Palladium-Catalyzed Cross-Coupling Reactions of 2-Indolylsilanols with Substituted Aryl Halides

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SUPPORTING INFORMATION

General Experimental:

Reactions were conducted using glassware that had been flame-dried under vacuum or oven-dried (180 °C) for at least 12 hours. Syringes and needles were dried (180 °C) for at least 12 hours and thoroughly flushed with argon prior to use. All reactions were conducted under an atmosphere of dry argon using a drying tube equipped with phosphorus pentoxide and calcium sulfate. Solvents used for extraction were reagent grade, and chromatography solvents were technical grade and distilled using the indicated drying agents: ethyl acetate (K_2CO_3), hexane (CaCl_2), toluene (sodium metal). Reaction solvent toluene (Fisher, ACS grade) was dried by percolation through a column packed with neutral alumina and a column packed with Q5 reactant, a supported copper catalyst for scavenging oxygen, under a positive pressure of argon. *n*-BuLi was titrated using a modification of Gilman's double titration method.¹

All ^1H NMR, ^{13}C NMR, and ^{19}F NMR spectra were obtained on Varian Unity 400 and Unity 500 MHz spectrometers using deuteriochloroform with residual chloroform as the internal reference (δ 7.26 ppm, ^1H ; δ 77.0 ppm, ^{13}C) or deuterobenzene with residual benzene as the internal reference (δ 7.15 ppm, ^1H ; δ 128.62 ppm, ^{13}C). Hexafluorobenzene was used as an internal reference for ^{19}F NMR (-160.0 ppm, ^{19}F). All chemical shifts are reported in ppm (δ) while multiplicities are indicated as s (singlet), d (doublet), t (triplet), q (quartet), or m (multiplet). All coupling constants (*J*) are reported in Hertz. Infrared spectra (IR) were obtained using a Mattson Galaxy 5020 spectrophotometer, and peaks are reported in reciprocal cm along with relative signal intensities: s (strong); m (medium); w (weak). Mass

spectrometry data was performed by the University of Illinois School for Chemical Sciences and molecular ion peaks are listed with relative abundances. Elemental analyses were conducted by the University of Illinois Microanalytical Service Laboratory.

Retention factors, R_f , are reported for analytical thin layer chromatography performed on Merck silica gel plates treated with F-254 indicator. Visualization was accomplished by UV light or aqueous KMnO_4 solution. Column chromatography was conducted using 230-400 mesh silica gel purchased from EM Science using the eluent and pressure given.

Analytical High Pressure Liquid Chromatography (HPLC) was performed on a Hewlett-Packard 1090 Series II liquid chromatograph equipped with a C18 reverse phase column. Compounds were separated using a gradient of increasing concentration of acetonitrile in a mobile phase of acetonitrile: water 60:40 to a final concentration of 100:0 acetonitrile: water over 10 min. At 10 min, the gradient was held at 100% acetonitrile for 4 min and decreased to 60:40 acetonitrile: water over 3 min for a total run time of 17 min. Compounds were detected using a UV detection unit with a wavelength of 254 nm. Response factors were generated by mixing 1: 0.2 molar ratios of compound to biphenyl internal standard in HPLC grade acetonitrile.

Commercial reagents were purified by recrystallization or distillation before use. Distillations were performed using a short-path, 3 cm, Vigreux column under reduced pressure. Bulb-to-bulb distillations were conducted using a Büchi GKR-50 Kugelrohr apparatus at the pressure specified. All reported boiling points are recorded air-bath temperatures (ABT). Melting points were conducted in vacuum-sealed glass tubes using a Thomas-Hoover Uni-Melt™ melting point apparatus and are corrected.

Anhydrous sodium *tert*-butoxide was purchased from Strem and stored in a dry box. Copper iodide was purchased from Aldrich and stored in a dry box. 1,4-Bis(diphenylphosphino)butane was purchased from Aldrich, recrystallized (EtOH) and stored under an atmosphere of nitrogen.

Literature Preparations:

N-Boc indole,² [CuOTMS]₄,³ and *N*-Methyl indole⁴ were prepared according to the literature procedure.

Preparation of *N*-Boc(2-indolyl)dimethylsilanol (1)

The following is a modification of a procedure by Vazquez et al.⁵ for the preparation of *N*-Boc 2-indolylsilanol. To a flame-dried, three-necked, 300 mL round-bottomed flask fitted with an argon inlet adaptor, thermocouple, magnetic stir bar and septum was placed 0.48 g (16.0 mmol) of *N*-Boc-indole followed by 7.5 mL of dry THF. The solution was cooled to 0 °C (internal) in an ice bath and 3.119 g (24.2 mmol, 1.5 equiv) of dimethyldichlorosilane was added. To this mixture was added via cannula a solution of LDA (prepared as described below) over 20 min.

The lithium diisopropylamide (LDA) solution was prepared by placing a solution of 2.82 mL (20.1 mmol, 1.25 equiv) of dry diisopropylamine in 3.0 mL of dry THF in a flame-dried, 50-mL two-necked round bottom flask fitted with an argon inlet adapter, magnetic stir bar and septum. The solution was cooled in a dry ice/isopropanol bath for 15 min and 12.96 mL (1.55 M in hexane, 20.1 mmol, 1.25 equiv) of a *n*-BuLi solution was slowly added. The resulting mixture was stirred for 5 min before being allowed to warm to 0 °C (ice bath) slowly. The solution was stirred for 20 min at 0 °C before being added to the solution prepared above.

The reaction mixture was stirred at 0 °C for 18 h whereupon 15.0 mL of sat. aq. NaHCO₃ solution was added. The aqueous layer was separated and extracted with EtOAc (4 x 35 mL). The combined organic layers were dried over Na₂SO₄ and filtered through #4

Whatman filter paper. The solvent was removed under reduced pressure to give a yellow oil which was immediately purified by silica gel chromatography (60 X 100 mm) by first eluting with 300 mL of hexane followed by hexane/EtOAc, 9/1 (30 X 50 mL fractions) to afford 3.34 g (71%) of **1** as a clear, colorless semi-solid. A portion was removed and distilled for elemental analysis.⁶

Data for **1**:

bp: 125 °C (7x10⁻⁵ mmHg, ABT)

¹H NMR: (500 MHz, CDCl₃)
7.96 (d, *J* = 8.36 1 H, HC(7)), 7.56 (d, *J* = 7.7, 1 H, HC(4)), 7.30 (m, 1 H, HC(6)), 7.21 (m, 1 H, HC(5)), 6.89 (s, 1 H, HC(3)), 2.80 (s, 1H, HO(2')), 1.73 (s, 9 H, H₃C(3'')), 0.45 (s, 6 H, HC(1')).

