Regiospecific Functionalization of Methyl C-H Bonds of Allkyl Groups in Reagents with Heteroatom Functionality

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and John F. Hartwig

JACS, **2004**, *126*, 15334

Examples of C-H Activation

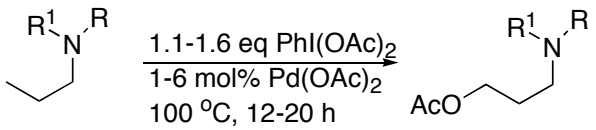
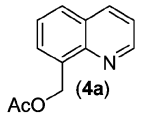
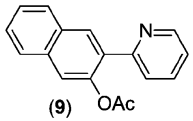
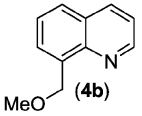
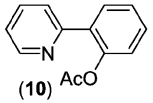
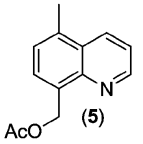
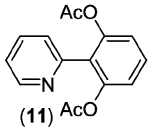
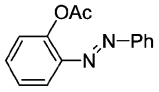
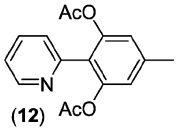
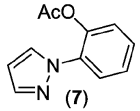
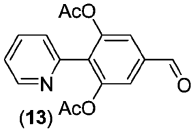
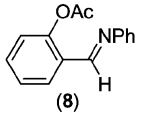


Table 2. Chelate-Directed Oxidation of sp^2 and sp^3 C−H Bonds[a,b]

Entry	Major Product	Yield[c]	Entry	Major Product	Yield[c]
1	 (4a)	88%	7	 (9)	72%
2	 (4b)	77%	8	 (10)	52%
3	 (5)	80%	9	 (11)	83%
4	 (6)	62%	10	 (12)	78%
5	 (7)	54%	11	 (13)	58%
6	 (8)	47%[d]			

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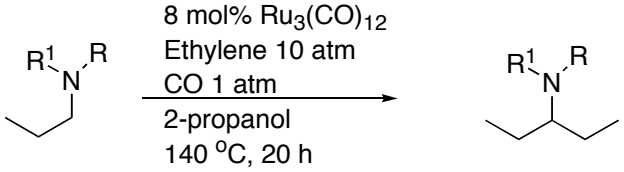
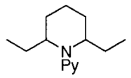
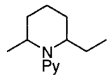
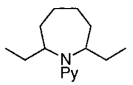
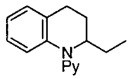
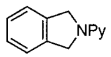
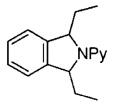
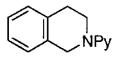
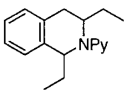


entry	substrate	products [b,c]
1	 4	 5 73% (60/40)
2	 6	 7 75% (63/37)
3	 8	 9 47%  10 14% (52:48)
4	 11	 12 73%
5	 13	 14 90% (80:20)
6[d]	 15	 16 85% (76:24)

