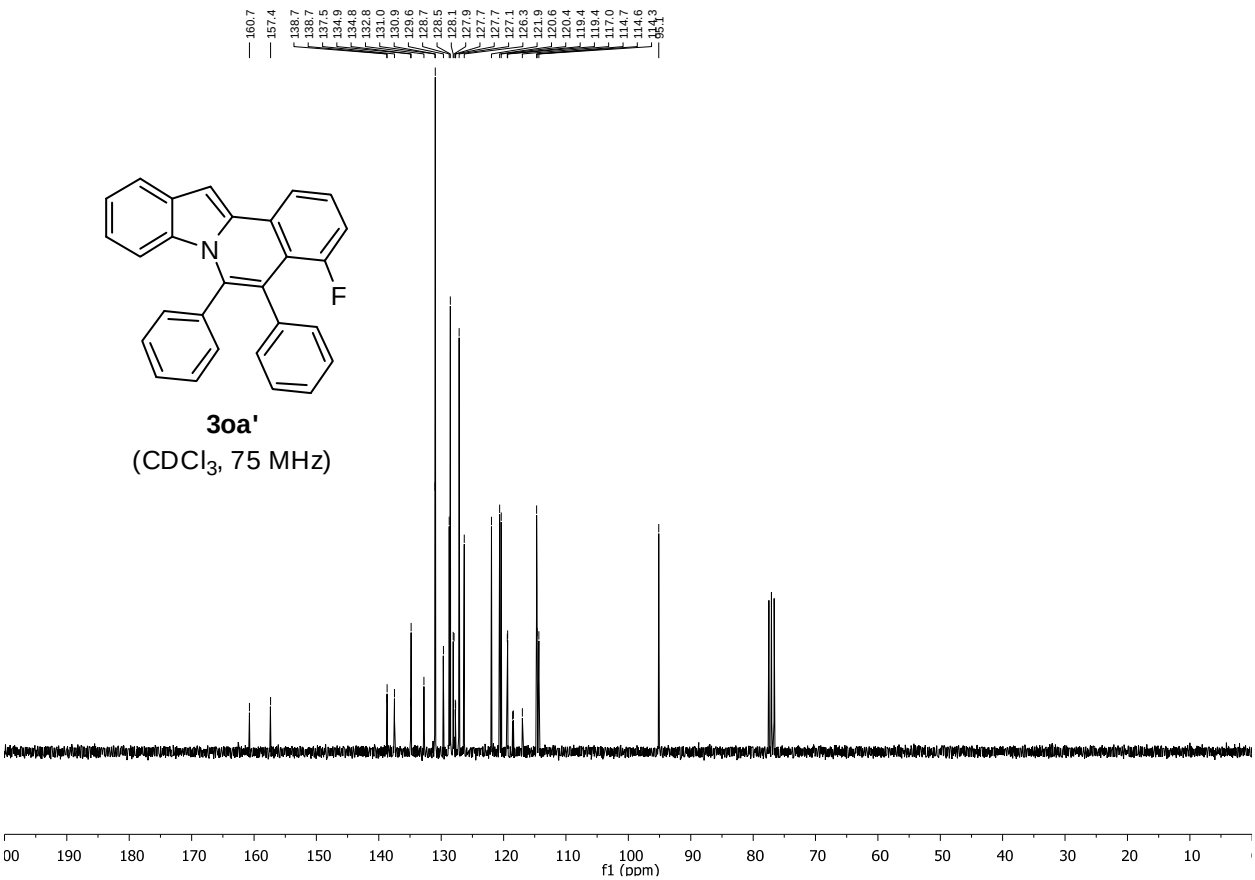


4-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3oa')



3oa'

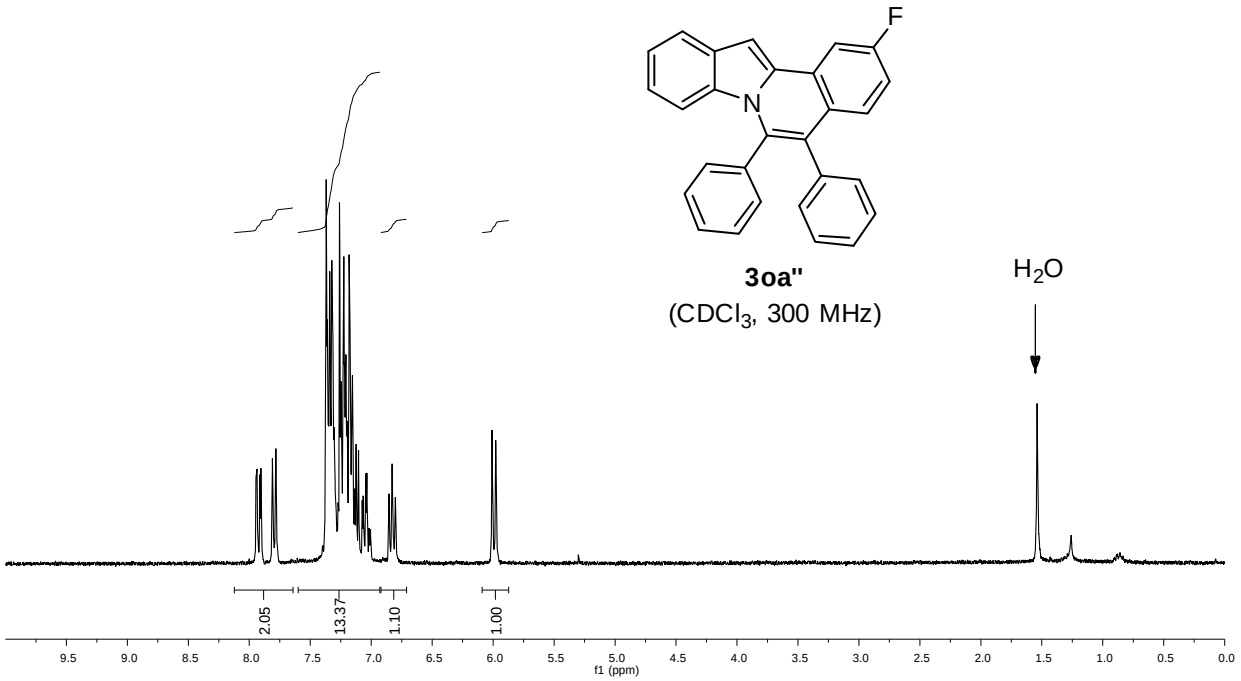
($CDCl_3$, 300 MHz)

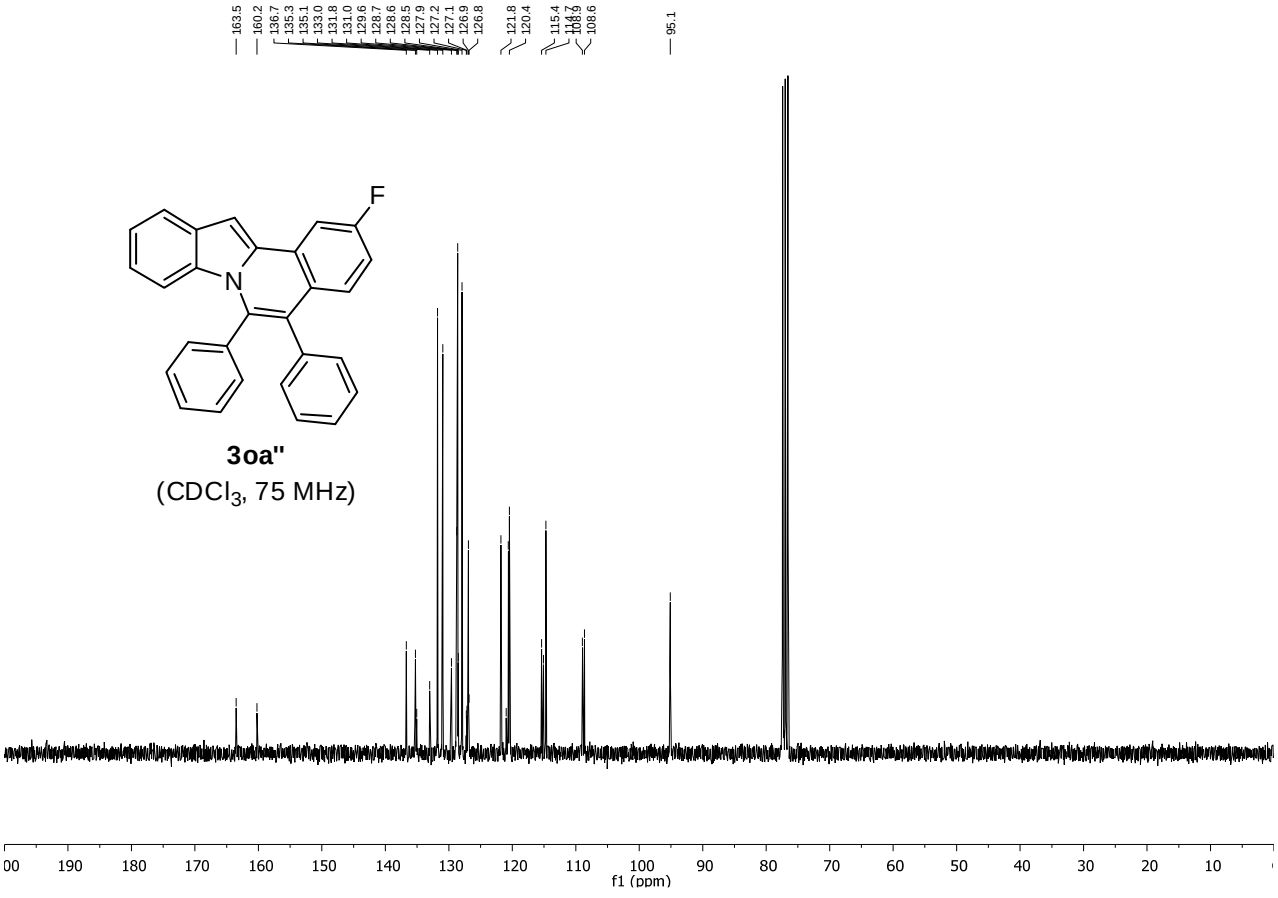


3oa'

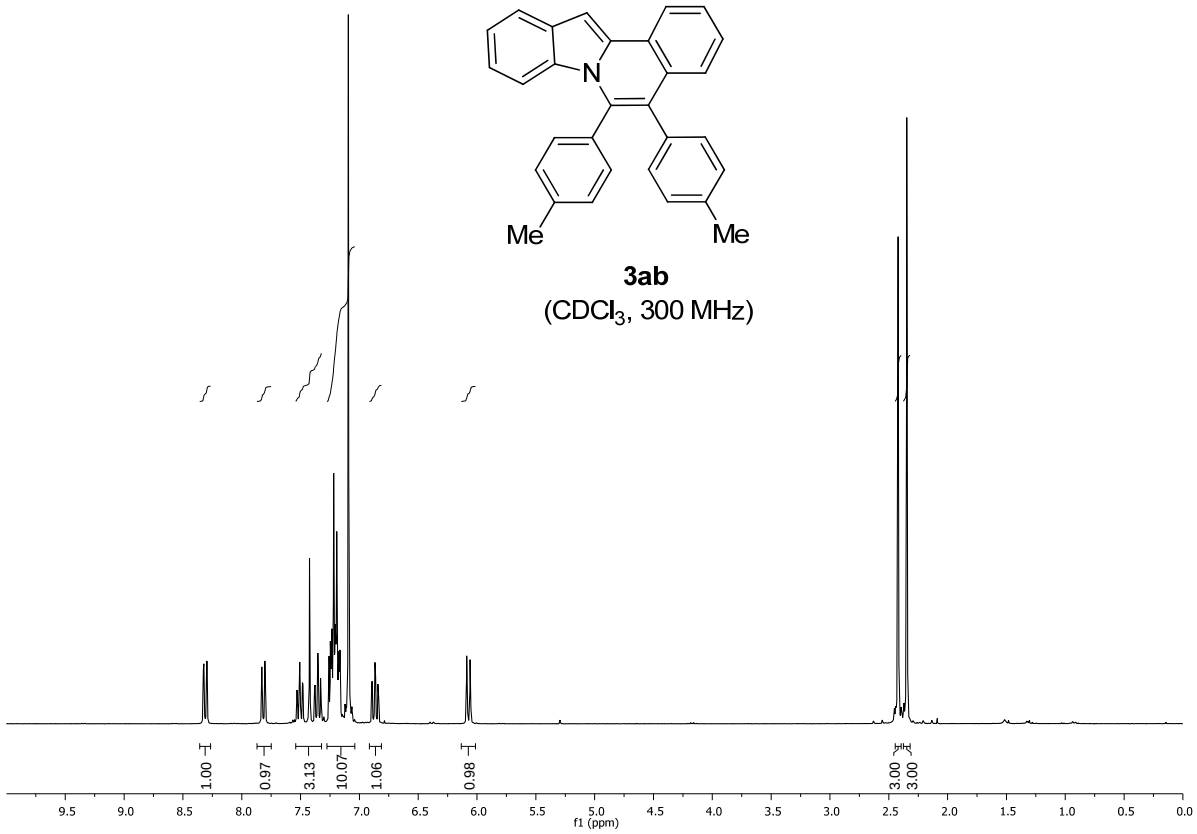
($CDCl_3$, 75 MHz)

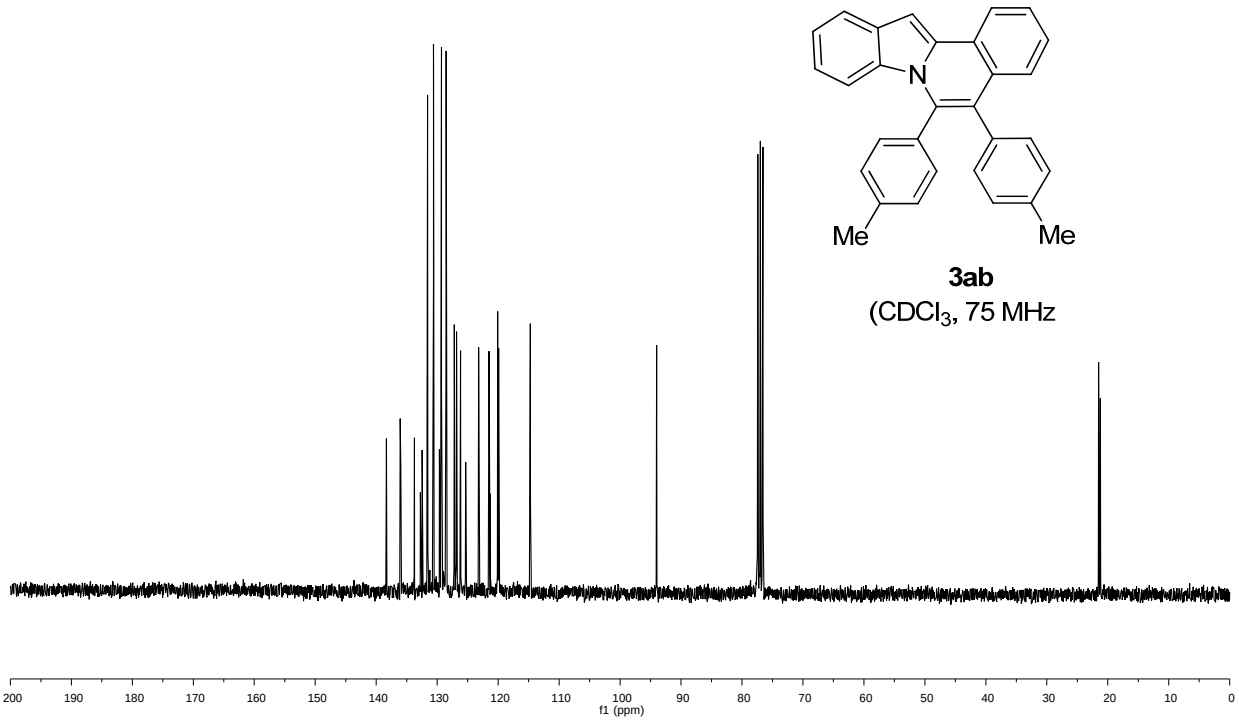
2-Fluoro-5,6-diphenylindolo[2,1-a]isoquinoline (3oa'')