¹³C NMR: (125.6 MHz, CDCl₃)
152.4 (C(1')), 140.8 (C(8)), 137.2 (C(9)), 131.1 (C(2)), 124.9 (C(7)), 122.7 (C(5)), 121.2 (C(4)), 119.5 (C(6)), 115.5 (C(3)), 84.8 (C(1'')), 28.1 (C(3'')), 0.13 (C(1'))

IR: 3405 (m), 2977 (s) 2248 (w), 1903 (w), 1720 (s), 1517 (m), 1471 (s), 1444 (s), 1376 (s) 1336 (s), 1251 (s), 1213 (m)

MS: (EI, 70 eV)
291 (12), 235 (19), 220 (28), 218 (10), 192 (22), 191 (100), 176 (99), 173 (18), 130 (19), 75 (17), 57 (88)

TLC: *R_f* 0.36 (hexane/EtOAc, 4/1) [silica gel, UV]

Analysis: C₁₅H₂₁NO₃Si (291.42)

Calculated: C, 61.82; H, 7.26; N, 4.81%

Found: C, 61.54; H, 7.26; N, 4.80%

Preparation of *N*-Methyl(2-indolyl)dimethylsilanol (5**)**

To a flame-dried, two-necked, 125 mL round-bottomed flask fitted with a reflux condenser, Teflon stopcock to septum, and magnetic stir bar was placed 5.00 g (38.1 mmol) of *N*-methylindole followed by 60.0 mL of dry ether. To the stirring mixture was added 25.0 mL (1.60 M in hexane, 40.0 mmol, 1.05 equiv) of an *n*-BuLi solution. The reaction mixture was placed in a 56 $^{\circ}\text{C}$ oil bath and was allowed to reflux for 5 h.

To a separate flame-dried, three-necked, 250-mL round-bottomed flask fitted with, septum, argon inlet, thermocouple, and magnetic stir bar was placed 2.80 g (12.6 mmol, 0.33 equiv) of hexamethylcyclotrisiloxane followed by 25.0 mL of dry ether. This mixture was cooled to 0 $^{\circ}\text{C}$ (ice bath) and the lithiated indole solution prepared above was slowly added by cannula. The reaction was slowly warmed to room temperature overnight (12 h). The resulting cloudy white solution was cooled to 0 $^{\circ}\text{C}$ and 60.0 mL of H_2O was slowly added.

The aqueous layer was separated and extracted with EtOAc (4 x 40 mL). The combined organic layers were dried over MgSO_4 and filtered through #4 Whatman filter paper. The solvent was removed under reduced pressure to give a yellow oil which was immediately purified by silica gel chromatography (40 X 100 mm) by first eluting with 250 mL of hexane followed by hexane/EtOAc, 4/1 (30 X 50 mL fractions). Recrystallization from hexane afforded 4.43 g (57%) of **5** as a white solid.

Data for 5:

mp: 44-46 $^{\circ}\text{C}$ (hexane)

^1H NMR: (500 MHz, CDCl_3)

7.64 (d, $J = 7.8$ 1 H, HC(4)), 7.34 (d, $J = 8.3$, 1 H, HC(7)), 7.27 (m, 1 H, HC(6)), 7.11 (m, 1 H, HC(5)), 6.76 (s, 1 H, HC(3)), 3.91 (s, 3 H, $\text{H}_3\text{C}(1'')$), 2.21 (s, 1H, HO(2')), 0.52 (s, 6 H, HC(1')).

^{13}C NMR: (125.6 MHz, CDCl_3)
 140.0 (C(8)), 139.7 (C(9)), 128.0 (C(2)), 122.5 (C(5)), 121.0 (C(4)), 119.3 (C(6)), 111.9 (C(7)), 109.2 (C(3)), 32.9 (C(1'')), 0.6 (C(1'))

IR: 3306 (s), 3057 (m), 2959 (m) 1608 (w), 1494 (s), 1465 (s), 1412 (w), 1358 (s)
 1329 (s), 1301 (s), 1255 (s), 1234 (m), 1166 (m), 1076 (s)

MS: (EI, 70 eV)
 205 (21), 191 (5), 190 (28), 144 (3), 131 (6), 130 (7), 62 (100), 61 (30)

TLC: R_f 0.20 (hexane/EtOAc, 4/1) [silica gel, UV]

Analysis: $\text{C}_{11}\text{H}_{15}\text{NOSi}$ (205.33)
 Calculated: C, 64.34; H, 7.36; N, 6.82%
 Found: C, 64.46; H, 7.26; N, 6.79%

General Procedure I: Cross Coupling Reactions of 4-Nitro-1-iodobenzene with 1 Monitored by HPLC Using Various Activators:

To an oven-dried, 1.5-mL, reaction vial equipped with a stir bar was added activator (0.2 mmol, 2.0 equiv) and additive (0.1 mmol, 1.0 equiv) under dry argon atmosphere inside a dry box. To this round-bottomed flask was added 24.9 mg (0.1 mmol, 1.0 equiv) of 1-iodo-4-nitrobenzene, palladium catalyst (0.10 equiv), and 3.0 mg (0.02 mmol, 0.2 equiv) of biphenyl. The flask was sealed with a rubber septum and evacuated (0.1 mm Hg) for a period of 5 min. The flask was back-filled with dry argon and this cycle was repeated twice. The solids were dissolved in 120 μL of dry degassed toluene and the mixture was stirred for 10 min before addition of the silanol solution prepared below.

In a separate oven-dried 2.5-mL, vial was added 34.9 mg of *N*-Boc(2-indolyl)dimethylsilanol (0.12 mmol, 1.2 equiv) which was placed under high vacuum for 5 min before being back-filled with argon. The silanol was dissolved in 60 μL of dry, argon-

degassed toluene and this solution was added to the above mixture by syringe. The vial containing the silanol was washed with 20 μ L of dry degassed toluene and that rinse was added to the reaction mixture. Aliquots of 10 μ L were removed by syringe and diluted in 1.0 mL of HPLC grade acetonitrile, mixed and injected onto the HPLC.

Reactions monitored by HPLC for completion used response factors as normalized standards to give molar ratios of products. Standard solutions were prepared in triplicate by mixing compound to biphenyl internal standard in a 1.0: 0.2 molar ratio amounts. Small aliquots of these solutions were injected in triplicate and the response factors were calculated using equation 1 and the average response factor value for the nine trials was used.

$$\text{FACTOR} = \frac{\left(\frac{\text{mmoles of compound}}{\text{area of compound}} \right)}{\left(\frac{\text{area of biphenyl}}{\text{mmoles of biphenyl}} \right)} \quad \text{eq. 1}$$

HPLC response factors:

N-BOC-2-indolyl-4-nitrobenzene	1.211
N-BOC indole	1.300
4,4'-dinitrobiphenyl	2.784

Compounds were quantitatively determined using: equation 2, area of biphenyl, area of compound, and mmols of biphenyl added to the reaction.

$$\text{mmoles of compound} = \frac{\text{FACTOR} \left(\frac{\text{area of compound}}{\text{area of biphenyl}} \right) \left(\text{mmoles of biphenyl} \right)}{\left(\frac{\text{area of biphenyl}}{\text{mmoles of biphenyl}} \right)} \quad \text{eq. 2}$$

Table 1, entry 1:

Following the General Procedure 1, a mixture of sodium hydride (4.8 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), [allylPdCl]₂ (1.8 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.8 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. **3a**, *t*_R 12.40 min (47%).

Table 1, entry 2:

Following the General Procedure 1, a mixture of potassium hydride (8.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), [allylPdCl]₂ (1.8 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.8 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. **3a**, *t*_R 12.40 min (23%).

Table 1, entry 3:

Following the General Procedure 1, a mixture of lithium *tert*-butoxide (16.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), [allylPdCl]₂ (1.8 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (35.0 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction

mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. **3a**, t_R 12.40 min (0%).

Table 1, entry 4:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol, 1.0 equiv), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), [allylPdCl]₂ (1.8 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. **3a**, t_R 12.40 min (46%).

Table 1, entry 5:

Following the General Procedure 1, a mixture of potassium *tert*-butoxide (22.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), [allylPdCl]₂ (1.8 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (35 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. **3a**, t_R 12.40 min (3%).