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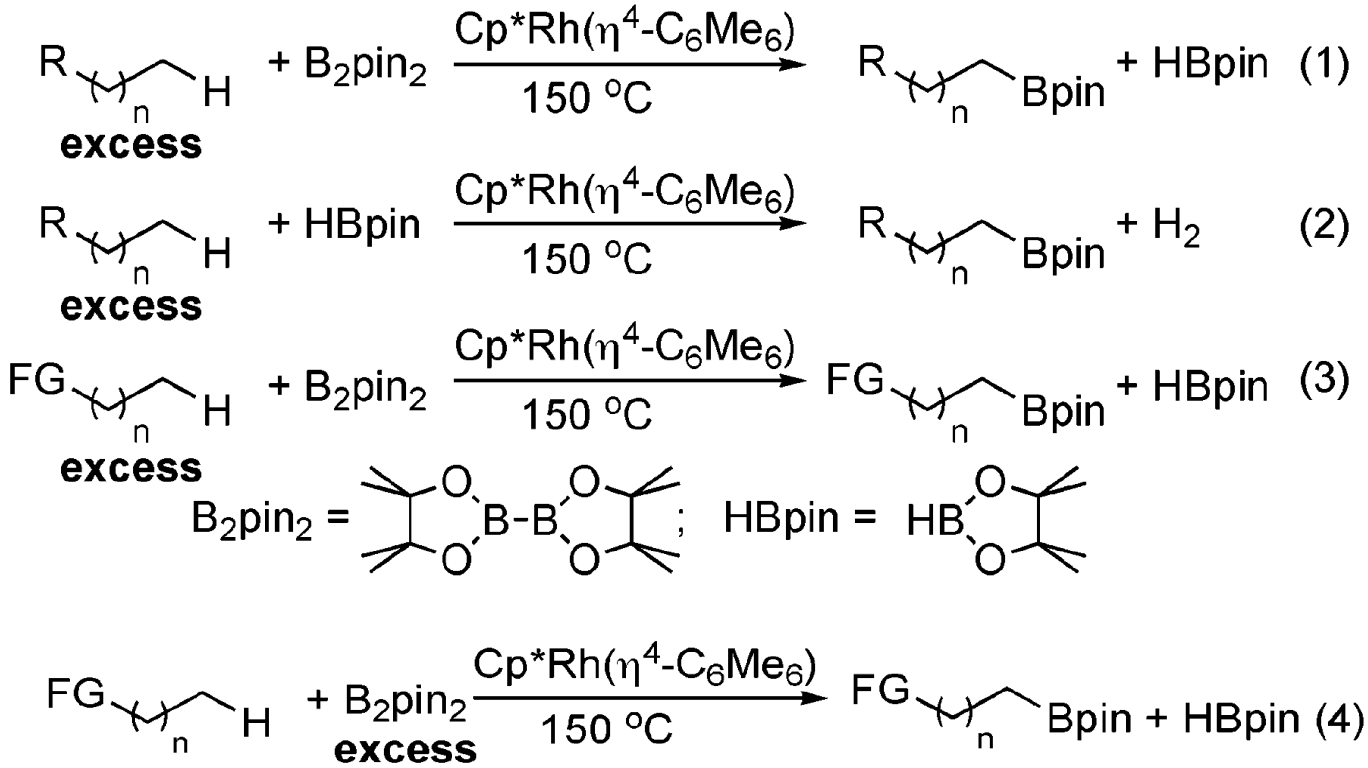
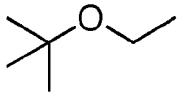
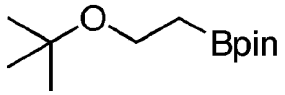
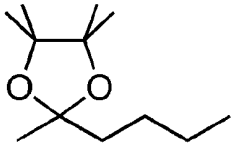
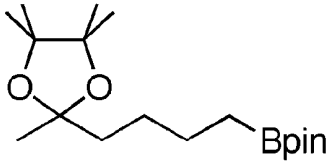
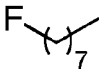
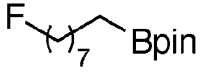
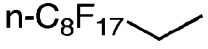
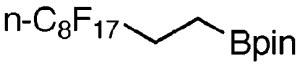
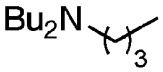
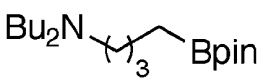
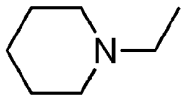
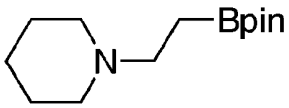
The Goal of this Work