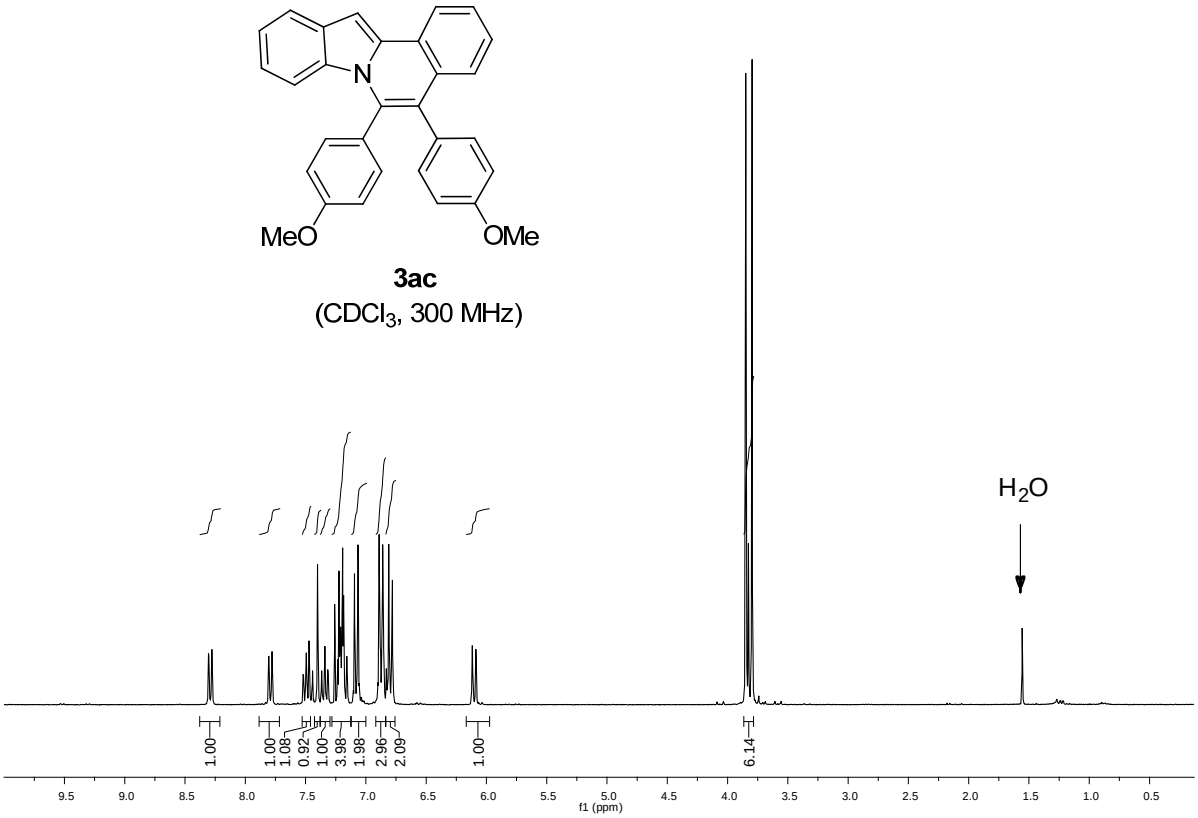


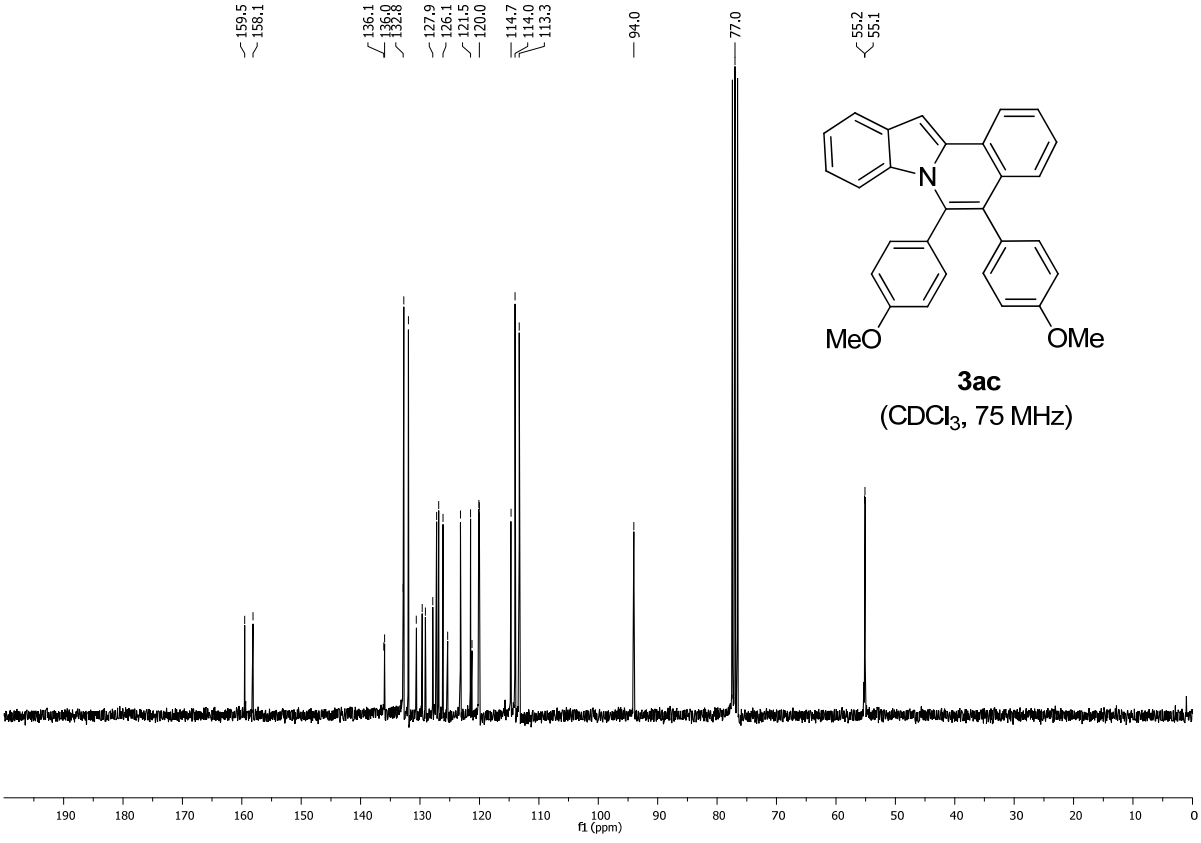
5,6-Di-(*p*-tolyl)indolo[2,1-a]isoquinoline (3ab)



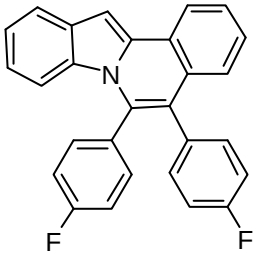


5,6-Di-(4-methoxyphenyl)indolo[2,1-a]isoquinoline (3ac)



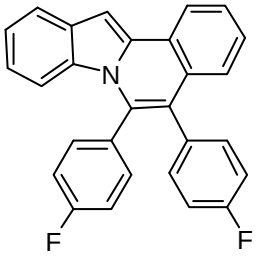


5,6-Bis(4-fluorophenyl)indolo[2,1-a]isoquinoline (3ad)



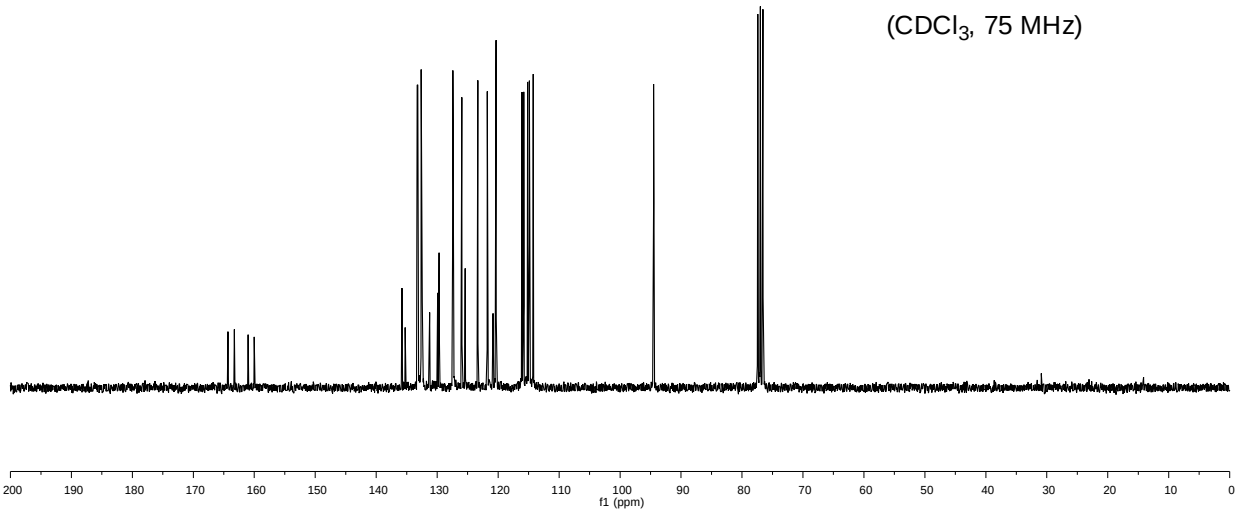
3ad

($CDCl_3$, 300 MHz)

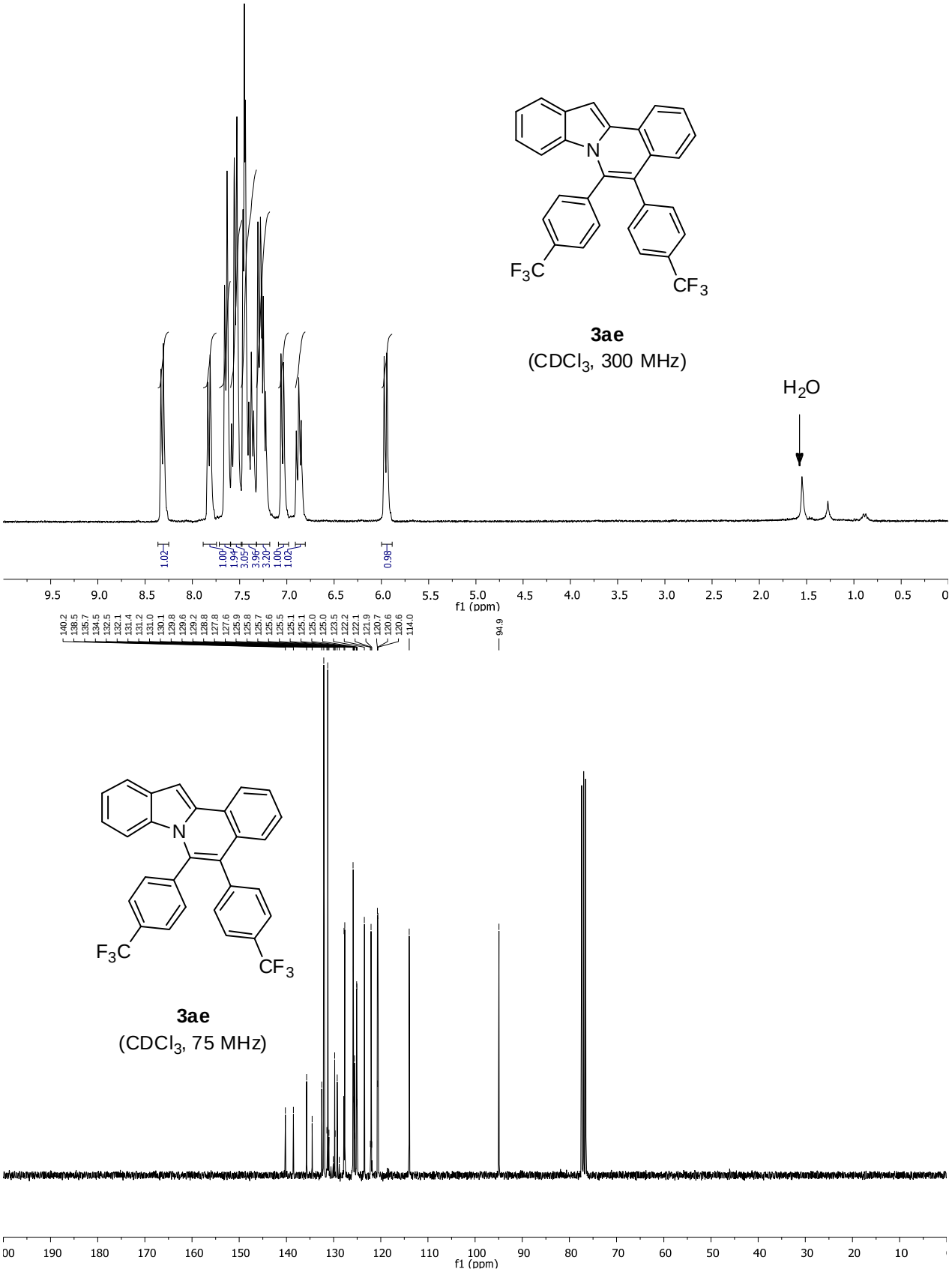


3ad

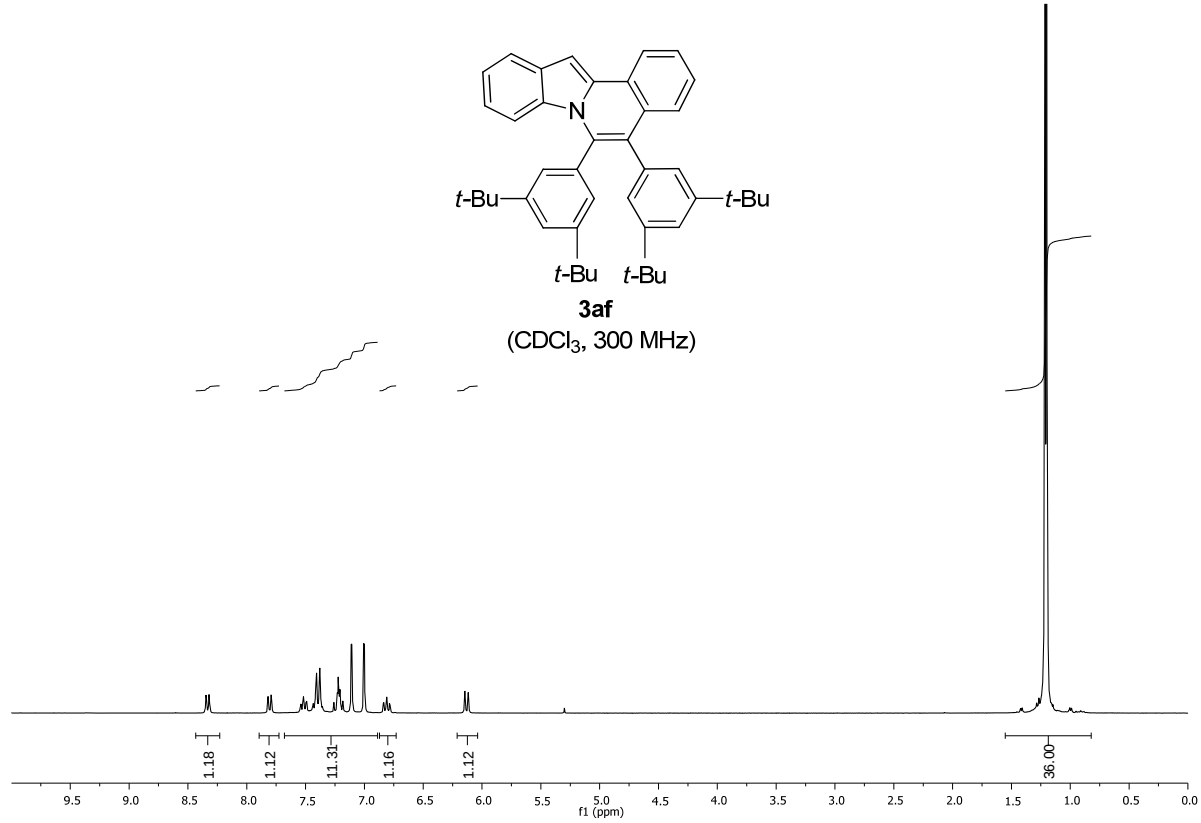
($CDCl_3$, 75 MHz)