Table 2, entry 1:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), PdCl₂ (1.8 mg, 0.01 mmol, 0.10 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (35 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the

reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, t_R 12.40 min (0%); analysis for 24 h data: **3**, t_R 12.40 min (3%).

Table 2, entry 2:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), PdCl₂(PPh₃)₂ (7.0 mg, 0.01 mmol, 0.10 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, t_R 12.40 min (0%); analysis for 24 h data: **3a**, t_R 12.40 min (15%).

Table 2, entry 3:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), Pd(OAc)₂ (2.2 mg, 0.01 mmol, 0.10 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, t_R 12.40 min (0%); analysis for 24 h data: **3a**, t_R 12.40 min (17%).

Table 2, entry 4:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0

equiv), [allylPdCl]₂ (1.8 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, *t_R* 12.40 min (22%); analysis for 24 h data: **3a**, *t_R* 12.40 min (46%).

Table 2, entry 5:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), PdBr₂ (2.6 mg, 0.01 mmol, 0.1 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, *t_R* 12.40 min (55%); analysis for 24 h data: **3a**, *t_R* 12.40 min (94%).

Table 2, entry 6:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), (CH₃CN)₂PdCl₂ (2.6 mg, 0.01 mmol, 0.1 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, *t_R* 12.40 min (57%); analysis for 24 h data: **3a**, *t_R* 12.40 min (98%).

Table 2, entry 7:

Following the General Procedure 1, a mixture of sodium *tert*-butoxide (19.0 mg, 0.2 mmol, 2.0 equiv), 1-iodo-4-nitrobenzene (24.9 mg, 0.1 mmol), CuI (19.0 mg, 0.1 mmol, 1.0 equiv), Pd₂(dba)₃•CHCl₃ (5.2 mg, 0.005 mmol, 0.05 equiv), and 120 μ L of dry degassed toluene was allowed to stir for a period of 10 min. A solution containing *N*-Boc(2-indolyl)dimethylsilanol (34.9 mg, 0.12 mmol, 1.2 equiv) in 60 μ L of dry, argon-degassed toluene was added to the reaction vial following the 10 min stir and the vial containing the silanol solution was washed with 20 μ L of toluene and that rinse was added to the reaction mixture and the mixture was stirred at rt for 24 h. An aliquot of the mixture was taken for HPLC analysis. Analysis for 12 h data: **3a**, *t_R* 12.40 min (87%); analysis for 24 h data: **3a**, *t_R* 12.40 min (107%).

General Procedure II: Cross-Coupling Reactions of Aryl Iodides with 1

To a flame-dried, 5-mL, round-bottomed flask equipped with a stir bar was added 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu and 190 mg (1.0 mmol, 1.0 equiv) of CuI under dry argon atmosphere inside a dry box. To this round-bottomed flask was added 1.0 mmol of aryl iodide, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃. The flask was sealed with a rubber septum and evacuated (0.1 mm Hg) for a period of 5 min. The flask was then back-filled with dry argon and this cycle was repeated twice. Finally the solids were dissolved in 600 μ L of dry degassed toluene and the mixture was stirred for 10 min before addition of the silanol solution prepared below.

In a separate flame-dried 5-mL, conical flask was added 349 mg of *N*-Boc(2-indolyl)dimethylsilanol (1.2 mmol, 1.2 equiv) which was placed under high vacuum for 5 min before being back-filled with argon. The silanol was dissolved in 300 μ L of dry, argon-

degassed toluene and this solution was added to the above mixture by syringe. The round-bottomed flask containing silanol was washed with 100 μ L of dry degassed toluene and that rinse was added to the reaction mixture. After being stirred at the temperature for the time specified, the dark-red, crude reaction mixture was diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). The combined organic layers were dried over MgSO₄ and were filtered through #4 Whatman filter paper. The solvent was removed under reduced pressure to give a dark red residue. A solution of the residue in 0.5 mL of toluene was loaded onto a silica gel column (20 X 100 mm) which was eluted with toluene (20 X 10 mL fractions), or eluted with 150 mL of hexane followed by hexane/EtOAc, 9/1 (20 X 10 mL fractions). Evaporation of the solvent and further purification by recrystallization provided the products.

Preparation of 2-(4'-Nitrophenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (**3a**)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 249 mg (1.0 mmol) of 1-iodo-4-nitrobenzene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of the silanol solution, the mixture was stirred at room temperature for 6 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane, 50 mL) afforded 284 mg (84%) of **3a** as light yellow needles.

Data for 3a:mp: 129-132 °C (hexane)¹H NMR: (500 MHz, CDCl₃)8.28 (d, *J* = 8.3, 2 H, HC(3')), 8.19 (d, *J* = 8.3, 1 H, HC(7)), 7.50 (m, 3 H, HC(2'), HC(4)), 7.38 (dd, *J* = 7.8, 7.1, 1 H, HC(6)), 7.29 (dd, *J* = 7.5, 7.3, 1 H, HC(5)), 6.69 (s, 1 H, HC(3)), 1.4 (s, 9 H, HC(3''))¹³C NMR: (125.6 MHz, CDCl₃)

149.8 (C(1')), 146.9 (C(4')), 141.4 (C(1')), 137.9 (C(8)), 137.8 (C(9)), 129.3 (C(2')), 128.9 (C(3')), 125.4 (C(2)), 123.4 (C(5)), 123.1 (C(4)), 121.0 (C(6)), 115.5 (C(7)), 112.1 (C(3)), 84.4 (C(2'')), 27.7 (C(3''))

IR: 2980 (m) 1736 (s), 1601 (s), 1558 (w), 1517 (s), 1451 (s), 1394 (m), 1325 (s), 1225 (s), 1213 (m), 1160 (s), 1133 (s), 1107 (m), 1026 (m), 911 (m), 858 (m)MS: (EI, 70 eV)338 (M⁺, 2), 324 (8), 323 (35), 268 (15), 267 (78), 223 (100), 208 (41), 180 (11), 178 (13), 57 (70)TLC: *R_f* 0.32 (hexane/EtOAc, 9/1) [silica gel, UV]Analysis: C₁₉H₁₈N₂O₄ (338.36)

Calculated: C, 67.44; H, 5.36; N, 8.28%

Found: C, 67.39; H, 5.27; N, 8.23%

Preparation of 2-(4'-Trifluoromethylphenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (3b)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 272 mg (1.0 mmol, 1.0 equiv) of 4-iodobenzotrifluoride, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 uL of dry

degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of silanol solution, the mixture was stirred at room temperature for 22 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (methanol, 10mL) afforded 298 mg (82%) of **3b** as a white solid.

