Supporting information

Facile Synthesis of Trifluoroethyl Compounds by the Suzuki Cross-Coupling Reactions of CF_3CH_2OTs with Arylboronic Acids

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General methods

All manipulations were carried out in glass reaction tube equipped with a magnetic stir bar in an inert atmosphere. Unless otherwise mentioned, solvents and reagents were purchased from commercial sources and used as received, the solvent DMSO was distilled from CaH_2. Analytical thin-layer chromatography was performed using silica gel 60 GF254 plates. The transformation progress was indicated by GC (Shimadzu GC-2010 Plus) or GC-MS (Thermo Fisher Scientific DSQⅡ). The high resolution mass spectrum was received via Agilent Technologies 6540 UHD Accurate-mass Q-Tof LC/MS, with ESI as ion source. Moreover, NMR spectra were obtained on Bruker AVANCE III 400 systems using $CDCl_3$ as solvent, TMS as

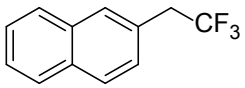
internal standard substance, with proton and carbon resonances at 400 and 100 MHz, respectively.

Experimental procedure

Representative procedure for the Pd-catalyzed trifluoroethylation of organoboronic acids.

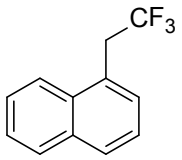
$Pd(OAc)_2$ (5.6 mg, 0.025 mmol, 5 mol%), palladacycle **Cat.1** (14.4 mg, 0.020 mmol, 4 mol%), NaI (225 mg, 1.5 mmol, 3.0 equiv), K_3PO_4 (318.0 mg, 1.5 mmol, 3.0 equiv), PPh_3 (1.3 mg, 0.005 mmol, 1 mol%), 2-naphthyl boronic acid (86.0 mg, 0.5 mmol, 1.0 equiv), CF_3CH_2OTs (381.0 mg, 1.5 mmol, 3.0 equiv) and DMSO (3 mL) were placed in dried glass reaction tube replaced air three times with argon. The reaction mixtures were stirred at 150°C for 4 hours. After the mixtures were cooled to room temperature and extracted with EtOAc and H_2O. The combined organic layer was washed with brine, and then dried over anhydrous Na_2SO_4. The solvent was evaporated under vacuum to afford the crude reaction mixture, and then purified by silica gel plates to produce the desired product **1a** in 54% yield as a white solid.

Characterization Data



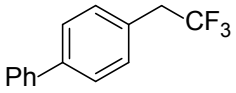
1a

2-(2,2,2-trifluoroethyl)naphthalene(1a, yield 54%): white solid，^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 7.90-7.80(m, 3H), 7.77(s, 1H), 7.56-7.45(m, 2H), 7.40(d, J = 8.7 Hz, 1H), 3.53(q, J = 10.8 Hz, 2H). ^{13}C NMR($CDCl_3$, 100 MHz): δ= 133.4, 133.0, 129.6, 128.5, 127.9, 127.8, 127.7, 127.6(q, J = 2.9 Hz), 126.6, 126.4, 126.0(q, J = 275.2 Hz), 40.5(q, J = 29.5 Hz). GC-MS(EI): 209.9 ($[M]^+$).



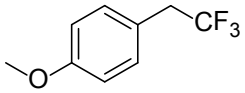
2a

1-(2,2,2-trifluoroethyl)naphthalene(2a, yield 50%): white solid, ^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 8.01（d, *J* = 8.4 Hz,1H）, 7.92-7.85(m, 2H), 7.61-7.44(m, 4H), 3.87(q, *J* = 10.6 Hz, 2H). ^{13}C NMR($CDCl_3$, 100 MHz): δ= 134.0, 132.5, 129.6, 129.2, 129.0, 126.7, 126.5, 126.2(q, *J* = 277.3 Hz), 126.0, 125.4(q, *J* = 2.3 Hz), 123.7, 36.9(q, *J* = 29.5 Hz). GC-MS(EI): 210.1 ($[M]^+$).



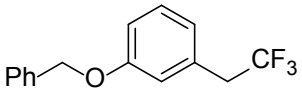
3a

4-(2,2,2-trifluoroethyl)-1,1'-biphenyl(3a, yield 52%): white solid, ^{1}H NMR ($CDCl_3$, 400 MHz, ppm): δ = 7.62-7.56(m, 4H), 7.48-7.42(m, 2H), 7.40-7.34(m, 3H), 3.41(q, *J* = 10.8 Hz, 2H). ^{13}C NMR(100 MHz, $CDCl_3$): δ= 141.2, 140.6, 130.7, 129.1(q, *J* = 2.9 Hz), 128.9, 127.6, 127.5, 127.3, 126.0(q, *J* = 276.6 Hz), 40.0(q, *J* = 30.0 Hz). GC-MS(EI): 235.9 ($[M]^+$).