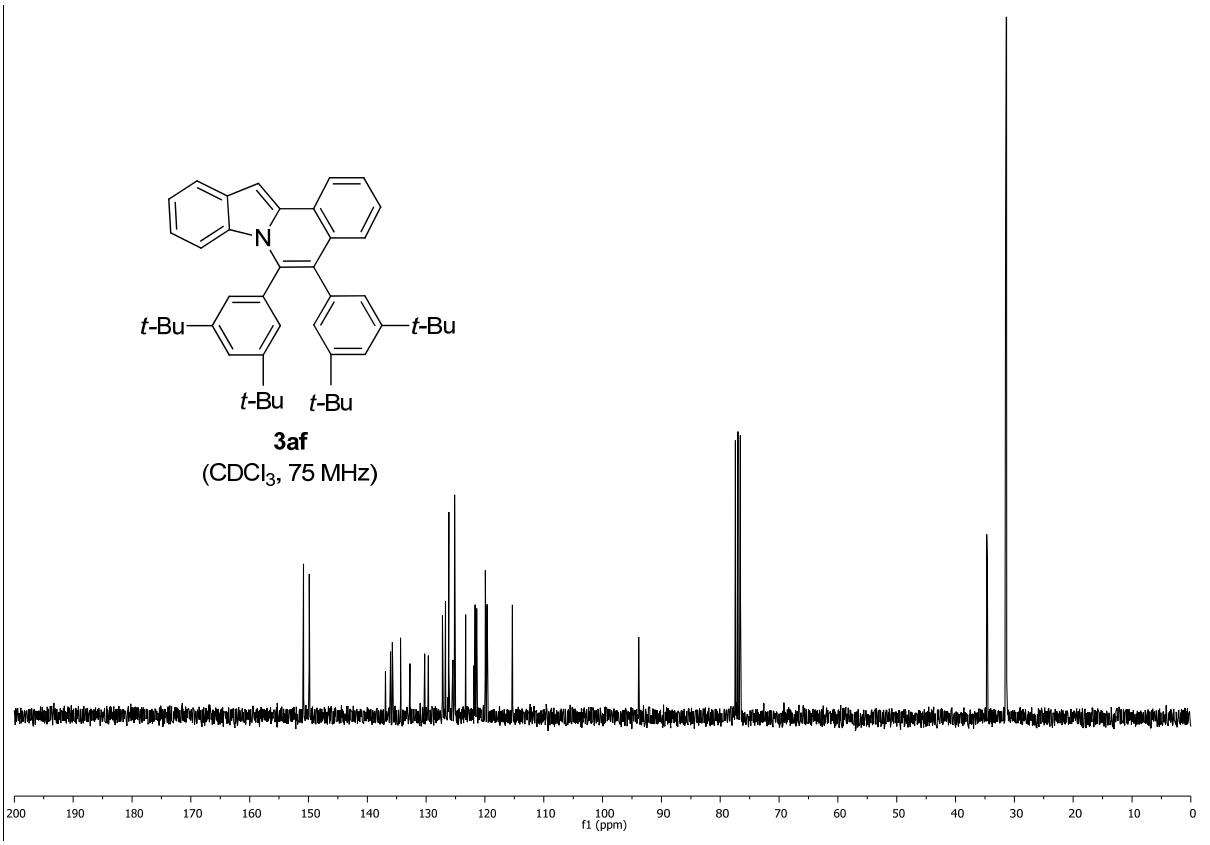


5,6-Bis{4-(trifluoromethyl)phenyl}indolo[2,1-a]isoquinoline (3ae)

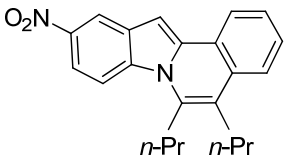


5,6-Bis(3,5-di-*tert*-butylphenyl)indolo[2,1-a]isoquinoline (3af)

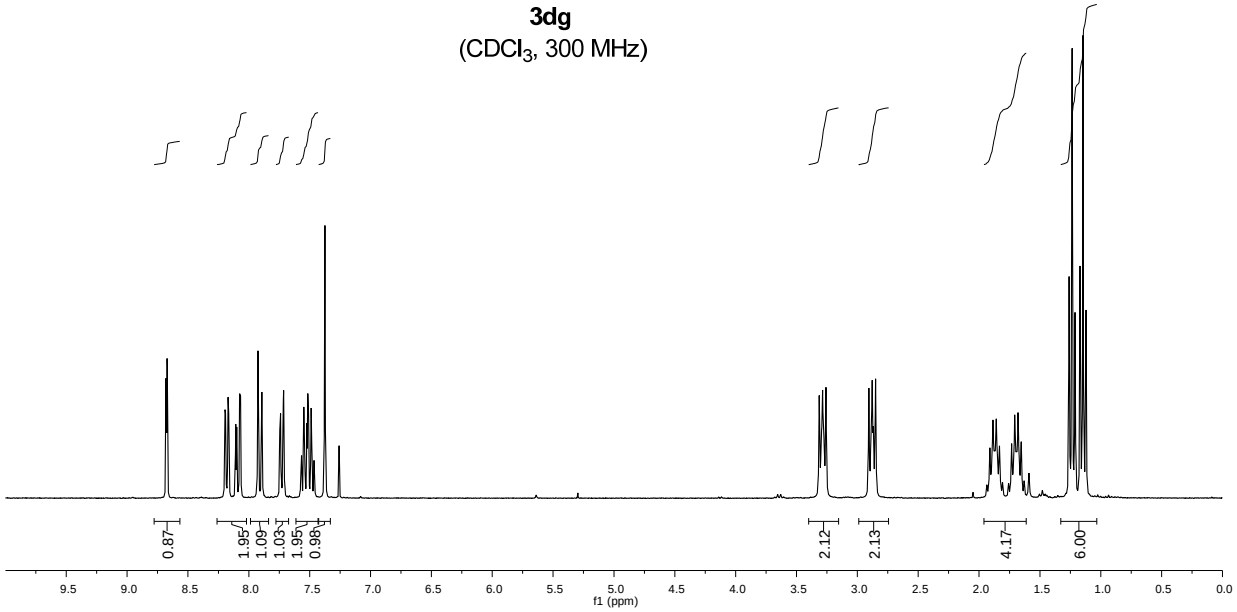


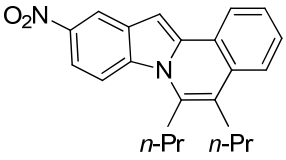


10-Nitro-5,6-dipropylindolo[2,1-a]isoquinoline (3dg)



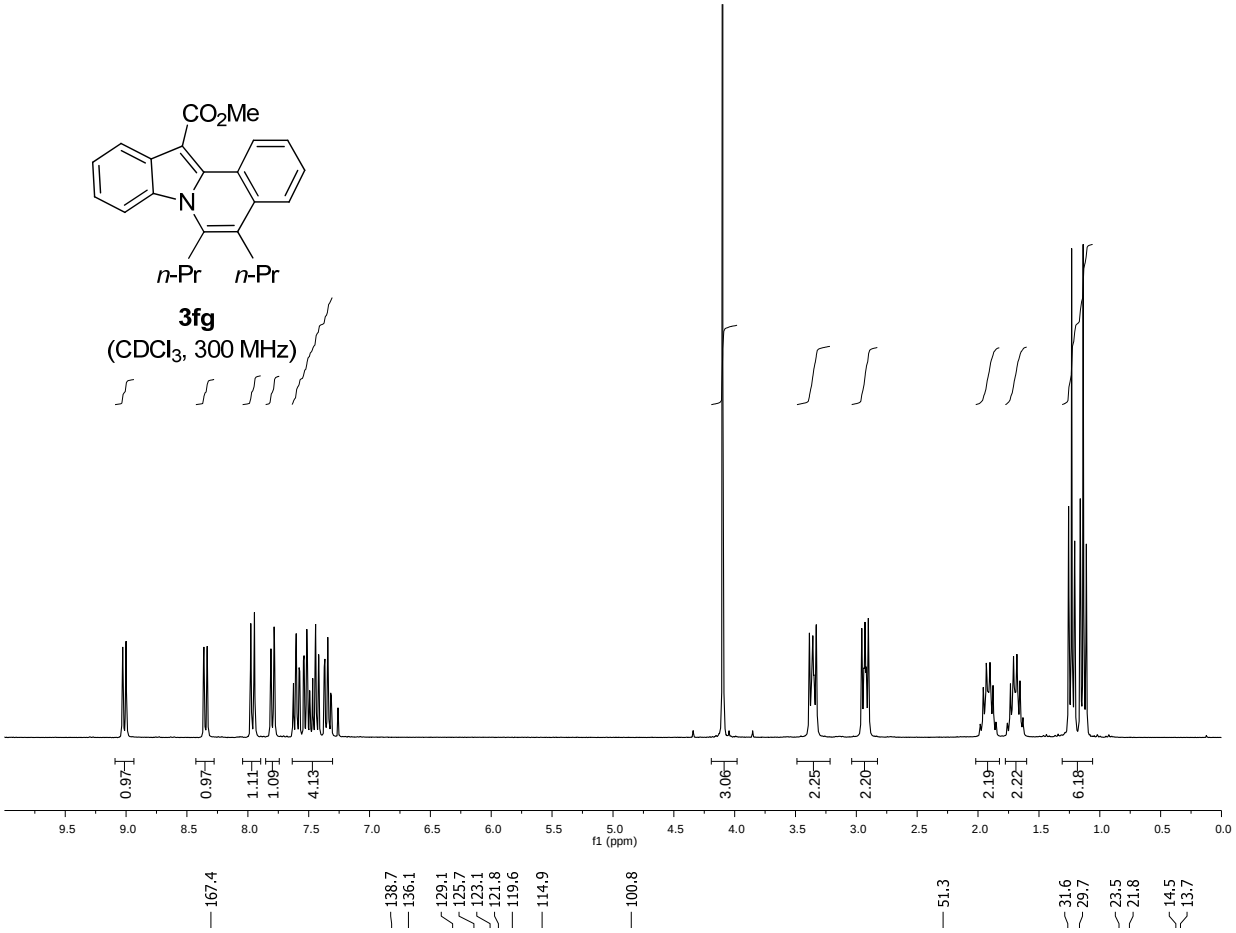
3dg
($CDCl_3$, 300 MHz)

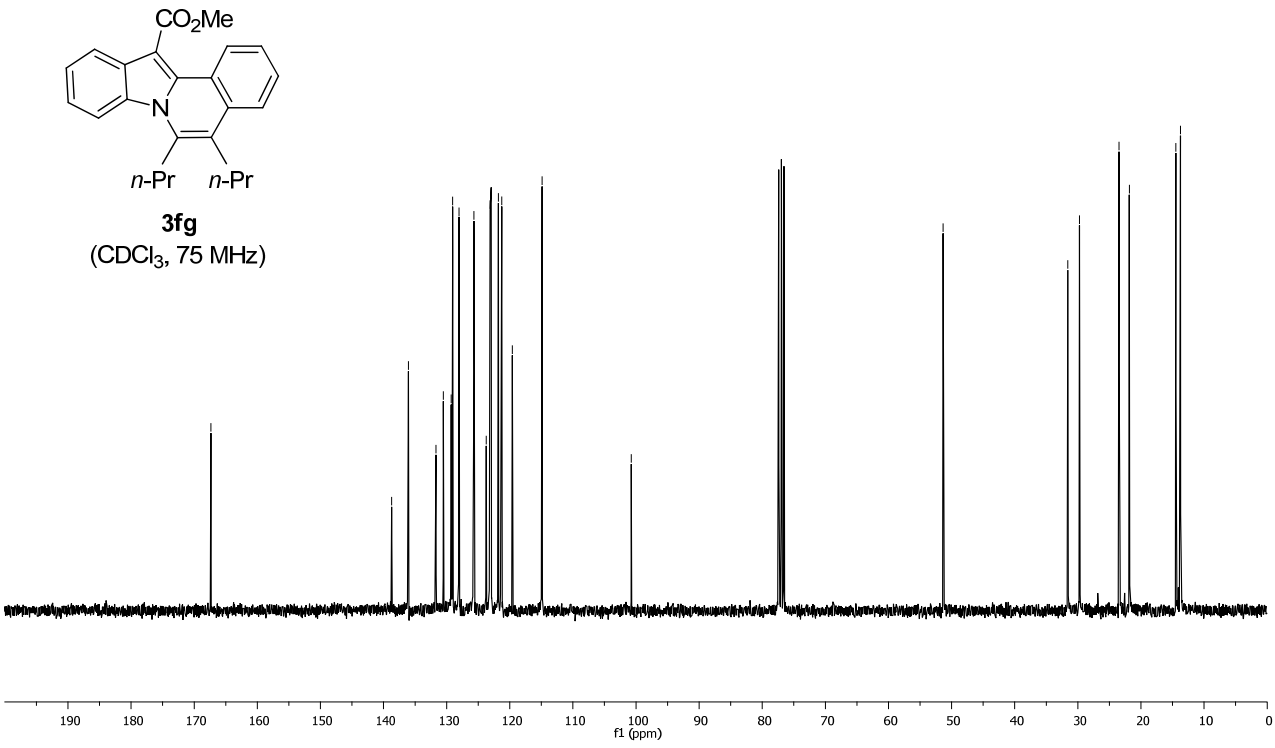




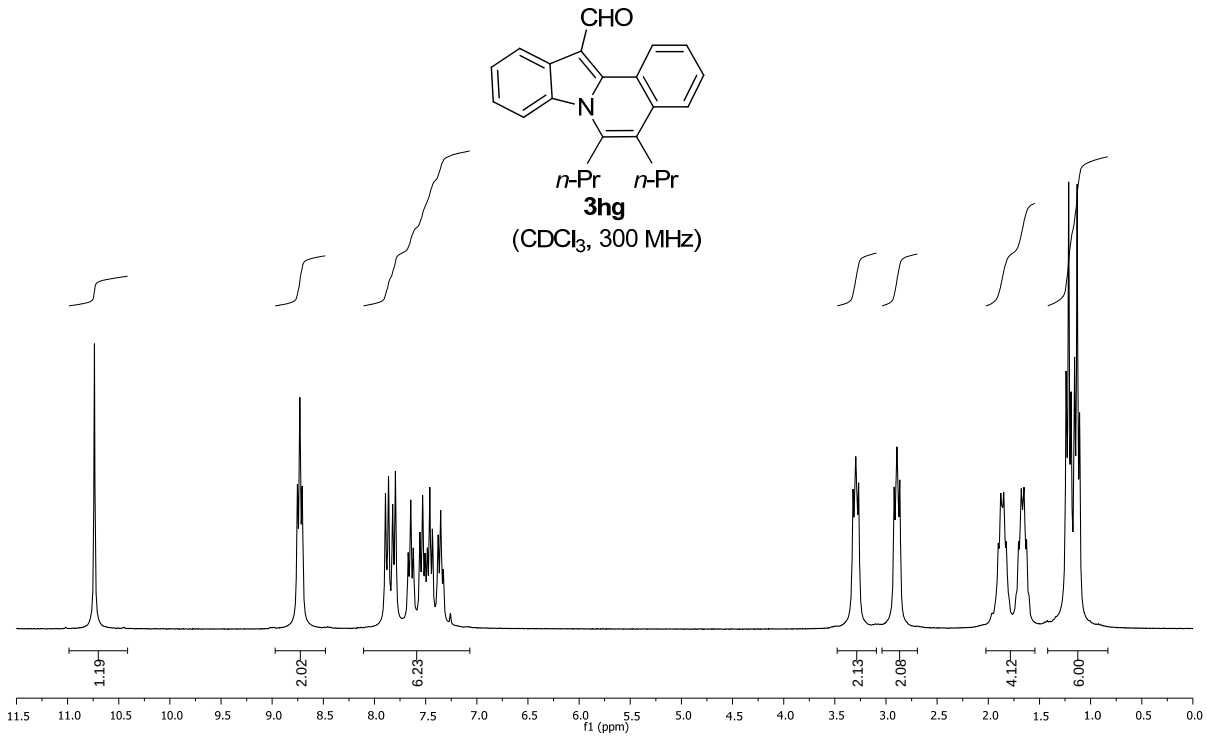
3dg
($CDCl_3$, 75 MHz)

