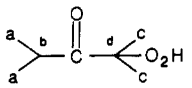
2[8], **3**[8], and **4**[7] were prepared by low-temperature reactions of the starting ketones with O_2 and KO-*t*-C_4H_9. The high purity of **2** was shown by ^{13}C NMR analysis:



C(e), 218.26; C(d), 87.95; C(b), 33.82; C(c), 21.13; C(a), 19.71. All hydroperoxide compounds used exhibited ^1H NMR resonances assignable to the OOH group: **2**, 8.70; c-$C_6H_{11}O_2H$, 8.40; *n*-$C_5H_{11}O_2H$, 8.54; and *t*-$C_4H_9O_2H$, 8.98 ppm. By use of bis(trimethylsilyl)acetamide derivatization, it was possible to detect GC/MS parent and parent − CH_3 m/e signals for four of the hydroperoxides: 2-methylcyclohexanone hydroperoxide, 216, 201; c-$C_6H_{11}O_2H$, 188,173; *t*-$C_4H_9O_2H$, 162,147; *n*-$C_5H_{11}O_2H$, 176,161.

Rates of reaction of Co^{2+} and Co^{3+} with the various alkyl hydroperoxides were followed by recording increases or decreases in absorbance at 610 nm (Co^{3+}) in HOAc and at 700 cm (Co^{3+}) in decalin. The starting concentrations of alkyl hydroperoxide solutions were determined by standardization with $NaI/Na_2S_2O_3$. Rates of reactions of the alkyl hydroperoxides with PPh_3 and *n*-$(C_4H_9)_4NI$ were followed by recording decreases in absorbance maxima for PPh_3 (260 nm) and increases for I_2 at 355 nm.

Numerous attempts to isolate α-ketocyclohexyl hydroperoxide (**1**) were unsuccessful. Preparative procedures included reaction of 0.16 M cyclohexanone with 0.36 M KO-*t*-C_4H_9 and O_2 in glyme/*t*-C_4H_9OH at −50 °C,[8] reaction of neat cyclohexanone with O_2 at 100 °C[6a], and reaction of neat cyclohexanone containing 1% *t*-$C_4H_9OOCOtC_4H_9$ at 100 °C.[6b] None of the product solutions contained more than trace amounts of **1**, based on NaI titration.

Acknowledgment. The able technical assistance of D. F. Oldham, E. Fok, and G. F. Diffendal is grateful acknowledged. Accurate mass measurements were done by Fulton Kitson.

Registry No. **1**, 50915-79-2; **2**, 3944-52-3; **2**·K, 112270-30-1; **3**, 21961-02-4; **3**·K, 112270-31-2; **4**, 5143-76-0; **4**·K, 112270-32-3; $Co(OAc)_2$, 71-48-7; NaBr, 7647-15-6; c-$C_6H_{11}ON{=}NO$-c-C_6H_{11}, 82522-48-3; $(2\text{-}C_4H_9OC(O)O)_2$, 19910-65-7; c-$C_6H_{11}O_2H$, 766-07-4; *n*-$C_5H_{11}O_2H$, 74-80-6; *t*-$C_4H_9O_2H$, 75-91-2; *n*-$C_5H_{11}OSO_2CH_3$, 6968-20-3; $(CH_3)_2CHC(O)CH(CH_3)_2$, 565-80-0; $CH_3C(O)CH(CH_3)_2$, 563-80-4; c-$C_6H_{11}OOSiMe_3$, 112296-48-7; *t*-$C_4H_9OOSiMe_3$, 3965-63-7; *n*-$C_5H_{11}OOSiMe_3$, 89131-58-8; PPh_3, 603-35-0; (*n*-$C_4H_9)_4NI$, 311-28-4; I^-, 20461-54-5; Co^{2+}, 22541-53-3; Co^{3+}, 22541-63-5; Co-$(O_2CC_7H_{15})_2$, 1588-79-0; cyclohexanone, 108-94-1; cyclohexene, 110-83-8; cyclohexene oxide, 286-20-4; 2,4,6-tri-*tert*-butylphenol, 732-26-3; *cis*-2-octene, 7642-04-8; *trans*-2-methyl-3-pentyloxirane, 28180-70-3; *cis*-2-methyl-3-pentyloxirane, 23024-54-6; cyclohexylmagnesium chloride, 931-51-1; 2-methylcyclohexanone, 583-60-8; 1-oxo-2-methyl-2-cyclohexyl trimethylsilyl peroxide, 112270-33-4.

