
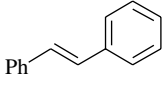

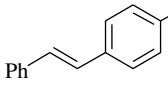

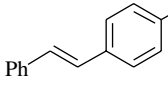

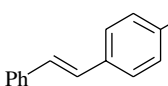

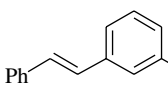

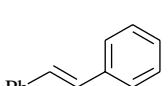



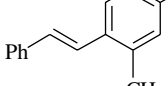


Table 1. Microwave enhanced cross-coupling reaction of potassium *trans*-2-phenylvinyltrifluoroborate, **1** with iodobenzenes^a

Entry	Aryl iodide, 2	Product, 3	Yield (%)
1	 2a	 3a	67
2	 2b	 3b	61
3	 2c	 3c	99
4	 2d	 3d	91
5	 2e	 3e	76
6	 2f	 3f	79
7	 2g	 3g	96
8	 2h	 3h	92

^a All yields are of pure products isolated by silica gel chromatography.

3.0 equiv of Hünig's base (*i*-Pr₂NEt), in isopropanol/water (2:1) was found to provide the coupled products in good to excellent yields.⁸ In the absence of a palladium catalyst, no coupling product was observed. The reactions are very straightforward stereoselective and relatively insensitive to the nature of the substituents. Reagents containing electron withdrawing groups (Table 1, entries 2–5), electron donating groups (Table 1, entries 6–8) all provide the cross-coupled styrene products in high yields. Having successfully utilized microwaves to enhance Suzuki coupling of potassium *trans*-2-phenylvinyltrifluoroborate with aryl halides, we then investigated the use of other substituted potassium arylvinyltrifluoroborates (Table 2). All reactants provided the cross-coupled stilbene products in excellent yields (Table 2, entries 1–6). An aliphatic vinyltrifluoroborate also readily participated in the reaction (Table 2, entry 7). Yields were generally somewhat lower for coupling reactions involving the alkynyl trifluoroborates; a situation also noted in thermal coupling reactions^{3f} (Table 2, entries 8–13).

The reactions are rapid and simple to perform. In a typical experiment, the organotrifluoroborate⁹ (0.50 mmol) and palladium catalyst (0.01 mmol) are placed in an argon flushed pyrex tube. The aryl halide (0.50 mmol) is then added along with diisopropyl ethyl amine (1.5 mmol) and 5 mL of isopropanol/water (2:1). The pyrex tube is capped with a rubber septum and placed in a CEM microwave unit and allowed to react at 100 °C for 10 min. The product is worked up by adding water (15 mL) and ether (15 mL), the ether layer separated, the solvent extracted, and the product isolated by column chromatography. The product yields generally exceed those obtained in the thermal reactions by ~10%³ⁱ whereas the coupling yields are similar for thermal reactions generating alkyne products.^{3j,k}

Table 2. Microwave enhanced cross-coupling reactions for the synthesis of styrenes and enynes^a

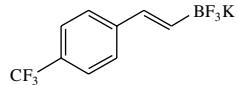

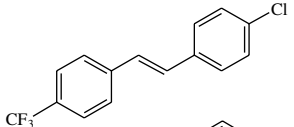
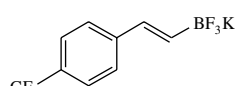

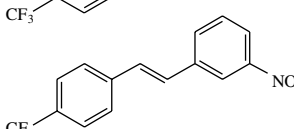
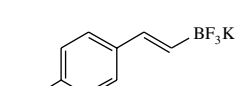

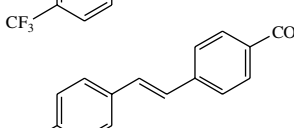
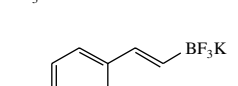

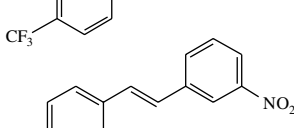
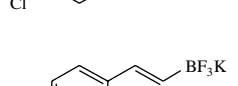

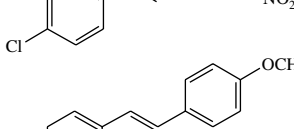
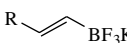
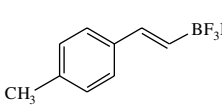
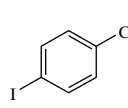
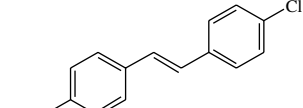
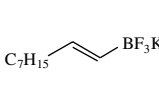
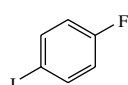
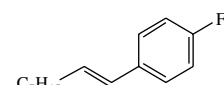
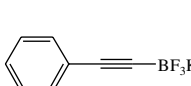
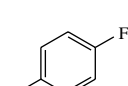
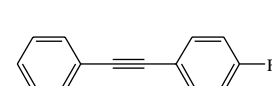
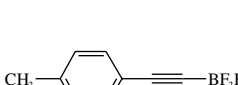
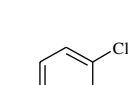
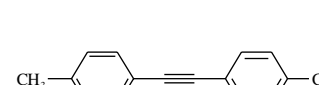