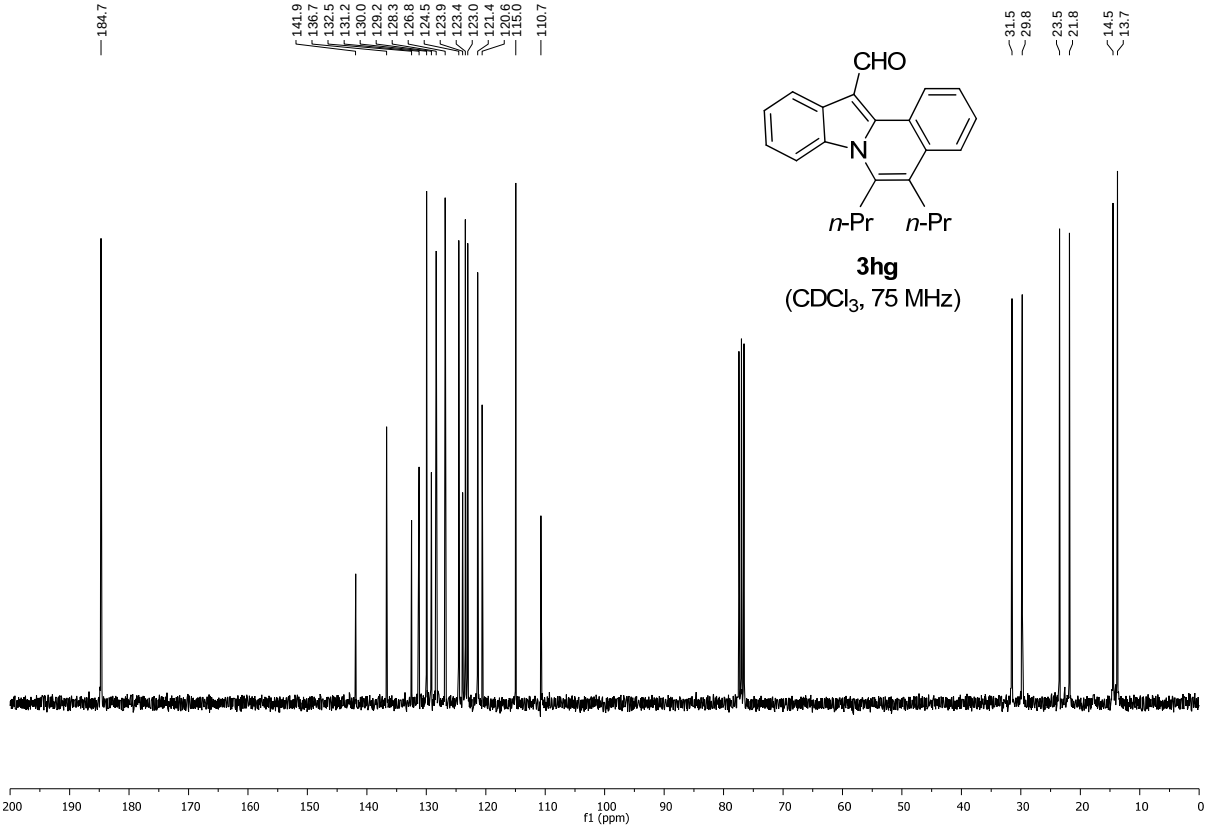
Methyl 5,6-dipropylindolo[2,1-a]isoquinoline-12-carboxylate (3fg)



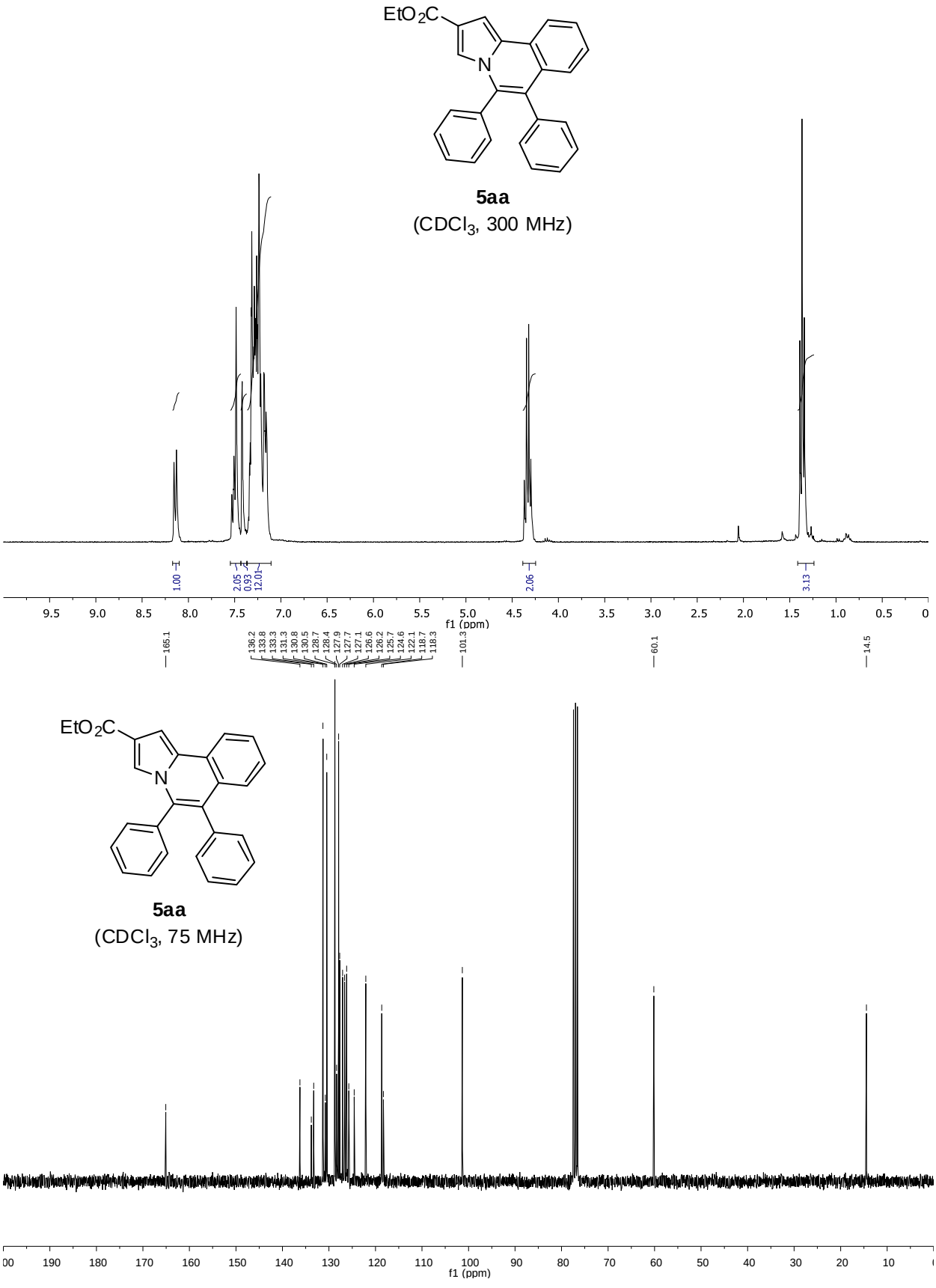


5,6-Dipropylindolo[2,1-a]isoquinoline-12-carbaldehyde (3hg)

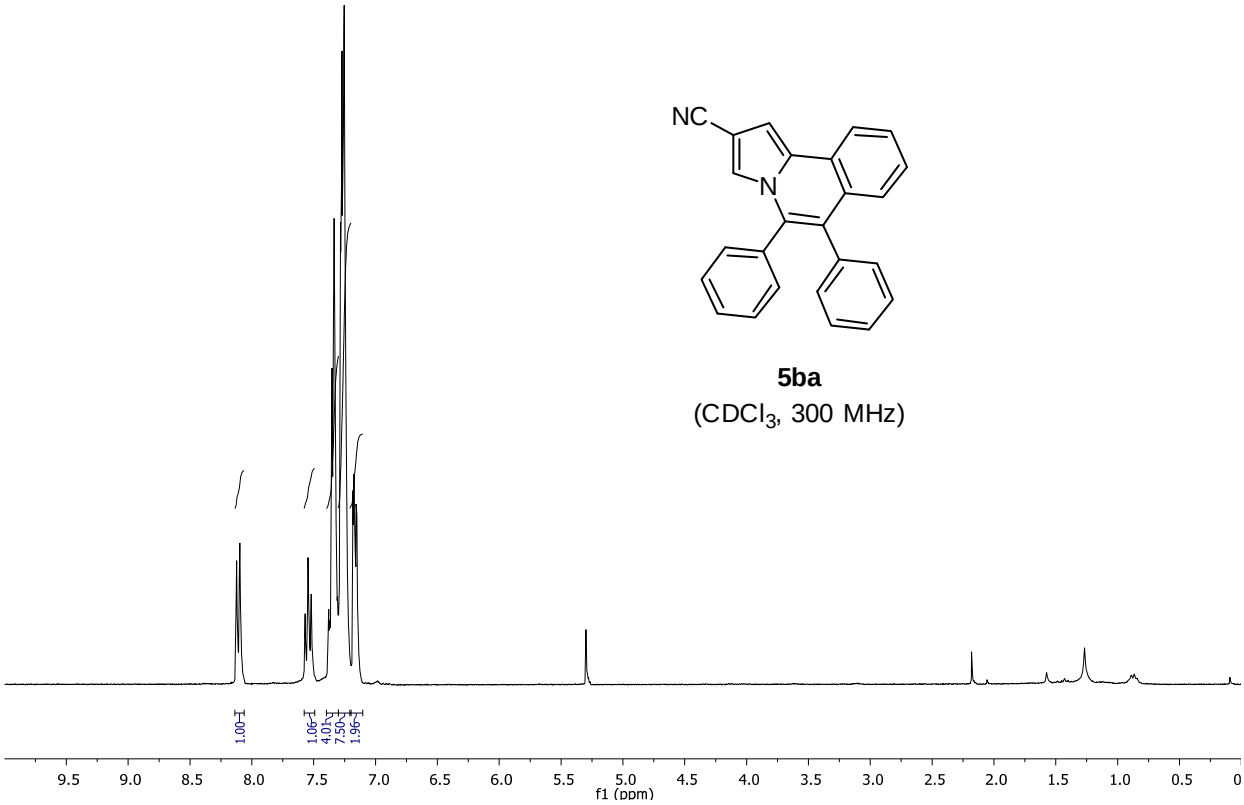




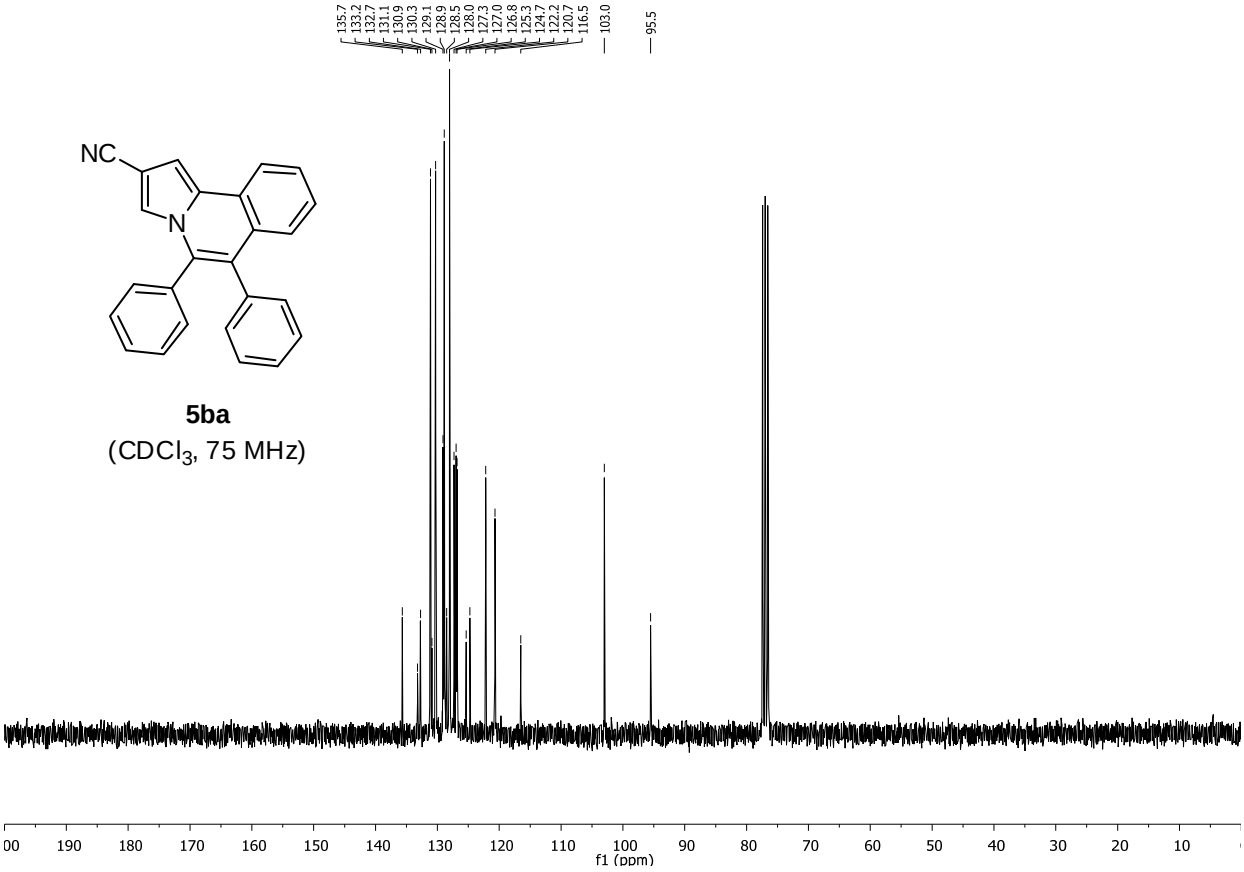
Ethyl 5,6-diphenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5aa)



5,6-Diphenylpyrrolo[2,1-a]isoquinoline-2-carbonitrile (5ba)