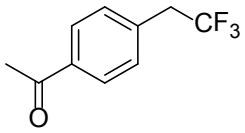
4a

1-methoxy-4-(2,2,2-trifluoroethyl)benzene(4a, yield 25%): colorless liquid, ^{1}H NMR(400 MHz, $CDCl_3$, ppm): δ= 7.22(d, *J* = 8.4 Hz, 2H), 6.90(d, *J* = 8.8 Hz, 2H), 3.81(s, 3H), 3.31(q, *J* = 10.8 Hz, 2H),. ^{13}C NMR(100 MHz, $CDCl_3$): δ = 159.4, 131.3, 125.9(q, *J* = 274.9 Hz), 122.2(q, *J* = 2.9 Hz), 114.1, 55.3, 39.3(q，*J* = 29.7 Hz). GC-MS(EI): 189.9 ($[M]^+$).



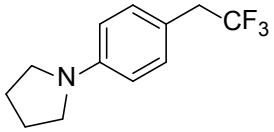
5a

1-(benzyloxy)-3-(2,2,2-trifluoroethyl)benzene(5a, yield 40%): white solid, ^{1}H NMR(400 MHz, $CDCl_3$, ppm): δ= 7.48-7.26(m, 6H), 7.02-6.86(m, 3 H), 5.08 (s, 2H), 3.35(q, *J* = 10.8 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 159.1, 136.9, 131.6(q, *J* = 2.8 Hz), 129.8, 128.7, 128.5(q, *J* = 276.3 Hz), 128.2, 127.7, 122.9, 117.1, 114.1, 70.2, 40.4(q, *J* = 29.9 Hz). GC-MS(EI): 266.0 ($[M]^+$).



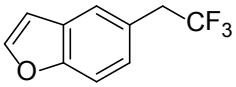
6a

1-(4-(2,2,2-trifluoroethyl)phenyl)ethanone(6a, yield 42%): white solid, ^{1}H NMR (400 MHz, $CDCl_3$, ppm): δ= 7.95(d, *J* = 8.0 Hz, 2H), 7.41(d, *J* = 8.0 Hz, 2H), 3.44(q, *J* = 10.8 Hz, 2H), 2.61(s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$, ppm): δ = 196.6, 135.9, 134.3, 129.4, 127.6, 124.4(q, *J* = 275.2 Hz), 39.1(q, *J* = 29.7 Hz), 25.6. GC-MS(EI): 201.9 ($[M]^+$).



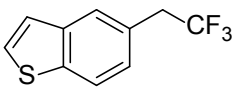
7a

1-(4-(2,2,2-trifluoroethyl)phenyl)pyrrolidine(7a, yield 41%): light yellow solid, ^{1}H NMR ($CDCl_3$, 400 MHz, ppm): δ= 7.13(d, *J* = 8.36 Hz, 2H), 6.53(d, *J* = 7.64 Hz, 2H), 3.32-3.19 (m, 6H), 2.04-1.96(m, 4H). ^{13}C NMR (100MHz, $CDCl_3$): δ = 147.7, 131.1, 126.1(q, *J* = 277.1 Hz), 116.5(q, *J* = 2.8 Hz), 111.7, 47.6, 39.4(q, *J* = 29.5 Hz), 25.6. GC-MS(EI): 229.0 ($[M]^+$).



8a

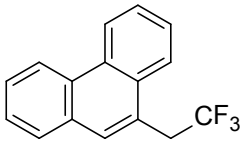
5-(2,2,2-trifluoroethyl)benzofuran(8a, yield 59%), colorless liquid, ^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 7.65(s, 1H), δ= 7.54(s, 1H), 7.49(d, *J* = 8.4 Hz, 1H), 7.22(d, *J* = 8.4 Hz, 1H), 6.76(s, 1H), 3.46(q, *J* = 10.7 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ= 154.7, 145.8, 127.9, 126.4, 126.1(q, *J* = 271.4 Hz), 124.6(q, *J* = 2.8 Hz), 122.9, 111.6, 106.6, 40.2(q, *J* = 29.7 Hz). GC-MS(EI): 199.9 ($[M]^+$).



9a

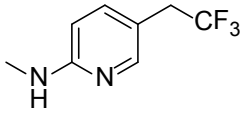
5-(2,2,2-trifluoroethyl)benzo[b]thiophene(9a, yield 46%): white solid, ^{1}H NMR ($CDCl_3$, 400 MHz, ppm): δ= 7. 87(d, *J* = 8.3 Hz,1H), 7.76(s, 1H), 7.48(d, *J* = 5.44 Hz ,1H), 7.32(d, *J* = 5.44 Hz ,1H), 7.27(d, *J* = 8.3 Hz ,1H), 3.49(q, *J* = 10.8 Hz, 2H). ^{13}C NMR(100 MHz, $CDCl_3$): δ= 140.0, 139.6, 127.4, 126.2(q, *J* = 2.8 Hz), 126.1, 126.0(q, *J* = 275.4 Hz), 125.4, 123.7, 122.8, 40.3(q, *J* = 29.4 Hz). GC-MS(EI):

215.8 ($[M]^+$).