Data for **3b**:

<u>mp:</u>	101-102 °C (methanol)
<u>¹H NMR:</u>	(500 MHz, CDCl ₃) 8.21 (d, <i>J</i> = 8.3, 1 H, HC(7)), 7.67 (d, <i>J</i> = 8.3, 2 H, HC(3')), 7.55 (m, 3 H, HC(2'), HC(4)), 7.36 (m, 1 H, HC(6)), 7.28 (m, 1 H, HC(5)), 6.62 (s, 1 H, HC(3)), 1.34 (s, 9 H, HC(3''))
<u>¹³C NMR:</u>	(125.6 MHz, CDCl ₃) 150.0 (C(1')), 138.8 (C(1')), 138.6 (C(8)), 137.6 (C(4')), 129.0 (C(9)), 129.0 (C(2')), 124.9 (C(3')), 124.8 (C(2)), 124.8 (C(5)), 124.7 (C(4)), 123.2 (C(6)), 120.7 (C(5')), 115.4 (C(7)), 111.0 (C(3)), 84.0 (C(2'')), 27.6 (C(3''))
<u>¹⁹F NMR:</u>	(470 MHz, CDCl ₃) -60.7 (FC(5'))
<u>IR:</u>	2982 (m), 1736 (s), 1619 (w), 1474 (w), 1453 (m), 1370 (m), 1324 (s), 1225 (m), 1164 (s), 1134 (s), 1108 (m), 1068 (m), 1027 (w), 852 (m)
<u>MS:</u>	(EI, 70 eV) 362 (M ⁺ , 4), 361 (17), 305 (31), 262 (17), 261 (100), 233 (12), 57 (99)
<u>TLC:</u>	R _f 0.39 (hexane/EtOAc, 9/1) [silica gel, UV]
<u>Analysis:</u>	C ₂₀ H ₁₈ F ₃ NO ₂ (361.36) Calculated: C, 66.48; H, 5.02; N, 3.88% Found: C, 66.53; H, 4.99; N, 3.99%

Preparation of 2-(4'- *tert*-Butoxycarbonylphenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (3c)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 304 mg (1.0 mmol) of 4-iodo-*tert*-butylbenzoate, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of the silanol solution, the mixture was stirred at room temperature for 24 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane, 10mL) afforded 329 mg (84%) of **3c** as white solid.

Data for **3c**:

mp: 99-100 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)
8.20 (d, *J* = 8.3, 1 H, HC(7)), 8.03 (d, *J* = 8.1, 2 H, HC(3')), 7.57 (d, *J* = 7.8, 1 H, HC(4)), 7.48 (d, *J* = 8.3, 2 H, HC(2')), 7.35 (m, 1 H, HC(6)), 7.27 (m, 1 H, HC(5)), 6.61 (s, 1H, HC(3)), 1.62 (s, 9 H, HC(7')), 1.36 (s, 9 H, HC(3'')).

¹³C NMR: (125.6 MHz, CDCl₃)
165.5 (C(5')), 150.0 (C(1')), 139.6 (C(1')), 138.9 (C(8)), 137.6 (C(4')), 130.9 (C(3')), 129.0 (C(9)), 128.9 (C(2')), 128.4 (C(2)), 124.7 (C(5)), 123.0 (C(4)), 120.7 (C(6)), 115.3 (C(7)), 110.9 (C(3)), 83.9 (C(6')), 81.1 (C(2')), 28.2 (C(7')), 27.6 (C(3''))

IR: 2979 (m), 1734 (s), 1711 (s), 1610 (w), 1452 (m), 1369 (s), 1325 (s), 1295 (s), 1224 (m), 1162 (s), 1134 (s), 1028 (w), 849 (w), 774 (w), 748 (w)

MS: (EI, 70 eV)

394 (M^+ , 4), 393 (13), 337 (23), 281 (13), 238 (17), 237 (100), 57 (49)

TLC: R_f 0.35 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: $C_{24}H_{27}NO_4$ (393.48)

Calculated: C, 73.26; H, 6.92; N, 3.56%

Found: C, 73.37; H, 6.99; N, 3.73%

Preparation of 2-(3'-Nitrophenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (**3d**)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 249 mg (1.0 mmol) of 1-iodo-3-nitrobenzene, and 52 mg (0.05 mmol, 0.05 equiv) of $Pd_2(dba)_3 \cdot CHCl_3$ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask fitted with a condenser. Following addition of silanol solution, the mixture was stirred at 40 °C for 12 h, diluted with 60 mL of deionized H_2O , and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO_2 (20mm), toluene) and recrystallization (hexane, 20 mL) afforded 237 mg (70%) of **3d** as faint yellow needles.

Data for **3d**:

mp: 130-132 °C (hexane)

1H NMR: (500 MHz, $CDCl_3$)

8.32 (s, $J = 2.0$, 1 H, HC(2')), 8.23 (m, 2 H, HC(7), HC(4')), 7.77 (m, 1 H, HC(5')), 7.59 (m, 2 H, HC(4), HC(6')), 7.39 (m, 1 H, HC(6)), 7.29 (m, 1 H, HC(5)), 6.68 (s, 1H, HC(3)), 1.38 (s, 9 H, HC(3''))

¹³C NMR: (125.6 MHz, CDCl₃)
 149.8 (C(1'')), 147.8 (C(2'')), 137.6 (C(1')), 137.6 (C(8)), 136.5 (C(6'')), 134.5 (C(5'')), 128.9 (C(9)), 128.7 (C(2)), 125.2 (C(4')), 123.7 (C(2')), 123.3 (C(5)), 122.3 (C(4)), 120.9 (C(6)), 115.5 (C(7)), 111.7 (C(3)), 84.2 (C(2'')), 27.7 (C(3''))

IR: 2976 (w), 1734 (s), 1529 (w), 1452 (m), 1325 (s), 1224 (m), 1158 (s), 1134 (m), 1030 (w), 911 (m), 821 (w), 739 (m)

MS: (EI, 70 eV)
 339 (M⁺, 3), 338 (12), 282 (16), 239 (17), 238 (100), 192 (20), 191 (20), 190 (15), 57 (91)

TLC: R_f 0.34 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: C₁₉H₁₈N₂O₄ (338.36)
 Calculated: C, 67.44; H, 5.36; N, 8.28%
 Found: C, 67.31; H, 5.24; N, 8.24%

Preparation of 2-Phenylindole-1-carboxylic Acid *tert*-Butyl Ester (3e)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 204 mg (1.0 mmol) of 1-iodobenzene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 uL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask fitted with a condenser. Following addition of silanol solution, the mixture was stirred at 40 °C for 12 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by

column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane, 10 mL) afforded 205 mg (70%) of **3e** as colorless crystals. The physical and spectroscopic data matched those from the literature.⁷

Data for **3e**:

mp: 76-78 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)

8.22 (d, *J* = 8.4, 1 H, HC(7)), 7.56 (d, *J* = 7.4 1 H, HC(4)), 7.38 (m, 6 H, HC(2'), HC(3'), HC(4'), HC(6)), 7.25 (m, 1 H, HC(5)), 6.56 (s, 1H, HC(3)), 1.30 (s, 9 H, HC(3''))

TLC: *R_f* 0.55 (hexane/EtOAc, 9/1) [silica gel, UV]

Preparation of 2-(2'-Methylphenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (3f**)**

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 218 mg (1.0 mmol) of 2-iodotoluene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 uL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask with condenser. Following addition of silanol solution, the mixture was stirred at 50 °C for 24 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), hexane to hexane/EtOAc, 9/1), and recrystallization (hexane, 5mL) afforded 224 mg (73 %) of **3f** as a white solid (plates).