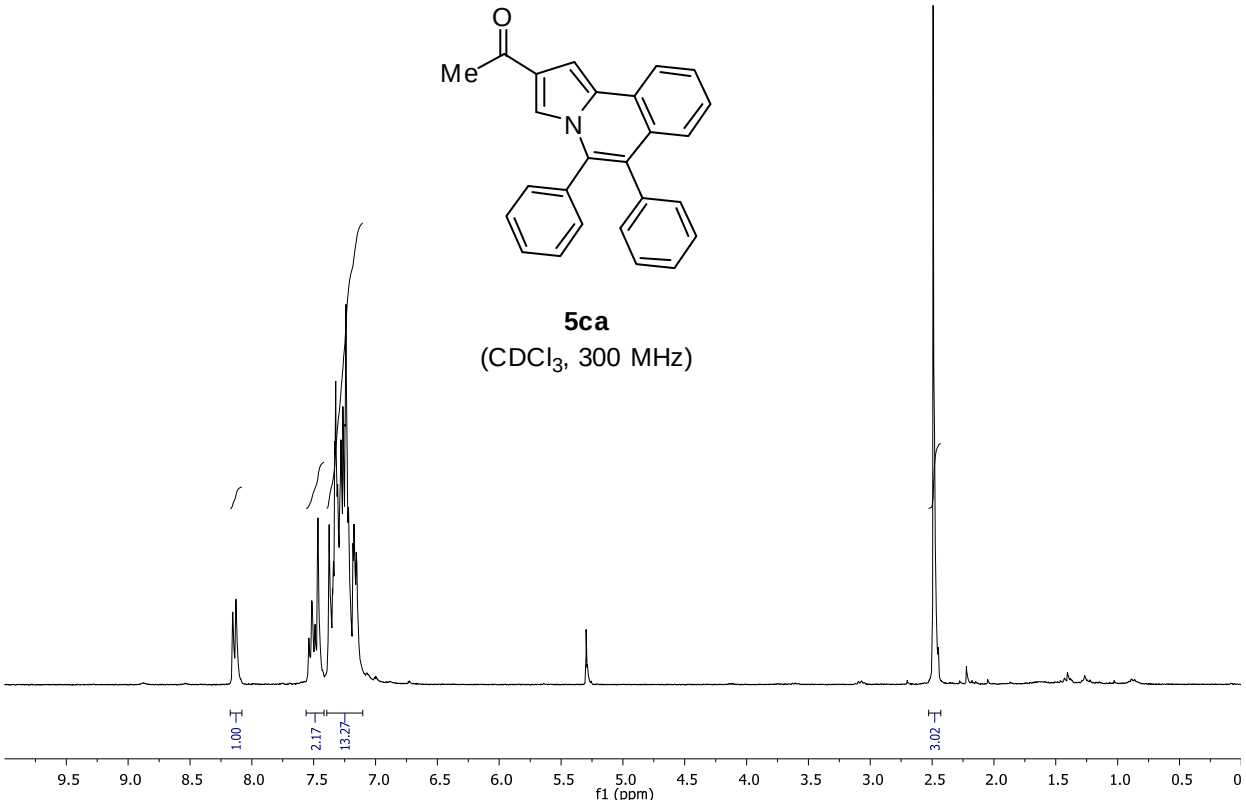


5ba
($CDCl_3$, 300 MHz)

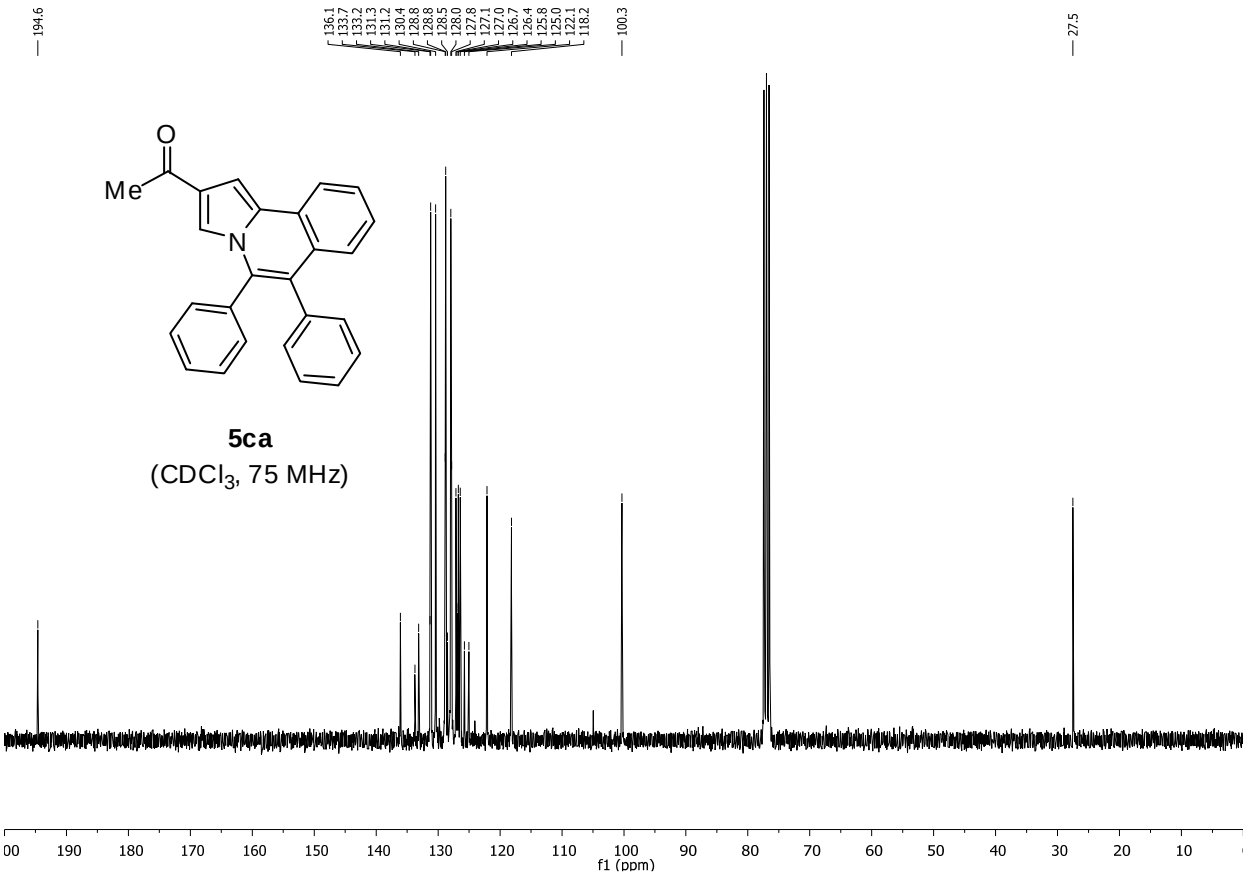


5ba
($CDCl_3$, 75 MHz)

1-(5,6-Diphenylpyrrolo[2,1-a]isoquinolin-2-yl)ethanone (5ca)

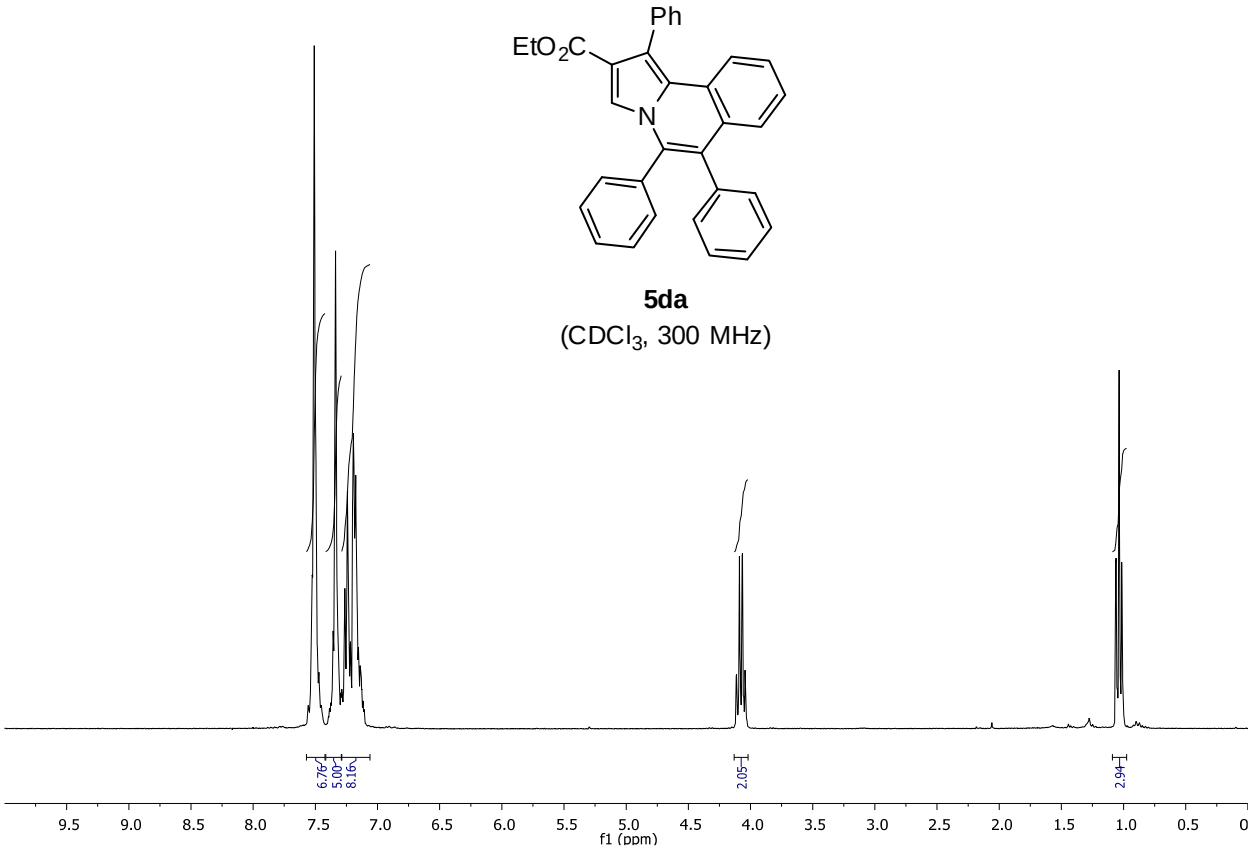


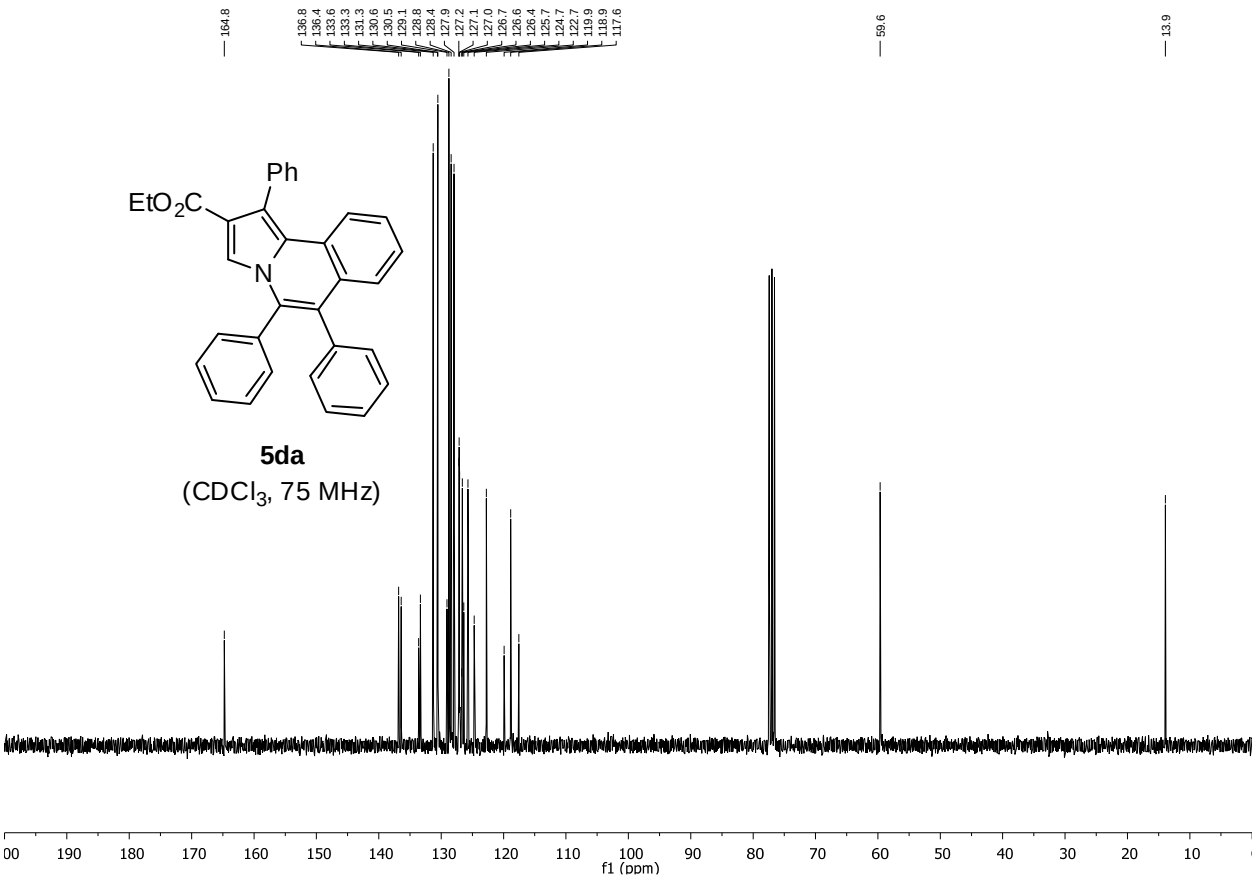
5ca
($CDCl_3$, 300 MHz)



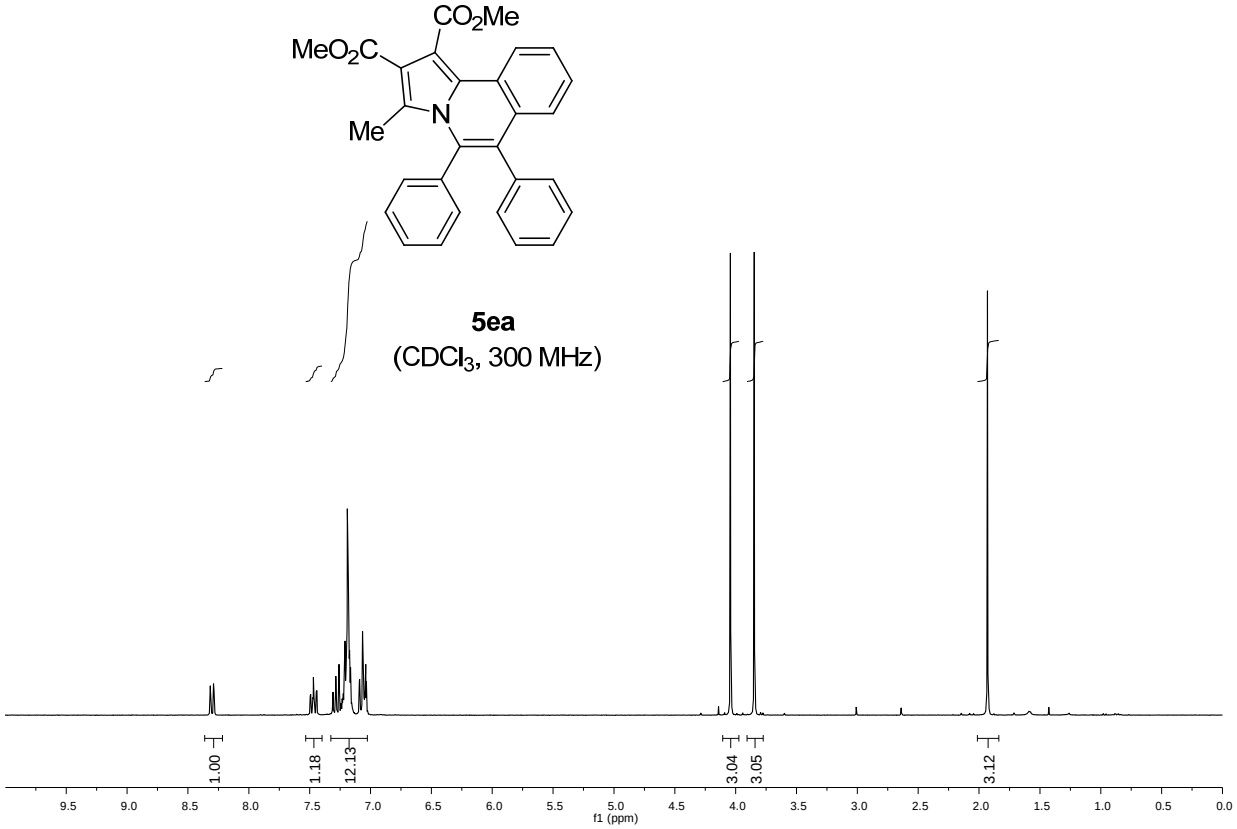
5ca
($CDCl_3$, 75 MHz)