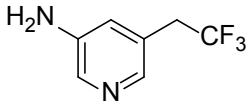
10a

9-(2,2,2-trifluoroethyl)phenanthrene(10a, yield 45%): white solid, ^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 8.80-8.75(m, 1H), 8.70(d, J = 8.1Hz, 1H), 8.08(d, J = 8.8 Hz, 1H), 7.89(dd, J_1 = 1.0 Hz, J_2 = 7.7 Hz, 1H), 7.77(s, 1H), 7.72-7.60(m, 4H), 3.92(q, J = 10.5 Hz, 2H). ^{13}C NMR($CDCl_3$, 100 MHz): δ= 131.2, 131.0, 130.9, 130.7, 130.6, 128.6, 127.6, 127.3, 127.1, 126.8, 126.2(q, J = 276.0Hz), 124.9(q, J = 2.7 Hz), 124.3(q, J = 1.5 Hz), 123.4, 122.7, 37.2(q, J = 30.0 Hz). GC-MS(EI): 259.0 ($[M]^+$).



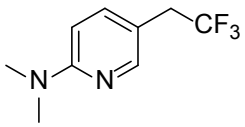
11a

N-methyl-5-(2,2,2-trifluoroethyl)pyridin-2-amine(11a, yield 51%): light yellow solid, ^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 7.96 (s,1H), 7.41 (dd, J_1 = 8.6 Hz，J_2 = 1.6 Hz, 1H), 6.42(d, J = 8.6 Hz, 1H), 4.97(s, 1H), 3.22(q, J = 10.7 Hz, 2H), 2.93(d, J = 5.12 Hz, 3H). ^{13}C NMR($CDCl_3$, 100 MHz,): δ= 159.3, 149.2, 139.1, 126.0(q, J = 275.0 Hz), 114.2(q, J = 2.7 Hz), 106.2, 37.0(q, J = 30.0 Hz), 29.1. LC-MS(ESI): m/z=235.1 $[M+H]^+$.



12a

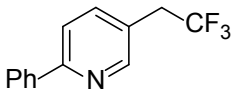
5-(2,2,2-trifluoroethyl)pyridin-3-amine(12a, yield 30%): light yellow liquid, ^{1}H NMR ($CDCl_3$, 400 MHz, ppm): δ= 8.05 (s, 1H), 7.92 (s, 1H), 6.91 (s, 1H), 3.77 (s, 2H), 3.28(q, J = 10.8 Hz, 2H). LC-MS(ESI): m/z=177.0 $[M+H]^+$.



13a

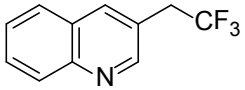
N,N-dimethyl-5-(2,2,2-trifluoroethyl)pyridin-2-amine(13a, yield 37%): light yellow solid, ^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 8.05(d, J = 2.2 Hz, 1H), 7.38 (dd, J_1 = 8.7 Hz, J_2 = 2.0 Hz, 1H), 6.5(d, J = 8.7 Hz, 1H), 3.24(q, J = 10.8 Hz, 2H), 3.09 (s ,6H) . ^{13}C NMR($CDCl_3$, 100 MHz): δ= 159.2, 149.2, 138.7, 125.9(q, J = 275.0

Hz), 112.8(q, J = 2.8 Hz), 105.7, 38.2, 36.8(q, J = 30.0 Hz). GC-MS(EI): 204.1 ($[M]^+$).



14a

2-phenyl-5-(2,2,2-trifluoroethyl)pyridine(**14a**, yield 46%): white solid, ^{1}H NMR ($CDCl_3$, 400 MHz, ppm): δ= 8.62(s, 1H), 8.00(d, J = 4.8 Hz, 2H), 7.78-7.68(m, 2H), 7.53-7.41(m, 3H), 3.44 (q, J = 10.6Hz, 2H). ^{13}C NMR ($CDCl_3$, 100 MHz): δ= 157.5, 151.0, 138.7, 138.4, 129.4, 128.9, 127.0, 125.5 (q, J = 275.3 Hz), 124.3(q, J = 2.7 Hz), 120.4, 37.5 (q, J = 30.3 Hz). GC-MS(EI): 237.0 ($[M]^+$).



15a

3-(2,2,2-trifluoroethyl)quinolone(**15a**, yield 37%): light yellow solid, ^{1}H NMR($CDCl_3$, 400 MHz, ppm): δ= 8.85(s, 1H), 8.20-8.10(m, 2H), 7.85(d, J = 8.1 Hz, 1H), 7.80-7.73(m, 1H), 7.60(t, J = 7.2 Hz, 1H), 3.59(q, J = 10.6 Hz, 2H). ^{13}C NMR($CDCl_3$, 100 MHz): δ= 171.2, 151.5, 147.7, 137.2, 130.0, 129.5, 129.3，127.7, 127.2, 125.4(q, J = 274.7 Hz), 37.9(q, J = 30.1 Hz). GC-MS(EI): 211.1 ($[M]^+$).