Data for 3f:

mp: 94-96 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)
8.28 (d, *J* = 8.4, 1 H, HC(7)), 7.56 (d, *J* = 7.7 1 H, HC(4)), 7.28 (m, 6 H, HC(3'), HC(4'), HC(5'), HC(6'), HC(5), HC(6)), 6.45 (s, 1H, HC(3)), 2.19 (s, 3H, HC(7')), 1.23 (s, 9 H, HC(3''))

¹³C NMR: (125.6 MHz, CDCl₃)
150.1 (C(1')), 139.4 (C(8)), 137.2 (C(1')), 136.8 (C(2')), 135.3 (C(9)), 129.7 (C(3')), 129.4 (C(4')), 129.3 (C(6')), 128.1 (C(5')), 125.2 (C(2)), 124.1 (C(5)), 122.8 (C(4)), 120.3 (C(6)), 115.5 (C(7)), 109.5 (C(3)), 82.9 (C(2')), 27.4 (C(3'')), 20.0 (C(7'))

IR: 2976 (w), 2922 (w), 2356 (w), 1731 (s), 1455 (m), 1362 (m), 1333 (s), 1224 (w), 1161 (m), 1136 (m), 1049 (w), 1020 (w), 858 (w), 840 (w), 747 (m)

MS: (EI, 70 eV)
308 (M⁺, 4), 307 (18), 251 (39), 207 (91), 206 (45), 178 (11), 62 (75), 61 (18), 57 (100)

TLC: *R_f* 0.48 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: C₂₀H₂₁NO₂ (307.39)

Calculated: C, 78.15; H, 6.89; N, 4.56%

Found: C, 78.06; H, 6.89; N, 4.70%

Preparation of 2-(4'-Methoxyphenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (**3g**)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 234 mg (1.0 mmol, 1.0 equiv) of 1-iodo-4-methoxybenzene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 uL of dry degassed toluene under an atmosphere of argon was prepared in a 1-piece 5-mL round bottomed flask fitted with a reflux jacket. Following addition of the silanol solution, the mixture was stirred at 50 °C for 24 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (methanol, 5mL) afforded 230 mg (72 %) of **3g** as a white solid.

Data for **3g**:

mp: 84-87 °C

¹H NMR: (500 MHz, CDCl₃)
 8.18 (d, *J* = 8.1, 1 H, HC(7)), 7.54 (d, *J* = 7.7, 1 H, HC(4)), 7.31 (m, 4 H, HC(2'), HC(6), HC(5)), 6.95 (d, *J* = 8.8, 2 H, HC(3')), 6.51 (s, 1 H, HC(3)), 3.9 (s, 3 H, HC(5')), 1.4 (s, 9 H, HC(3''))

¹³C NMR: (125.6 MHz, CDCl₃)
 159.2 (C(1')), 150.3 (C(4')), 140.4 (C(8)), 137.3 (C(1')), 129.9 (C(9)), 129.3 (C(2')), 127.4 (C(2)), 124.0 (C(5)), 122.8 (C(4)), 120.3 (C(6)), 115.2 (C(3')), 113.2 (C(7)), 109.5 (C(3)), 83.3 (C(2'')), 55.3 (C(5')), 27.7 (C(3''))

IR: 2979 (w), 2836 (w), 1730 (s), 1614 (m), 1506 (s), 1453 (s), 1394 (w), 1369 (s), 1330 (s), 1247 (s), 1225 (m), 1160 (s), 1133 (s), 1044 (m), 847 (w), 809 (w), 749 (m)

MS: (EI, 70 eV)

324 (M^+ , 10), 323 (42), 267 (85), 223 (100), 208 (6), 208 (38), 178 (10), 135 (10), 57 (59)

TLC: R_f (0.33) (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: $C_{20}H_{21}NO_3$ (323.39)

Calculated: C, 74.28; H, 6.55; N, 4.33%

Found: C, 74.16; H, 6.52; N, 4.43%

Preparation of 2-(2'-Methoxyphenyl)indole-1-carboxylic Acid *tert*-Butyl Ester (**3h**)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 234 mg (1.0 mmol) of 1-iodo-2-methoxybenzene, and 52 mg (0.05 mmol, 0.05 equiv) of $\text{Pd}_2(\text{dba})_3 \cdot \text{CHCl}_3$ in 600 μL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask fitted with a condenser. Following addition of the silanol solution, the mixture was stirred at 50°C for 24 h, diluted with 60 mL of deionized H_2O , and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO_2 (20mm), hexane to hexane/EtOAc, 9/1) afforded 228 mg (70%) of **3h** as a clear colorless semi-solid.

Data for **3h**:

$^1\text{H NMR}$: (500 MHz, CDCl_3)

8.20 (d, $J = 8.3$, 1 H, HC(7)), 7.55 (d, $J = 7.6$, 1 H, HC(4)), 7.36 (m, 2 H, HC(5'), HC(6')), 7.31 (m, 1 H, HC(6)), 7.22 (m, 1H, HC(4')), 7.01 (m, 1 H,

HC(5)), 6.90 (m, 1 H, HC(3')), 6.51 (s, 1H HC(3)), 3.76 (s, 3H, HC(5')), 1.31 (s, 9 H, HC(3''))

¹³C NMR: (125.6 MHz, CDCl₃)
157.1 (C(1')), 150.2 (C(2')), 137.3 (C(8)), 137.0 (C(4')), 130.1 (C(9)), 129.4 (C(6')), 129.1 (C(1')), 124.6 (C(2)), 124.0 (C(5)), 122.4 (C(4)), 120.4 (C(6)), 120.4 (C(5')), 115.0 (C(7)), 109.8 (C(3')), 109.4 (C(3)), 82.6 (C(2'')), 55.2 (C(5')), 27.5 (C(3''))

IR: 2978 (w), 1731 (s), 1588 (w), 1562 (s), 1489 (m), 1453 (s), 1394 (w), 1362 (m), 1335 (s), 1245 (s), 1221 (m), 1162 (s), 1136 (s), 1116 (m), 1052 (w), 1026 (w), 844 (w), 812 (w), 785 (w), 748 (m)

MS: (EI, 70 eV)
324 (M⁺, 6), 323 (23), 267 (18), 232 (11), 223 (91), 222 (47), 208 (28), 204 (15), 193 (11), 180 (16), 165 (15), 130 (15), 117 (22), 84 (38), 57 (100)

TLC: *R_f* 0.39 (hexane/EtOAc, 9/1) [silica gel, UV]

HPLC: *t_R* **3h**, 13.33 min (97.5%) (C18, acetonitrile/water, 60/40)

HRMS: Calculated for C₂₀H₂₁NO₃: 323.1521; found: 323.1518

Preparation of 2-(1'-Naphthyl)indole-1-carboxylic Acid *tert*-Butyl Ester (**3i**)

Following General Procedure II, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 254 mg (1.0 mmol) of 1-iodonaphthalene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 uL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask fitted with a condenser. Following addition of the silanol solution, the mixture was

stirred at 60 °C for 24 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane, 5 mL) afforded 236 mg (75%) of **3i** as a white solid.