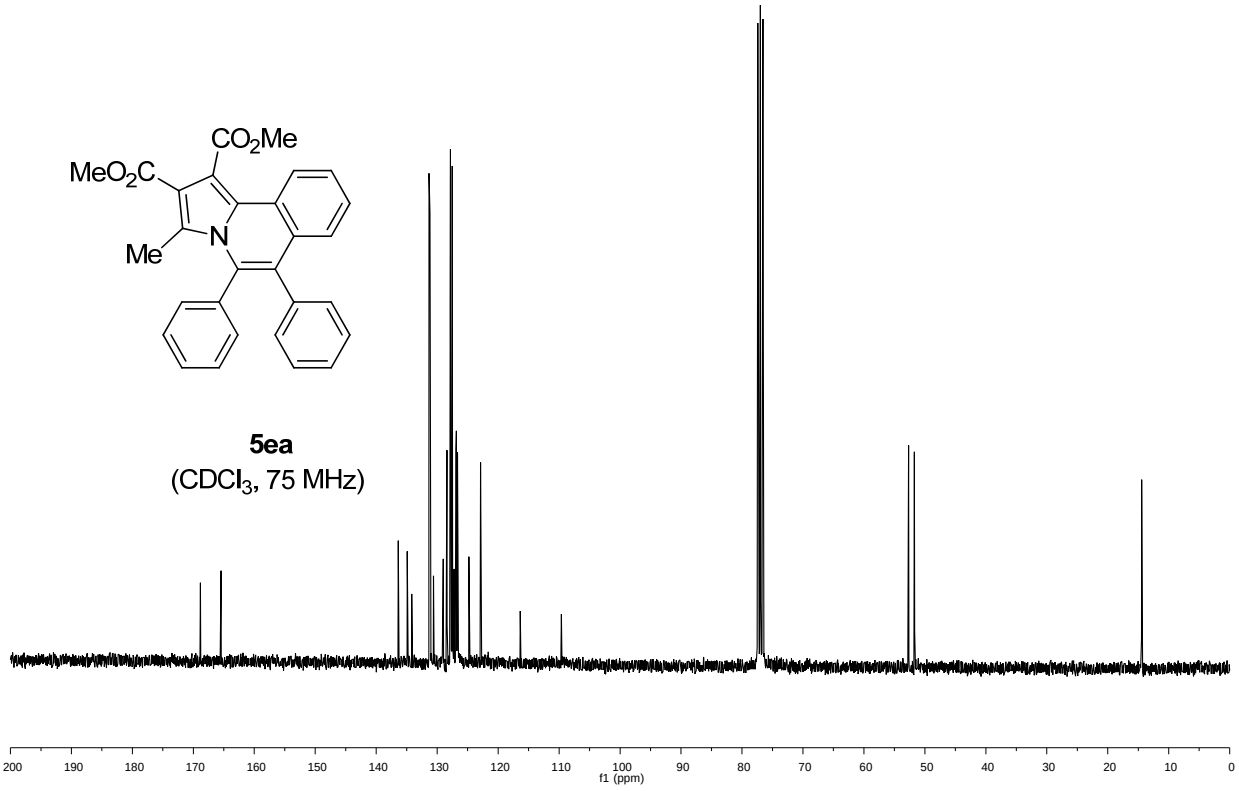
Ethyl 1,5,6-triphenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5da)



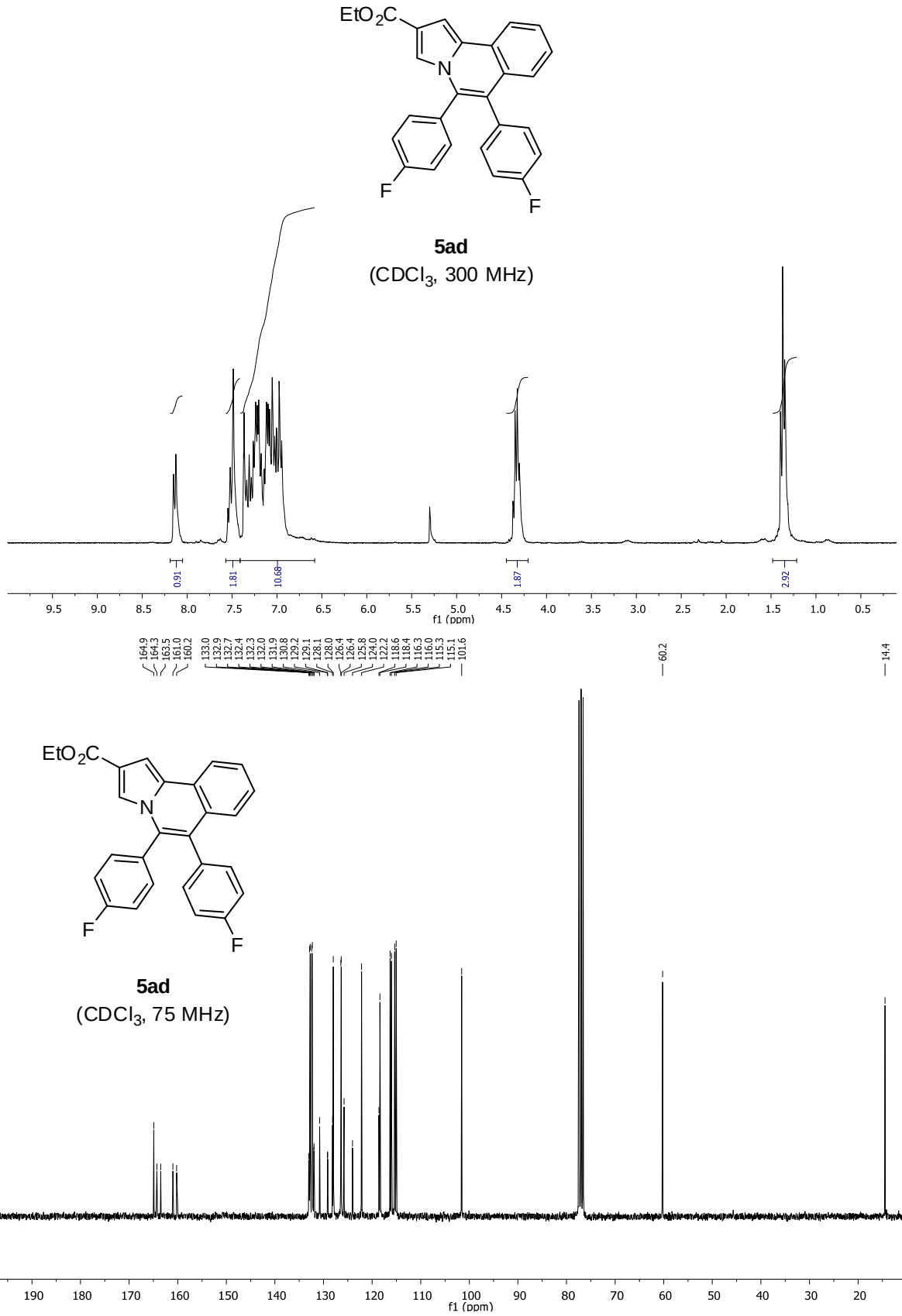


Dimethyl 3-methyl-5,6-diphenylpyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5ea)