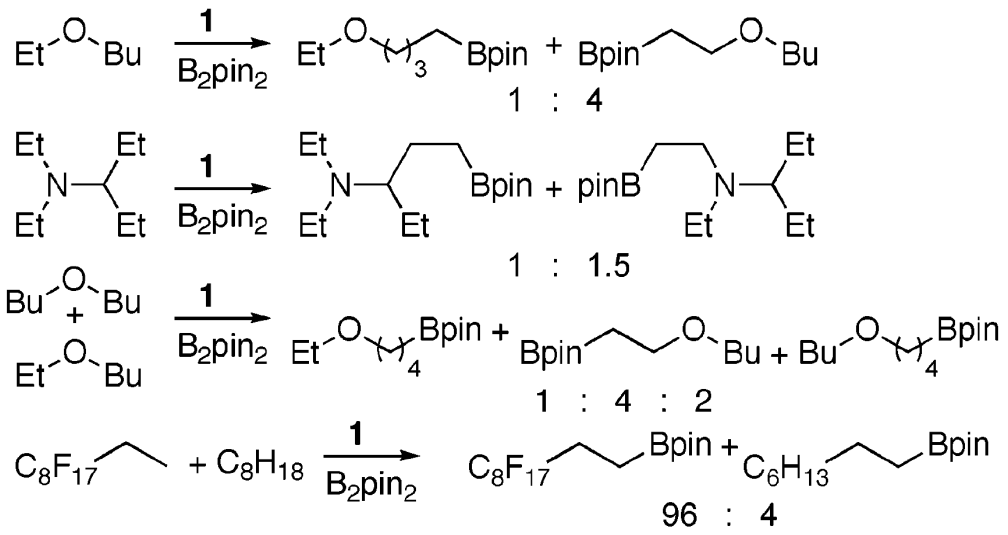


Reactant	Product	reactant: B_2pin_2	mol% **1**	Yield(%)[b]
		10:1	5	91
		1:1	10	48[c]
		10:1	5	74
		1:2	17	70
		10:1	5	83[d]
		1:2	10	46
		10:1	5	90
		1:2	10	84
		10:1	5	75[e]
		1:1	10	33
		10:1	5	55[e]
		1:2	10	67

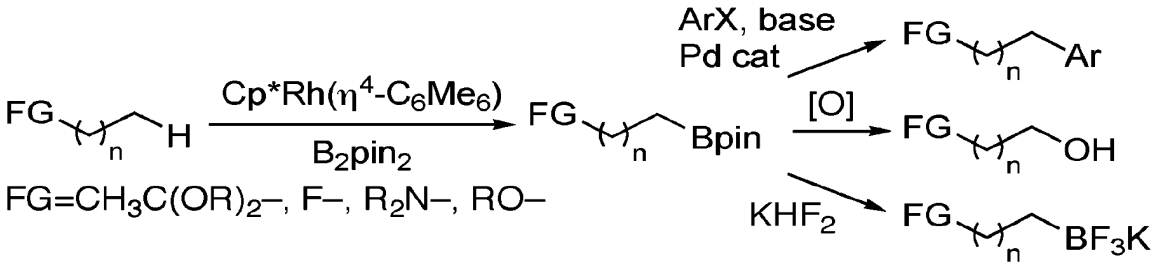
[a] Conditions: B_2pin_2, **1**, neat, 150 °C, 24 h. [b] Yields calculated by GC areas. [c] In cyclohexane solvent (3 equiv). [d] 140 °C, 12 h. [e] Yield based on conversion to H_2.

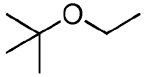
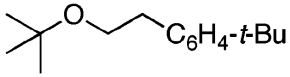
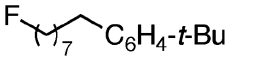
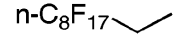
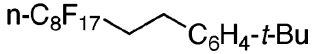
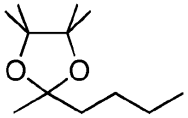
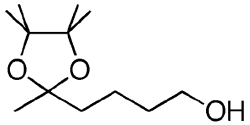
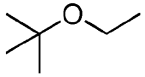
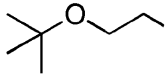
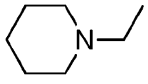
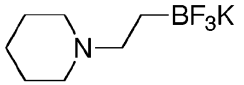
Electronic Effects on Selectivity

Scheme 1



Functionalization of Bpin Alkanes



Entry	Reactant	Product	Cond.[a]	Yield(%)
1			A,B	87[b]
2			A,C	29[b]
3			A,B	64[b]
4			A,D	68[c]
5			A,E	86[c]
6			A,E	69[c,d]

[a] Conditions: (A) B_2pin_2, 5 mol % **1**, neat, 150 °C; (B) 1-bromo-4-*tert*-butylbenzene (2 equiv), CsOH (4 equiv), $Pd(dba)_2$ (10 mol %), and $Fc(P^iPr_2)_2$ (10 mol %) in toluene, 100 °C; (C) Same as B, but CsF and DMF used in place of CsOH and toluene; (D) H_2O_2 and KOH in THF and H_2O; (E) KHF_2 in MeOH. [b] Yields calculated by GC. [c] Yields calculated by ^1H NMR. [d] Yield based on the reaction of B_2pin_2 with R−H to form R−Bpin and H_2.