Data for **3i**:

mp: 88-89 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)

8.38 (d, *J* = 8.3, 1 H, HC(7)), 7.90 (m, 2 H, HC(5'), HC(4')), 7.64 (m, 2 H, HC(4), HC(8')), 7.50 (m, 3 H, HC(2'), HC(3'), HC(7')), 7.41 (m, 2 H, HC(6'), HC(6)), 7.31 (m, 1 H, HC(5)), 6.67 (s, 1 H, HC(3)), 0.82 (s, 9 H, HC(3''))

¹³C NMR: (125.6 MHz, CDCl₃)

150.0 (C(1'')), 138.3 (C(1')), 137.1 (C(8)), 133.3 (C(10')), 133.2 (C(9')), 133.1 (C(8')), 129.3 (C(5')), 128.3 (C(4')), 128.0 (C(9)), 127.0 (C(7')), 126.4 (C(6')), 125.9 (C(3')), 125.7 (C(2')), 125.1 (C(2)), 124.4 (C(5)), 122.9 (C(4)), 120.4 (C(6)), 115.5 (C(7)), 110.7 (C(3)), 82.7 (C(2'')), 26.9 (C(3''))

IR: 3057 (w), 2980 (w), 1731 (s), 1560 (w), 1474 (w), 1454 (s), 1394 (w), 1364 (m), 1333 (s), 1254 (w), 1230 (m), 1160 (s), 1137 (m), 1112 (w), 1090 (m), 1054 (w), 992 (w), 848 (w), 801 (w), 776 (m), 748 (m)

MS: (EI, 70 eV)

344 (M⁺, 7), 343 (26), 288 (8), 287 (38), 244 (20), 243 (100), 242 (43), 241 (31), 57.1 (39)

TLC: *R_f* 0.55 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: C₂₃H₂₁NO₂ (343.42)

Calculated: C, 80.44; H, 6.16; N, 4.08%

Found: C, 80.43; H, 6.17; N, 4.22%

General Procedure III: Cross-Coupling Reactions of Aryl Iodides with 5

To a flame-dried, 5-mL, round-bottomed flask equipped with a stir bar was added 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu and 190 mg (1.0 mmol, 1.0 equiv) of CuI under dry argon atmosphere inside a dry box. To this round-bottomed flask was added aryl iodide (1.0 mmol), and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃. The flask was sealed with a rubber septum and evacuated (0.1 mm Hg) for a period of 5 min. The flask was then back-filled with dry argon and this cycle was repeated twice. Finally the solids were dissolved in 600 μ L of dry degassed toluene and the mixture was stirred for 10 min before addition of the silanol solution prepared below.

In a separate flame-dried 5-mL, conical flask was added 246 mg of *N*-methyl(2-indolyl)dimethylsilanol (1.2 mmol, 1.2 equiv) which was placed under high vacuum for 5 min before being back-filled with argon. The silanol was dissolved in 300 μ L of dry, argon-degassed toluene and this solution was added to the above mixture by syringe. The round-bottomed flask containing silanol was washed with 100 μ L of dry degassed toluene and that rinse was added to the reaction mixture. After being stirred at the temperature for the time specified, the dark-red, crude reaction mixture was diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). The combined organic layers were dried over MgSO₄ and were filtered through #4 Whatman filter paper. The solvent was removed under reduced pressure to give a dark red residue. A solution of the residue in 0.5 mL of toluene was loaded onto a silica gel column (20 X 100 mm) which was eluted with toluene (20 X 10 mL fractions). Evaporation of the solvent and further purification by recrystallization provided the products.

Preparation of 2-(4'-Nitrophenyl)1-methyl-indole (7a) and 2,3-bis(4'-Nitrophenyl) 1-methylindole (8a)

Following General Procedure III, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 249 mg (1.0 mmol) of 1-iodo-4-nitrobenzene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of the silanol solution, the mixture was stirred at room temperature for 3 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane/EtOAc, 4/1; 10 mL) afforded 157 mg (62%) of **7a** as a yellow solid along with 30 mg (16%) of **8a** as a red solid.

Data for 7a:

mp: 163-164 °C (hexane/EtOAc, 4/1)

¹H NMR: (500 MHz, CDCl₃)

8.34 (d, J = 8.8, 2 H, HC(3')), 7.70 (d, J = 8.8, 2 H, HC(2')), 7.67 (d, J = 8.1, 1 H, HC(4)), 7.40 (d, J = 8.3, 1 H, HC(7)), 7.32 (m, 1 H, HC(6)), 7.19 (t, J = 7.8, 1 H, HC(5)), 6.72 (s, 1 H, HC(3)), 3.81 (s, 3 H, HC(1'')).

¹³C NMR: (125.6 MHz, CDCl₃)
147.0 (C(4')), 139.2 (C(1')), 139.2 (C(8)), 138.9 (C(9)), 129.5 (C(2)), 127.7 (C(2')), 123.9 (C(3')), 123.0 (C(5)), 121.0 (C(4)), 120.5 (C(6)), 109.9 (C(7)), 104.1 (C(3)), 31.5 (C(1'))

IR: 2924 (s), 2854 (s), 1594 (w), 1509 (w), 1462 (m), 1377 (w), 1341 (w), 1165 (w), 1107 (w), 1005 (w), 866 (w), 854 (w), 792 (w), 751 (w)

MS: (EI, 70 eV)
252 (100), 222 (25), 206 (40), 204 (25), 191 (17), 102 (9), 62 (21), 57 (3)

TLC: *R_f* 0.23 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: C₁₅H₁₂N₂O₂ (252.27)
Calculated: C, 71.42; H, 4.79; N, 11.10%
Found: C, 71.37; H, 4.77; N, 10.86%

Data for 8a:

mp: 258-260 °C (hexane/EtOAc, 4/1)

¹H NMR: (500 MHz, CDCl₃)
8.30 (d, *J* = 8.8, 2 H, HC(3')), 8.16 (d, *J* = 9.0, 2 H, HC(3'')), 7.77 (d, *J* = 7.9, 1 H, HC(4)), 7.51 (d, *J* = 8.8, 2 H, HC(2')), 7.48 (d, *J* = 8.2, 1 H, HC(7)), 7.40 (m, 3 H, HC(2''), HC(6)), 7.29 (t, *J* = 8.0, 1 H, HC(5)), 3.74 (s, 3 H, HC(1''')).

¹³C NMR: (125.6 MHz, CDCl₃)
147.7 (C(4')), 145.8 (C(4'')), 141.8 (C(1')), 139.0 (C(1'')), 137.8 (C(8)), 136.2 (C(2')), 131.9 (C(2'')), 130.1 (C(9)), 126.3 (C(2)), 124.1 (C(3')), 124.0 (C(3'')), 123.8 (C(5)), 121.6 (C(4)), 119.4 (C(6)), 114.9 (C(3)), 110.2 (C(7)), 31.3 (C(1'''))

IR: 2936 (w), 2853 (w), 1596 (w), 1520 (w), 1501 (m), 1464 (s), 1376 (w), 1350 (s), 1107 (w), 1088 (w), 874 (w), 860 (w), 745 (w)

MS: (EI, 70 eV)
374 (M⁺, 6), 373 (27), 343 (28), 314 (24), 313 (100), 297 (16), 282 (10), 268 (20), 252 (59), 222 (32), 206 (24), 205 (15), 204 (15), 191 (11), 158 (50), 149 (24), 141 (11), 115 (23), 111 (10), 71 (18), 57 (54)

TLC: R_f 0.08 (hexane/EtOAc, 9/1) [silica gel, UV]
HPLC: t_R **8a**, 11.88 min (100%) (C18, acetonitrile/water, 60/40)
HRMS: Calculated for $C_{21}H_{15}N_3O_4$: 373.1063; found: 373.1055

Preparation of 2-(4'-Cyanophenyl)-1-methylindole (7b) and 2,3-bis(4'-Cyanophenyl)-1-methyl-indole (8b) [

Following General Procedure III, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 229 mg (1.0 mmol) of 1-iodo-4-cyanobenzene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of the silanol solution, the mixture was stirred at room temperature for 3 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane, 10 mL) afforded 145 mg (62%) of **7b** as a white solid along with 51 mg (30%) of **8b** as an off-white solid.