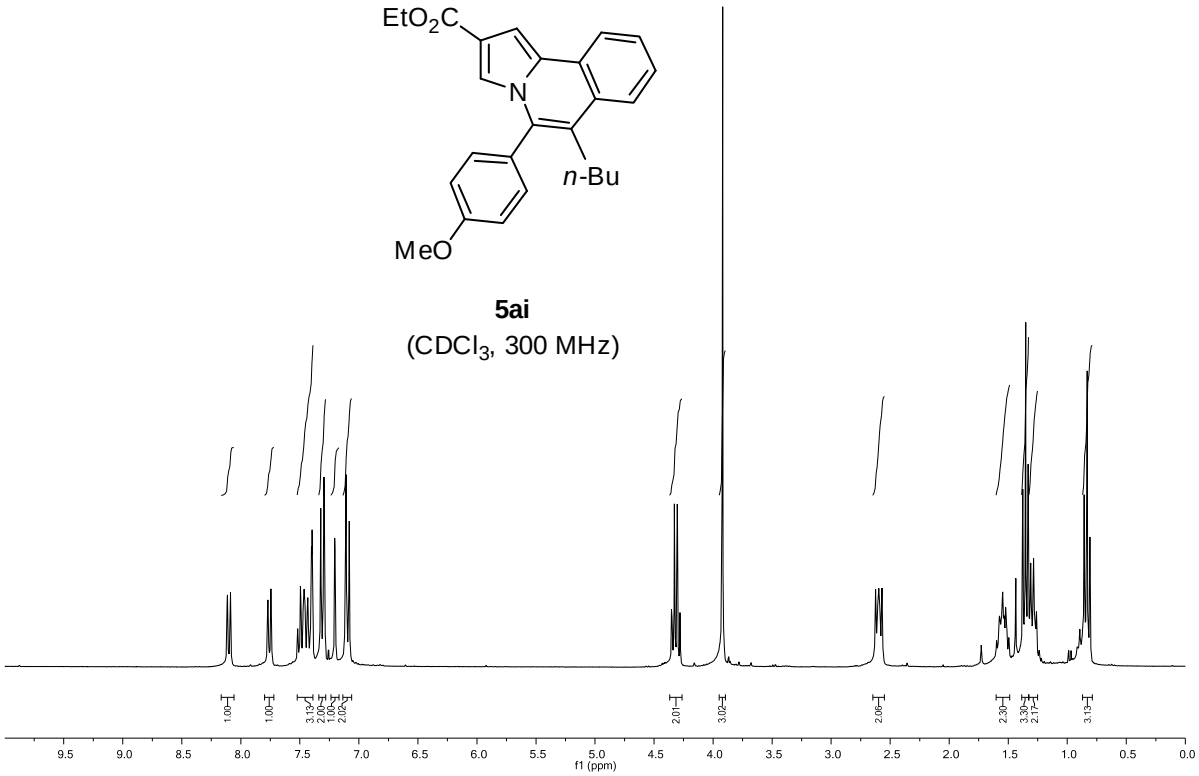


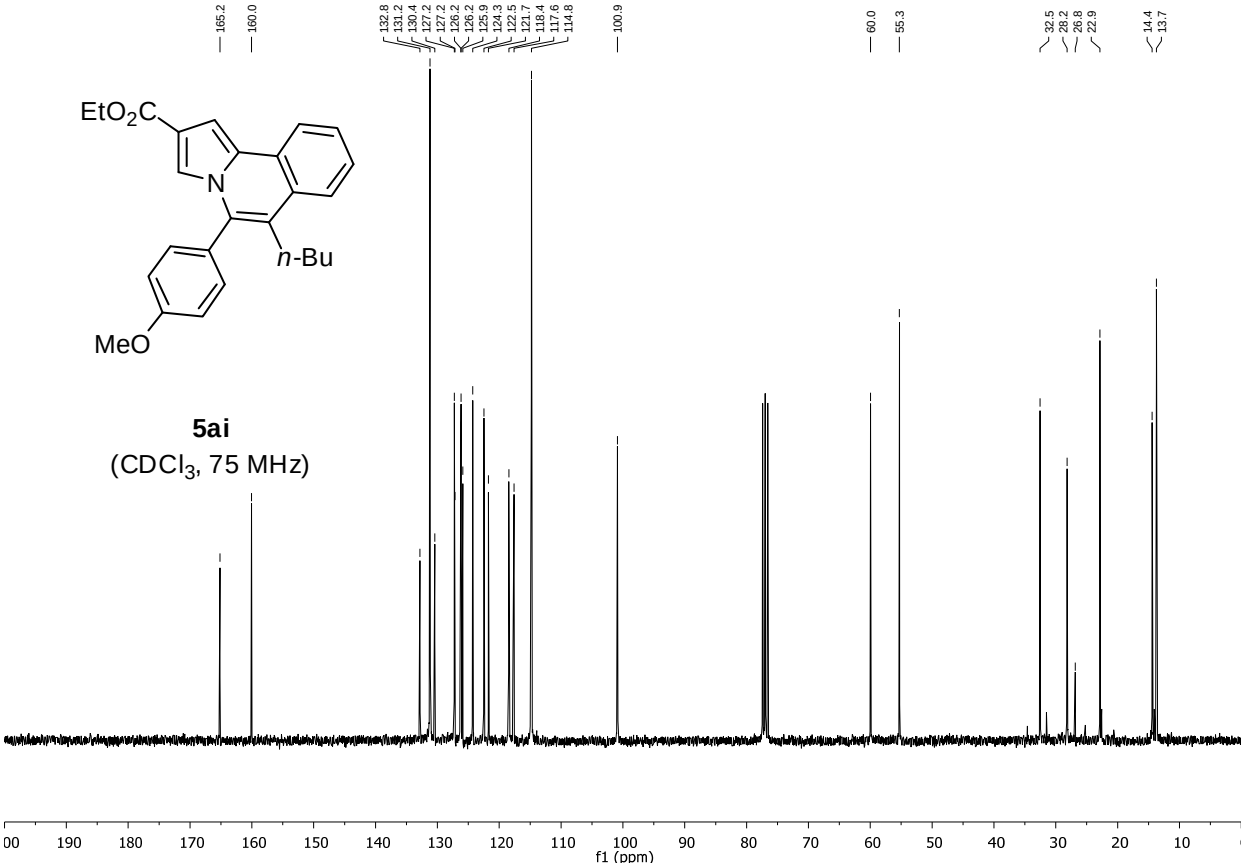


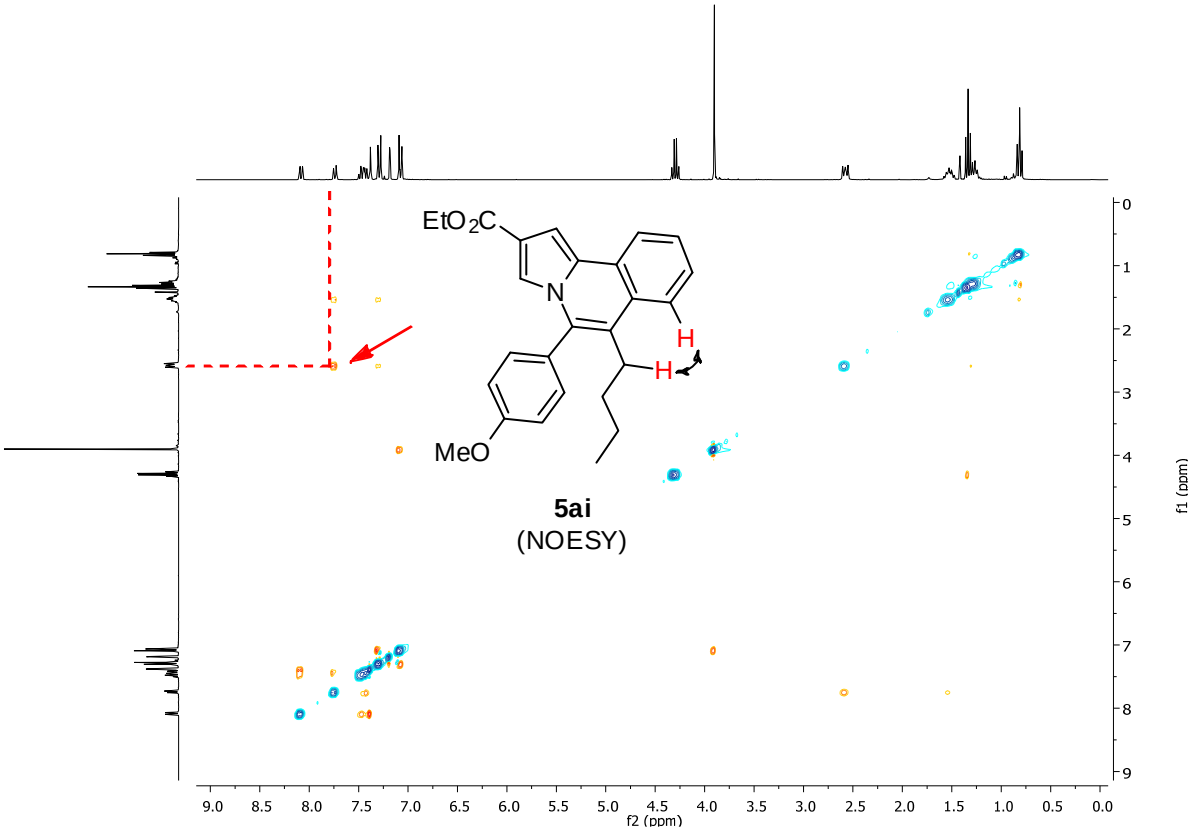
Ethyl 5,6-bis(4-fluorophenyl)pyrrolo[2,1-a]isoquinoline-2-carboxylate (5ad)



Ethyl 6-butyl-5-(4-methoxyphenyl)pyrrolo[2,1-a]isoquinoline-2-carboxylate (5ai)

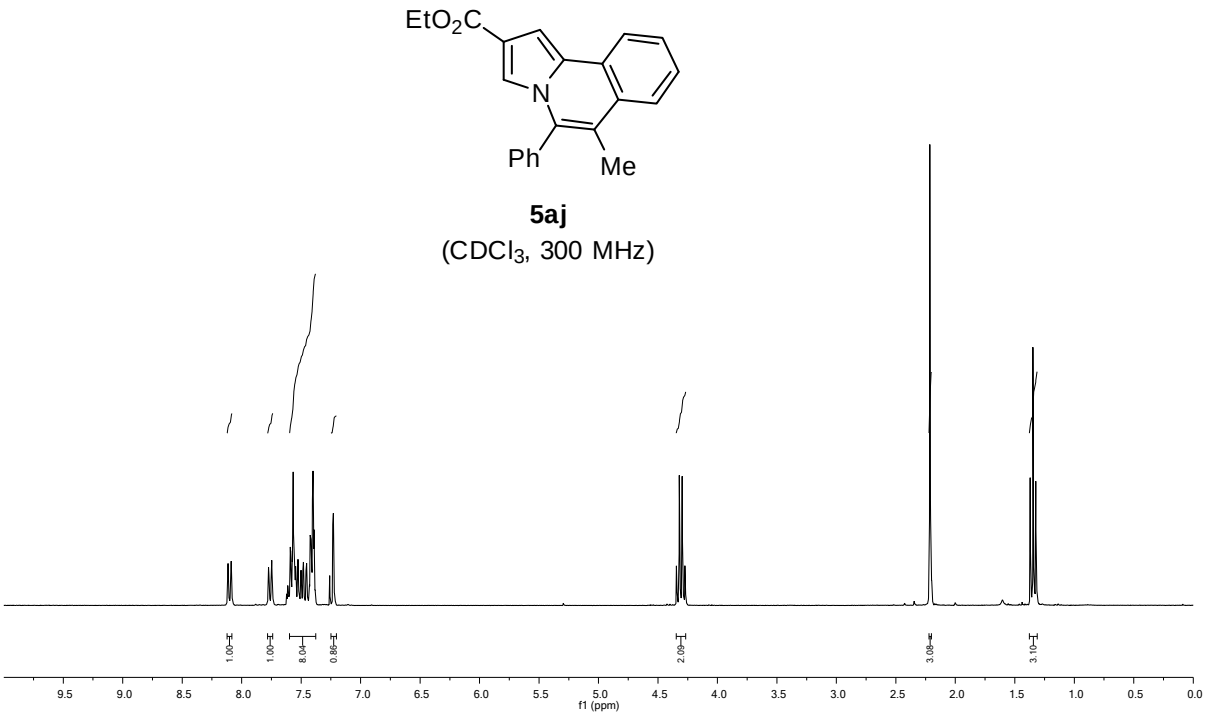


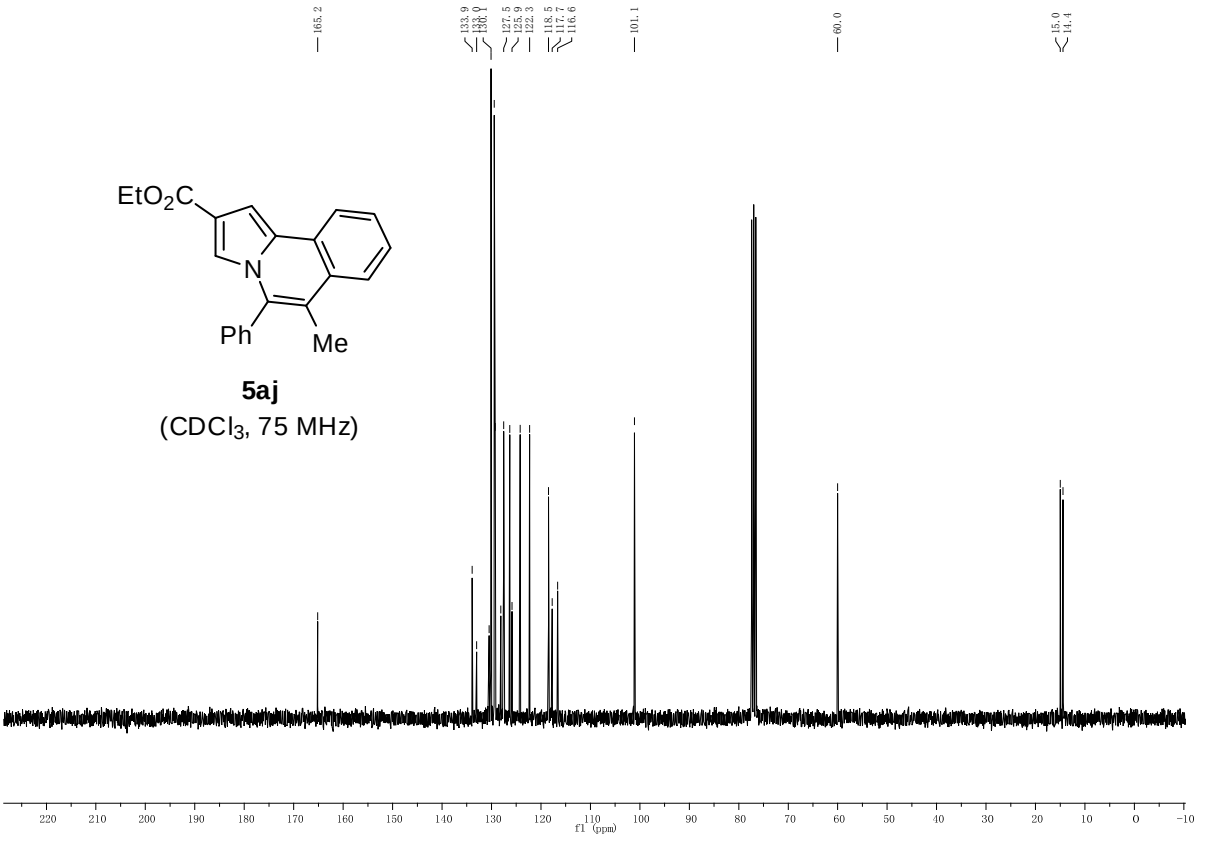


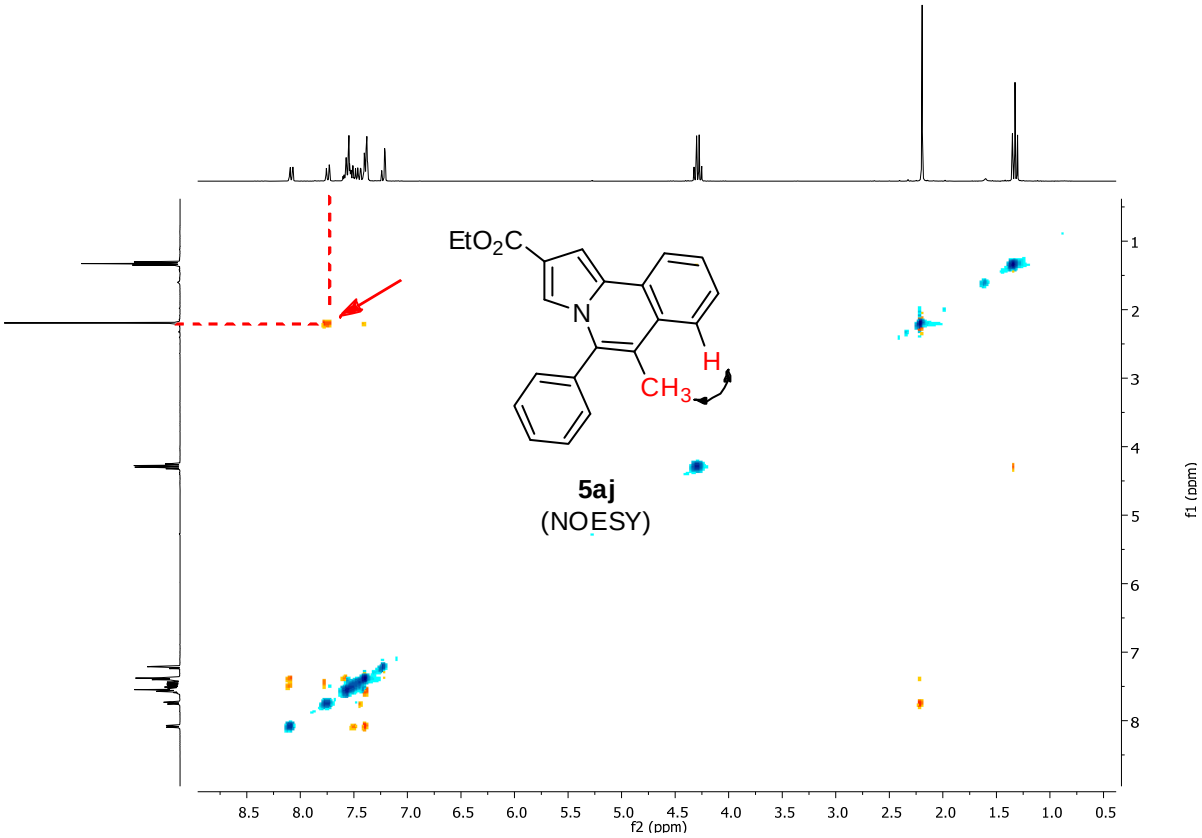


5ai
(NOESY)

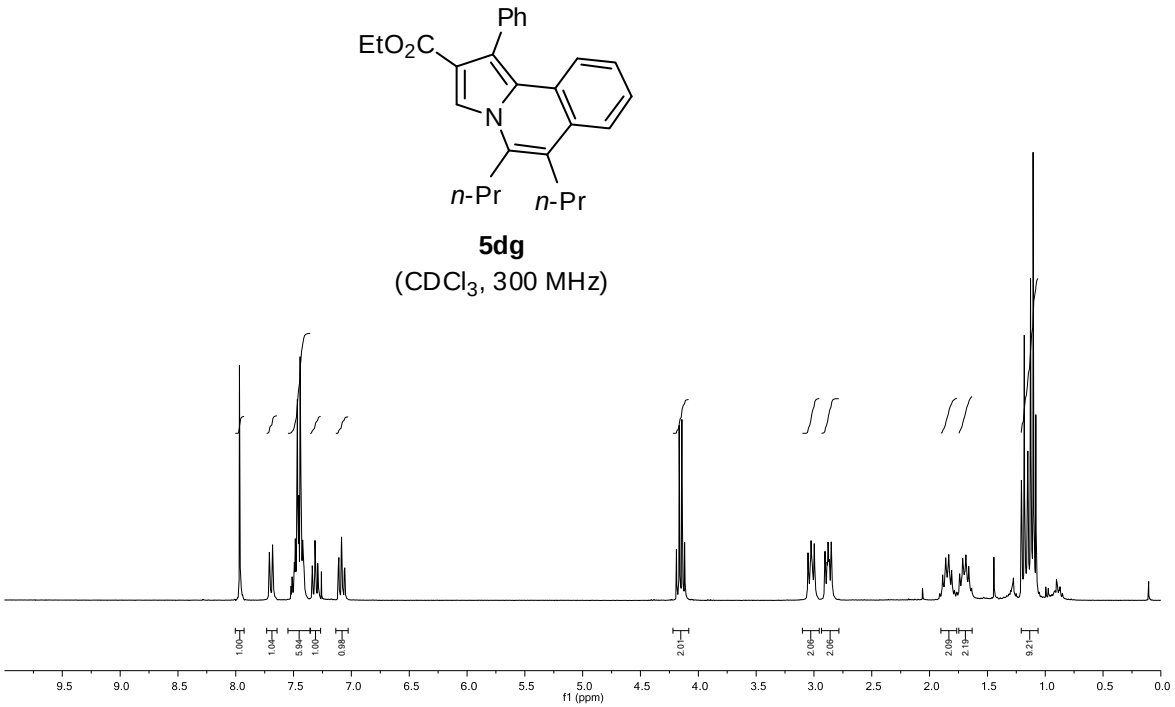
Ethyl 6-methyl-5-phenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5aj)