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[13] Williams, H. R.; Mosher, H. S. *J. Am. Chem. Soc.* **1954**, *76*, 2984.

Communications

On the Formation of Biaryls in Aromatic Nitration. The Role of the Nitrosonium Ion[1,2]

Summary: $NOBF_4$ and NO_2 in CH_2Cl_2/CF_3COOH mixtures were found to be efficient catalysts for the synthesis of certain biaryls via an oxygen-promoted oxidative dimerization step. The need for better control of the presence, role, and action of NO^+ in aromatic nitration reactions was pointed out.

Sir: Many of the common side reactions in electrophilic aromatic nitration (EAN) are of the oxidative substitution type[3] and can in some cases be suspected to proceed via an initial electron transfer (ET) step.[4] As an example, the formation of biaryls upon anodic oxidation of aromatics (eq 1) is mediated by radical cations[5] and hence the formation of biaryls can be taken as evidence *in favor* of an initial ET step in EAN (eq 2).

$$\mathrm{ArH} \xrightarrow[\text{anode}]{-e^-} \mathrm{ArH}^{\bullet+} \xrightarrow{\mathrm{ArH}} \xrightarrow{-e^-,\,-2H^+} \mathrm{ArAr} \qquad (1)$$

$$\mathrm{ArH} \xrightarrow{NO_2^+} \mathrm{ArH}^{\bullet+}NO_2 \xrightarrow{-NO_2} \mathrm{ArH}^{\bullet+} \xrightarrow[2.\ -e^-,\ 2H^+]{1.\ \mathrm{ArH}} \mathrm{ArAr} \qquad (2)$$

Table I. Reactions of Substituted Naphthalenes with $NOBF_4$ in CF_3COOH/CH_2Cl_2 Mixtures ([ArH] = [$NOBF_4$] = 0.04 M[a])

1-X-$C_{10}H_7$	consumed ArH, % (yield of ArAr, %)			
	20% CF_3COOH/CH_2Cl_2		80% CF_3COOH/CH_2Cl_2	
X =	1 h	20 h	1 h	20 h
CN	0 (0)	0 (0)	0 (0)	0 (≈0)
Br	10 (1)	28 (8)[b]	32 (6)	77 (43)
H	40 (0)	59 (0)	78 (0)	100 (0)
CH_3	82 (54)	100 (41)	100 (56)	
OCH_3	100 (41)			

[a] Reaction of 1.00 mmol of ArH in 20 (5) mL of CH_2Cl_2 with 1.00 mmol of $NOBF_4$ suspended in 5 (20) mL of CF_3COOH in tightly stoppered, magnetically stirred 25-mL Erlenmeyer flasks at 20 °C. [b] After 120 h: 46 (27).

However, the evidence *against* the action of NO_2^+ as a powerful outer-sphere ET oxidant[4,6] nowadays must be regarded as fairly substantial, and we have therefore suggested either or both of two other routes to be responsible for the formation of radical cations under EAN conditions[4,6b] (eq 3 and 4).

inner-sphere ET:

$$\mathrm{ArH} + NO_2^+ \rightarrow \mathrm{Ar}^+(\mathrm{H})NO_2 \xrightarrow{-NO_2} \mathrm{ArH}^{\bullet+} \qquad (3)$$

oxidation by NO^+:

$$\mathrm{ArH} + NO^+ \rightarrow \mathrm{ArH}^{\bullet+} + NO \qquad (4)$$

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[1] Aromatic Nitration via Electron Transfer. 7. Part 6, see ref 4.

[2] Presented at the EUCHEM Conference on "Electron Transfer Reactions in Organic Chemistry", Visby, Sweden, June 1987.

[3] Suzuki, H. *Synthesis* **1977**, 217. Examples include quinone formation, nitrooxylation, biaryl coupling, and side-chain substitution reactions. 4,4′-Dimethoxy-1,1′-binaphthyl was reported as the sole product in a NO_2^+-based nitration of 1-methoxynaphthalene. Alcorn, P. G. E.; Wells, P. R. *Aust. J. Chem.* **1965**, *18*, 1391.

[4] Eberson, L.; Radner, F. *Acc. Chem. Res.* **1987**, *20*, 53.

[5] Eberson, L.; Nyberg, K. *Acc. Chem. Res.* **1973**, *6*, 106.