Data for 7b:

mp: 161-162 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)
7.76 (m, 2 H, HC(3')), 7.65 (m, 3 H, HC(2'), HC(4)), 7.39 (d, *J* = 8.2, 1 H, HC(7)), 7.30 (t, *J* = 7.1, 1 H, HC(6)), 7.18 (t, *J* = 7.1, 1 H, HC(5)), 6.66 (s, 1 H, HC(3)), 3.78 (s, 3 H, HC(1'))

¹³C NMR: (125.6 MHz, CDCl₃)
139.3 (C(1')), 139.0 (C(8)), 137.4 (C(3')), 132.3 (C(9)), 129.5 (C(2)), 127.7 (C(2')), 122.8 (C(5)), 120.9 (C(4)), 120.4 (C(6)), 118.8 (C(5')), 111.2 (C(4')), 109.8 (C(7)), 103.5 (C(3)), 31.5 (C(1'))

IR: 2924 (s), 2854 (s), 2224 (w), 1604 (w), 1465 (w), 1377 (w), 846 (w), 798 (w), 755 (w)

MS: (EI, 70 eV)
233 (M⁺, 23), 232 (100), 231 (36), 190 (14), 116 (7), 102 (8), 63 (5)

TLC: *R_f* 0.16 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: C₁₆H₁₂N₂ (232.28)

Calculated: C, 82.73; H, 5.21; N, 12.06%

Found: C, 82.60; H, 5.03; N, 11.86%

Data for 8b:

mp: 278-280 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)
7.74 (d, *J* = 8.8, 1 H, HC(4)), 7.72 (d, *J* = 8.6, 2 H, HC(3')), 7.58 (d, *J* = 8.6, 2 H, HC(2')), 7.46 (d, *J* = 8.1, 1 H, HC(7)), 7.43 (d, *J* = 8.3, 2 H, HC(3'')), 7.39 (t, *J* = 7.6, 1 H, HC(6)), 7.33 (d, *J* = 8.3, 2 H, HC(2'')), 7.26 (t, *J* = 7.9, 1 H, HC(5)), 3.71 (s, 3 H, HC(1''')).

¹³C NMR: (125.6 MHz, CDCl₃)
139.7 (C(1')), 137.9 (C(8)), 136.2 (C(1'')), 136.0 (C(3')), 132.5 (C(3'')), 132.3 (C(9)), 131.7 (C(2)), 130.2 (C(2')), 126.2 (C(2'')), 123.6 (C(5)), 121.4 (C(4)), 119.4 (C(6)), 119.1 (C(3)), 118.3 (C(5')), 114.9 (C(5'')), 112.4 (C(4')), 110.1 (C(4'')), 109.4 (C(7)), 31.3 (C(1'''))

IR: 2925 (s), 2854 (s), 2226 (m), 1602 (w), 1560 (w), 1541 (w), 1508 (w), 1466 (m), 1376 (m), 1262 (w), 1088 (w), 1016 (w), 867 (w), 831 (w), 750 (w)

MS: (EI, 70 eV)
334 (M^+ , 27), 333 (100), 317 (9), 159 (4), 119 (3), 91 (3)

TLC: R_f 0.02 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: $C_{23}H_{15}N_3$ (333.39)
Calculated: C, 82.86; H, 4.54; N, 12.60%
Found: C, 82.62; H, 4.47; N, 12.48%

Preparation of 2-Phenyl-1-methyl-indole (**7c**)

Following General Procedure III, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of $NaOt\text{-}Bu$, 190 mg (1.0 mmol, 1.0 equiv) of CuI , 204 mg (1.0 mmol) of 1-iodobenzene, and 52 mg (0.05 mmol, 0.05 equiv) of $Pd_2(dba)_3 \cdot CHCl_3$ in 600 μL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of silanol solution, the mixture was stirred at room temperature for 3 h, diluted with 60 mL of deionized H_2O , and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO_2 (20mm), toluene) and recrystallization (hexane, 10 mL) afforded 170 mg (82%) of **7c** as a white solid. The physical and spectroscopic data matched those from the literature.⁸

Data for **7c**:

mp: 97-100 $^{\circ}C$ (hexane)

7.64 (d, $J = 7.8$, 1 H, HC(4)), 7.52 (m, 2 H, HC(2')), 7.48 (m, 2 H, HC(3')), 7.40 (m, 2 H, HC(7), HC(6)), 7.26 (m, 1 H, HC(4')), 7.15 (dt, $J = 7.8$, 0.7, 1 H, HC(5)), 6.57 (s, 1 H, HC(3)), 3.76 (s, 3 H, H₃C(1''))

TLC: R_f 0.42 (hexane/EtOAc, 9/1) [silica gel, UV]

Preparation of (1-Methyl-2-indolyl)thiophene (7d)

Following General Procedure III, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 210 mg (1.0 mmol) of 2-iodothiophene, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of silanol solution, the mixture was stirred at room temperature for 6 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) and recrystallization (hexane, 5 mL) afforded 155 mg (73%) of **7d** as a faint yellow solid.

Data for 7d:

mp: 58-59 °C (hexane)

¹H NMR: (500 MHz, CDCl₃)

7.62 (d, $J = 8.1$, 1 H, HC(4)), 7.40 (d, $J = 5.1$, 1 H, HC(4')), 7.35 (d, $J = 8.3$, 1 H, HC(7)), 7.25 (m, 1 H, HC(6)), 7.21 (d, $J = 3.7$, 1 H, HC(2')), 7.14 (m, 2 H, HC(5), HC(3')), 6.68 (s, 1 H, HC(3)), 3.85 (s, 3 H, H₃C(1''))

¹³C NMR: (125.6 MHz, CDCl₃)

138.3 (C(1')), 134.2 (C(8)), 133.9 (C(9)), 127.7 (C(2)), 127.6 (C(3')), 126.7 (C(4')), 126.2 (C(2')), 122.1 (C(5)), 120.5 (C(4)), 120.0 (C(6)), 109.5 (C(7)), 102.8 (C(3)), 31.0 (C(1''))

IR: 2964 (s), 2941 (s), 2874 (s), 2843 (s), 1464 (s), 1417 (w), 1377 (m), 1364 (m), 1336 (m), 1224 (w), 1144 (w), 1100 (w), 967 (w), 920 (w), 850 (m), 830 (w), 779 (s), 747 (s), 731 (s)

MS: (EI, 70 eV)
214 (M^+ , 17), 213 (100), 198 (7), 107 (5), 89 (3), 63 (3)

TLC: R_f 0.38 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: $C_{13}H_{11}NS$ (333.39)

Calculated: C, 73.20; H, 5.20; N, 6.57%

Found: C, 72.89; H, 5.19; N, 6.57%

Preparation of 2-(4'-Methoxyphenyl)-1-methylindole (7e)

Following General Procedure III, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 234 mg (1.0 mmol) of 1-iodo-4-methoxybenzene, and 52 mg (0.05 mmol, 0.05 equiv) of $Pd_2(dba)_3 \cdot CHCl_3$ in 600 μ L of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask. Following addition of the silanol solution, the mixture was stirred at room temperature for 3 h, diluted with 60 mL of deionized H_2O , and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO_2 (20mm), toluene) and recrystallization (hexane, 5 mL) afforded 189 mg (80%) of **7e** as a white solid. The physical and spectroscopic data matched those from the literature.⁹

Data for **7e**:

mp: 116-118 $^{\circ}C$ (hexane)

1H NMR: (500 MHz, $CDCl_3$)