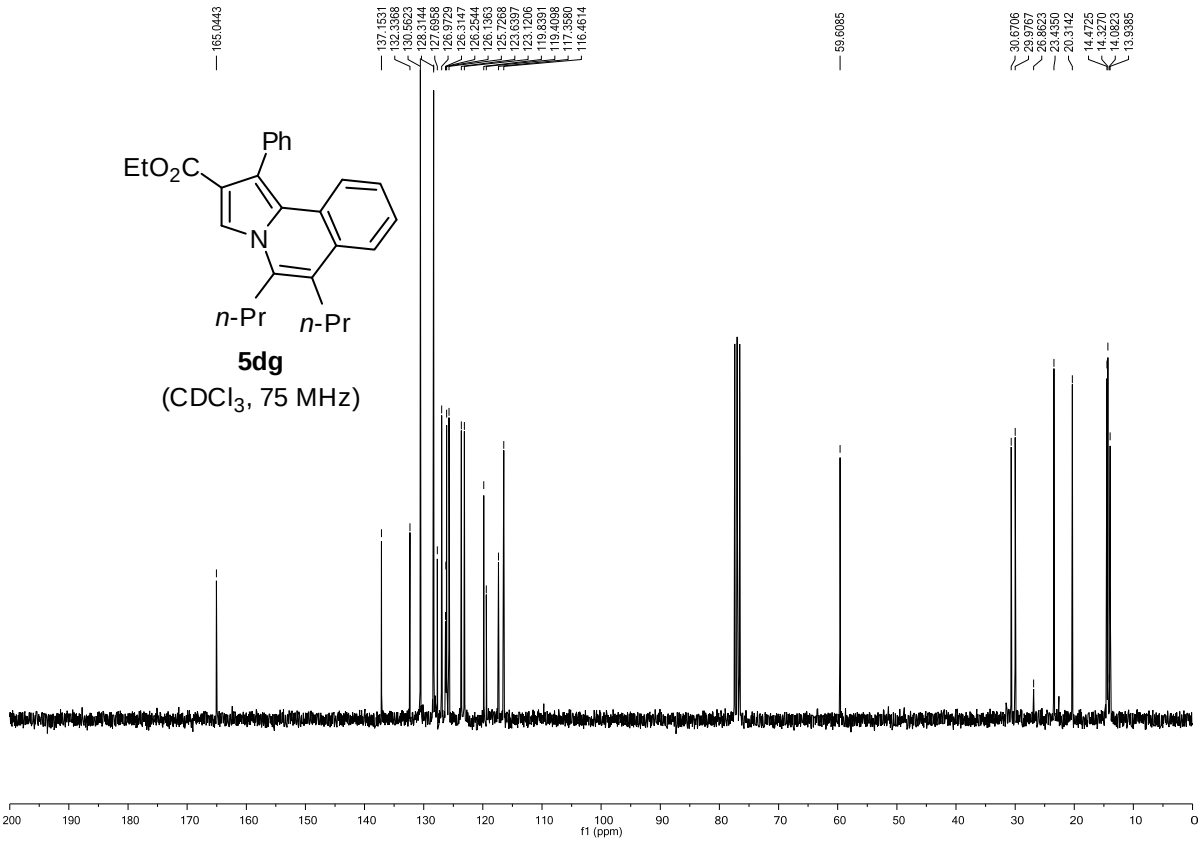




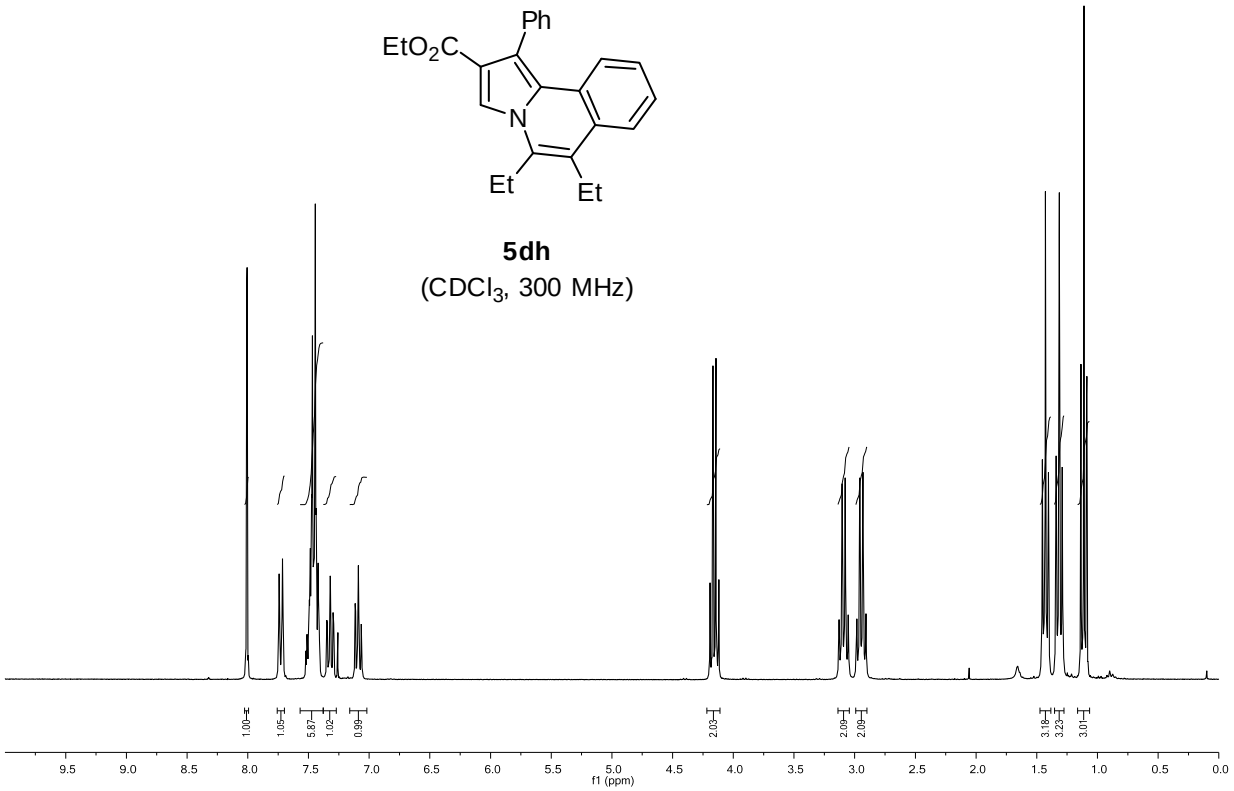


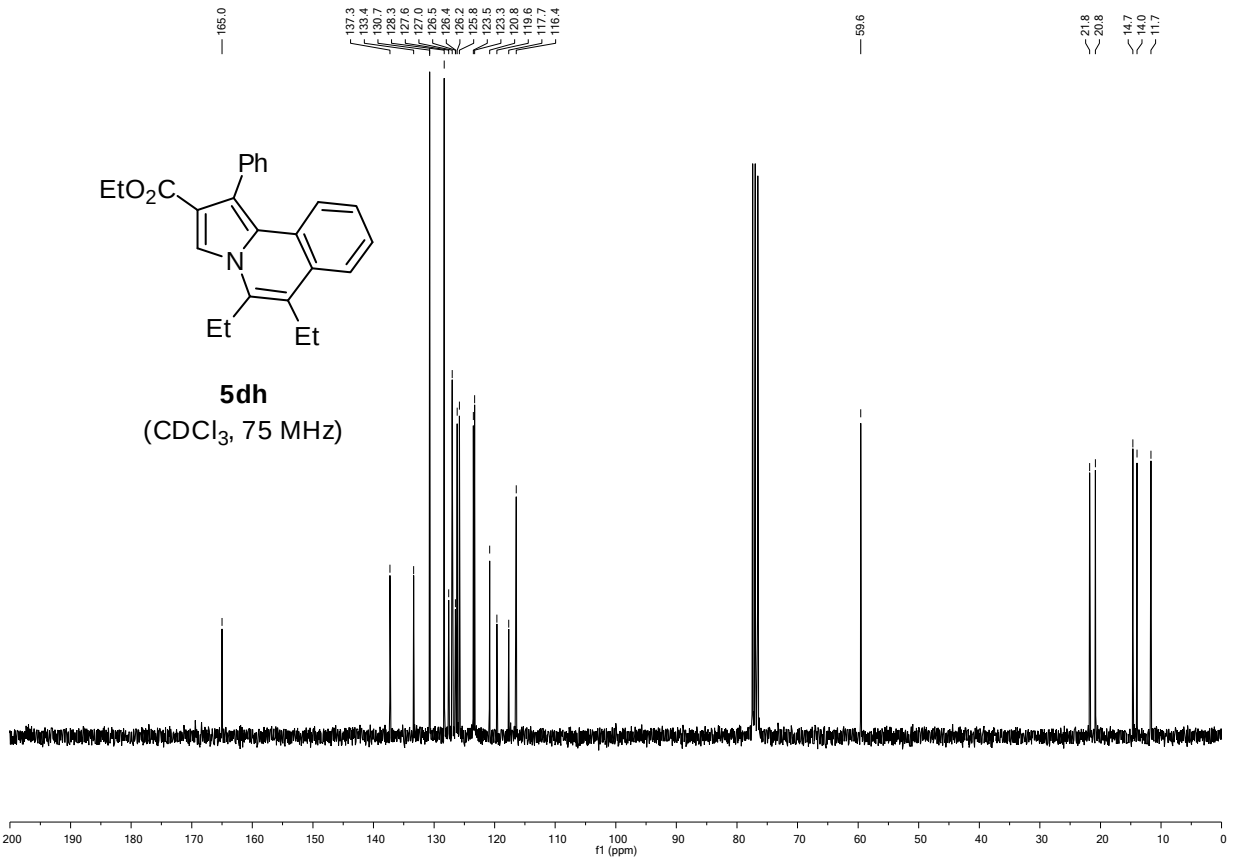
Ethyl 5,6-dimethyl-1-phenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5dg)



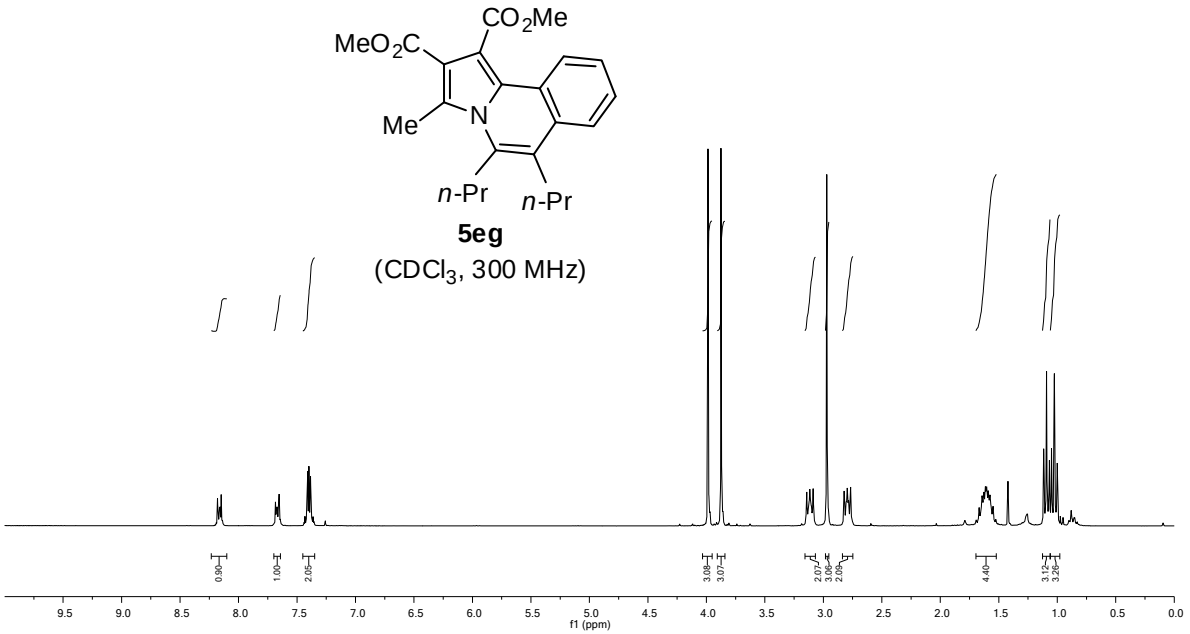


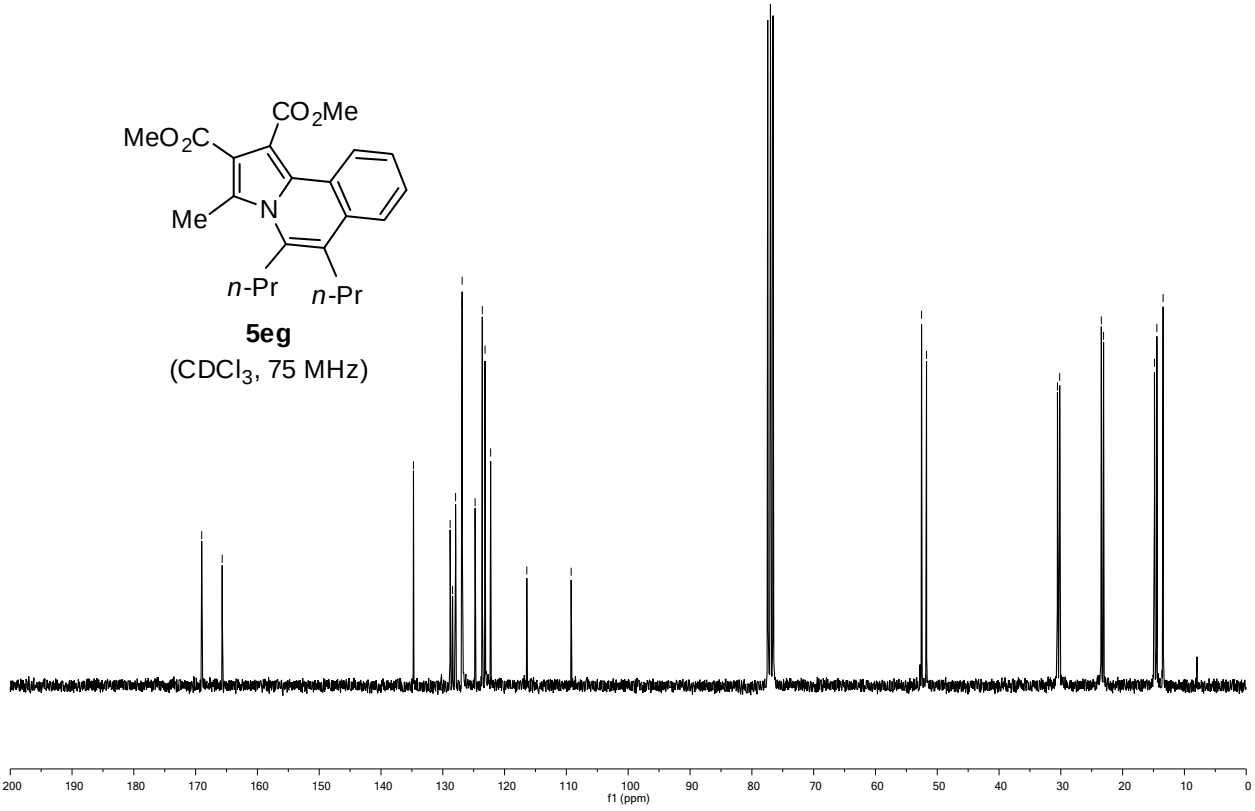
Ethyl 5,6-diethyl-1-phenylpyrrolo[2,1-a]isoquinoline-2-carboxylate (5dh)



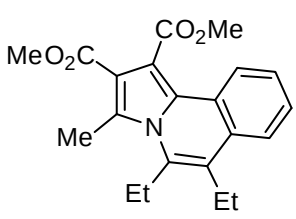


Dimethyl 3-methyl-5,6-di(*n*-propyl)pyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5eg)



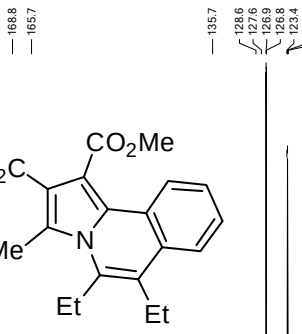


Dimethyl 5,6-diethyl-3-methylpyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5eh)



5eh

($CDCl_3$, 300 MHz)



5eh

($CDCl_3$, 75 MHz)

Dimethyl 6-(*n*-butyl)-5-(4-methoxyphenyl)-3-methylpyrrolo[2,1-a]isoquinoline-1,2-dicaboxylate (5ei)