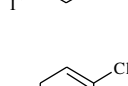
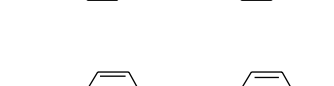
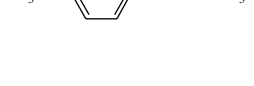
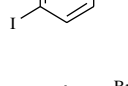
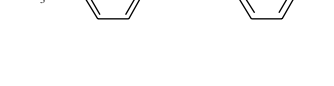
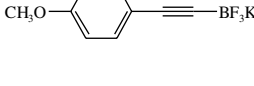
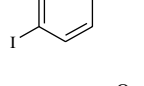
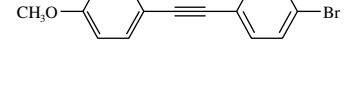
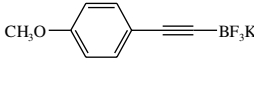
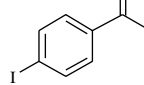
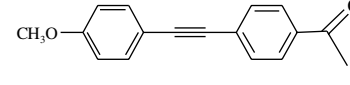
Entry	R-CH=CH-BF ₃ K	Aryl iodide	Product ^b	Yields (%)
1				92
2				81
3				95
4				87
5				85

Table 2 (continued)

Entry	R-  BF ₃ K	Aryl iodide	Product ^b	Yields (%)
6				94
7				91
8				60
9				65
10				68
11				72
12				69
13				52

^a All yields are of pure products isolated by silica gel chromatography.

^b Satisfactory combustion analyses were obtained for all new compounds.¹⁰

Acknowledgments

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References and notes

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8. Pd₂dba₃·CHCl₃/dppf, Pd₂dba₃/(*o*-toyl)₃, Pd(OAc)₂/dppf, and Pd(OAc)₂ were found to be less effective. Bases evaluated included diisopropylamine, cesium carbonate, potassium carbonate, and triethylamine.
9. The trifluoroborates were prepared according to the literature procedures. See, for example: Vedejs, E.; Chapma, R. W.; Fields, S. C.; Lin, S.; Schrimpf, M. R. *J. Org. Chem.* **1995**, *60*, 3020, and Ref. 3f.
10. Analytical data for new compounds: 4'-Chloro-4-trifluoromethyl-*trans*-stilbene: ¹H NMR (CDCl₃, 300 MHz): δ 7.56 (m, 4H, -C₆H₄), 7.43 (d, *J* = 8.7 Hz, 2H, -C₆H₄), 7.31 (d, *J* = 8.7 Hz, 2H, -C₆H₄), 7.05 (m, 2H). ¹³C NMR (CDCl₃, 75.5 MHz): δ 140.3, 135.0, 133.8, 129.7, 128.9, 127.6, 125.6. ¹⁹F NMR (CDCl₃, 282.3 MHz): δ -62.8. Calcd for C₁₅H₁₀F₃Cl: C, 63.73; H, 3.57. Found: C, 63.84; H, 3.53. 4'-Acetyl-4-trifluoromethyl-*trans*-stilbene: ¹H NMR (CDCl₃, 300 MHz): δ 7.97 (m, 2H), 7.61 (m, 6H), 7.21 (s, 2H), 2.61 (s, 3H). Calcd for C₁₇H₁₃OF₃: C, 70.34; H, 4.51. Found: C, 70.31; H, 4.45. 1-Fluoro-4-non-1-enylbenzene: ¹H NMR (CDCl₃, 300 MHz): δ 7.25 (m, 2H), 6.96 (m, 2H), 6.32 (d, *J* = 15.9 Hz, 1H), 6.13 (dt, *J* = 15.9, 6.9 Hz, 1H), 2.18 (q, *J* = 7.2 Hz, 2H), 1.47–1.25 (m, 10H), 0.88 (t, *J* = 6.9 Hz, 3H). ¹³C NMR (CDCl₃, 75.5 MHz): δ 163.4, 134.0, 130.9, 128.4, 127.2, 115.3, 32.9, 31.8, 29.7, 29.3, 22.6, 14.1. Calcd for C₁₅H₂₁F: C, 81.77; H, 9.61. Found: C, 81.21; H, 9.94.