7.62 (d, $J = 7.5$, 1 H, HC(4)), 7.44 (d, $J = 8.8$, 2 H, HC(2')), 7.35 (d, $J = 8.1$, 1 H, HC(7)), 7.23 (dt, $J = 8.2$, 1.3 1 H, HC(6)), 7.13 (dt, $J = 7.9$, 1.0, 1 H,

HC(5)), 7.00 (d, $J = 8.8$, 2 H, HC(3')), 6.50 (s, 1 H, HC(3)), 3.88 (s, 3 H, H₃C(5')), 3.73 (s, 3 H, HC(1''))

TLC: R_f 0.28 (hexane/EtOAc, 9/1) [silica gel, UV]

General Procedure IV: Cross-Coupling Reactions of Aryl Bromides (6) with 5:

To a flame-dried, 5-mL, round-bottomed flask equipped with a stir bar was added 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu and 190 mg (1.0 mmol, 1.0 equiv) of CuI under dry argon atmosphere inside a dry box. To this round-bottomed flask was added aryl bromide (1.0 mmol), 85 mg of dppb (0.20 mmol, 0.20 equiv) and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃. The flask was sealed with a rubber septum and evacuated (0.1 mm Hg) for a period of 5 min. The flask was then back-filled with dry argon and this cycle was repeated twice. Finally the solids were dissolved in 600 μ L of dry degassed toluene and the mixture was stirred for 10 min before addition of the silanol solution prepared below.

In a separate flame-dried 5-mL, conical flask was added 246 mg of *N*-methyl(2-indolyl)dimethylsilanol (1.2 mmol, 1.2 equiv) which was placed under high vacuum for 5 min before being back-filled with argon. The silanol was dissolved in 300 μ L of dry, argon-degassed toluene and this solution was added to the above mixture by syringe. The round-bottomed flask containing the silanol was washed with 100 μ L of dry degassed toluene and that rinse was added to the reaction mixture. After being stirred at the temperature for the time specified, the dark-red, crude reaction mixture was diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). The combined organic layers were dried over MgSO₄ and were filtered through #4 Whatman filter paper. The solvent was removed under reduced pressure to give a dark red residue. A solution of the residue in 0.5 mL of toluene was loaded onto a silica gel column (20 X 100 mm) which was eluted with toluene (20 X 10 mL

fractions). Evaporation of the solvent and further purification by recrystallization provided the products.

Preparation of 2-(4'-Nitro-phenyl)-1-methyl-indole (7a) [JDB-VI-90]

Following General Procedure IV, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 202 mg (1.0 mmol) of 1-bromo-4-nitrobenzene, 85 mg (0.2 mmol, 0.2 equiv) of dppb, and 52 mg (0.05 mmol, 0.05 equiv) of Pd₂(dba)₃•CHCl₃ in 600 uL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask fitted with a condenser. Following addition of the silanol solution, the mixture was stirred at 55 °C for 20 h, diluted with 60 mL of deionized H₂O, and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO₂ (20mm), toluene) recrystallization (hexane/EtOAc, 4/1; 10 mL) afforded 212 mg (84%) of **7a** as a yellow solid.

Data for **7a**:

mp: 163-164 °C (hexane/EtOAc, 4/1)

¹H NMR: (500 MHz, CDCl₃)

8.34 (d, *J* = 8.8, 2 H, HC(3')), 7.70 (d, *J* = 8.8, 2 H, HC(2')), 7.67 (d, *J* = 8.1, 1 H, HC(4)), 7.40 (d, *J* = 8.3, 1 H, HC(7)), 7.32 (m, 1 H, HC(6)), 7.19 (t, *J* = 7.8, 1 H, HC(5)), 6.72 (s, 1 H, HC(3)), 3.81 (s, 3 H, HC(1'')).

¹³C NMR: (125.6 MHz, CDCl₃)

147.0 (C(4')), 139.2 (C(1')), 139.2 (C(8)), 138.9 (C(9)), 129.5 (C(2)), 127.7 (C(2')), 123.9 (C(3')), 123.0 (C(5)), 121.0 (C(4)), 120.5 (C(6)), 109.9 (C(7)), 104.1 (C(3)), 31.5 (C(1''))

IR: 2924 (s), 2854 (s), 1594 (w), 1509 (w), 1462 (m), 1377 (w), 1341 (w), 1165 (w), 1107 (w), 1005 (w), 866 (w), 854 (w), 792 (w), 751 (w)

MS: (EI, 70 eV)

252 (100), 222 (25), 206 (40), 204 (25), 191 (17), 102 (9), 62 (21), 57 (3)

TLC: R_f 0.23 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: $C_{15}H_{12}N_2O_2$ (252.27)

Calculated: C, 71.42; H, 4.79; N, 11.10%

Found: C, 71.37; H, 4.77; N, 10.86%

Preparation of 2-(4'-Cyano-phenyl)-1-methyl-indole (7b) [JDB-VI-91]

Following General Procedure IV, a solution containing 192 mg (2.0 mmol, 2.0 equiv) of NaOt-Bu, 190 mg (1.0 mmol, 1.0 equiv) of CuI, 182 mg (1.0 mmol) of 1-bromo-4-nitrobenzene, 85 mg (0.2 mmol, 0.2 equiv) of dppb, and 52 mg (0.05 mmol, 0.05 equiv) of $\text{Pd}_2(\text{dba})_3\cdot\text{CHCl}_3$ in 600 μL of dry degassed toluene under an atmosphere of argon was prepared in a 5-mL round bottomed flask fitted with a reflux condenser. Following addition of the silanol solution, the mixture was stirred at 55 $^\circ\text{C}$ for 20 h, diluted with 60 mL of deionized H_2O , and 20 mL of EtOAc. The organic layer was separated, and the aqueous layer was washed with EtOAc (5 X 20 mL). Purification by column chromatography (SiO_2 (20mm), toluene) and recrystallization (hexane, 10 mL) afforded 168 mg (72%) of **7b** as a white solid.

Data for 7b:

mp: 161-162 $^\circ\text{C}$ (hexane)

$^1\text{H NMR}$: (500 MHz, CDCl_3)

7.76 (m, 2 H, HC(3')), 7.65 (m, 3 H, HC(2'), HC(4)), 7.39 (d, $J = 8.2$, 1 H, HC(7)), 7.30 (t, $J = 7.1$, 1 H, HC(6)), 7.18 (t, $J = 7.1$, 1 H, HC(5)), 6.66 (s, 1 H, HC(3)), 3.78 (s, 3 H, HC(1'))

¹³C NMR: (125.6 MHz, CDCl₃)
139.3 (C(1')), 139.0 (C(8)), 137.4 (C(3')), 132.3 (C(9)), 129.5 (C(2)), 127.7 (C(2')), 122.8 (C(5)), 120.9 (C(4)), 120.4 (C(6)), 118.8 (C(5')), 111.2 (C(4')), 109.8 (C(7)), 103.5 (C(3)), 31.5 (C(1''))

IR: 2924 (s), 2854 (s), 2224 (w), 1604 (w), 1465 (w), 1377 (w), 846 (w), 798 (w), 755 (w)

MS: (EI, 70 eV)
233 (M⁺, 23), 232 (100), 231 (36), 190 (14), 116 (7), 102 (8), 63 (5)

TLC: R_f 0.16 (hexane/EtOAc, 9/1) [silica gel, UV]

Analysis: C₁₆H₁₂N₂ (232.28)

Calculated:	C, 82.73;	H, 5.21;	N, 12.06%
Found:	C, 82.60;	H, 5.03;	N, 11.86%

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