[6] Eberson, L.; Radner, F. (a) *Acta Chem. Scand.* **1984**, *38*, 861; (b) **1985**, *39*, 357; (c) **1985**, *39*, 343.

Table II. Effect of Reaction Conditions on the Biaryl Coupling of 1-Methoxynaphthalene[a]

source of NO_x[b]	ratio ArH/NO_x	atmosphere[c]	mmol ArAr formed	mmol ArH recovered	yield based on NO_x[19] (%)	material balance (%)
$NOBF_4$	20	argon	0.02	0.96	40	100
$NOBF_4$	20	air	0.48	0.00	960	96
$NOBF_4$	20	oxygen	0.24	0.00	480	48
$NOBF_4$	100	air	0.27	0.46	2700	100
NO_2	20	argon	0.01	1.00	20	102
NO_2	20	air	0.35	0.28	700	98

[a] Reaction of 1.00 mmol of 1-methoxynaphthalene for 20 min with 0.01–0.05 mmol of $NOBF_4$ (NO_2) in 8 mL of CH_2Cl_2/2 mL of CF_3COOH in different atmospheres at 20 °C. Reactions were performed in 25-mL Erlenmeyer flasks and with magnetical stirring. [b] $NOBF_4$ initially dissolved in CF_3COOH; NO_2 initially dissolved in CH_2Cl_2. [c] A gentle stream of Ar, a balloon filled with O_2, and an ordinary drying tube to furnish the ambient air, respectively.

The presence of NO^+ and/or lower oxides of nitrogen[7] in any sample of nitric acid that has not been carefully purified as well as in most, if not all, commercial samples of nitronium salts[8] calls for some attention to what roles NO^+ can exert in EAN. This paper demonstrates that eq 4 provides a reasonable explanation for the formation of biaryls (and polymerization products) in EAN and describes how NO^+ or NO_2 can be used as catalysts in a highly efficient biaryl synthesis, in which oxygen is used as the stoichiometric oxidant.

The action of $NOBF_4$ on readily oxidizable aromatics,[9] e.g. pyrene, has generally resulted in the formation of the corresponding radical cation salt,[6,10] whereas with less readily oxidizable aromatics, e.g. mesitylene, charge-transfer complexes were formed.[11,12] Treatment of naphthalene with $NOBF_4$ in CH_2Cl_2/sulfolane caused no reaction,[6a] whereas in CF_3COOH polymer formation was observed.[15] It therefore appeared appropriate to investigate the action of $NOBF_4$ on some substituted naphthalenes (1-X-$C_{10}H_7$; X = OCH_3, CH_3, H, Br, CN) in media of varying acidity.[16]

Table I summarizes the reactions of equimolar amounts of $NOBF_4$ and the naphthalenes in mixtures of CH_2Cl_2 and CF_3COOH. The rate of consumption parallels the ease of oxidation of the ArH and increases as the acidity of the system increases.[17] The use of stoichiometric amounts of $NOBF_4$ has a detrimental effect on the reaction as demonstrated by the low ratios of consumed ArH to formed ArAr.[18] Increasing the ArH:NO^+ ratio to 2:1 has only a limited improving effect on the yields and mass balances. With X = CH_3 and OCH_3 strange color phenomena and lower yields were observed when the reaction mixtures were exposed to air. The reactions were therefore suspected of being promoted by oxygen, as confirmed by the results presented in Table II.

When mixtures of X = OCH_3 and 1–5 mol % of $NOBF_4$ in 20% CF_3COOH/CH_2Cl_2 were exposed to air via a drying tube, the biaryl was formed in quantitative yields. Yields based on NO^+ were 1000–4000%,[19] to be compared with <50% when the reactions were performed under argon. The use of neat oxygen was not advantageous; yields were actually lowered due to further oxidations.[20] With X = CH_3 similar results were observed; in air a 520% yield based on NO^+ was found. Other suitable substrates for this coupling reaction are the polyalkoxybenzenes; e.g., starting with 1,2,4-trimethoxybenzene, 2,2′,4,4′,5,5′-hexamethoxybiphenyl could be isolated in 92% substance yield.

When the source of NO_x was changed to NO_2/N_2O_4 the same general reaction pattern persisted, demonstrating the rapid interconversion between the lower oxidation states of nitrogen in this system.[21] The catalytic reaction can at present best be represented as follows (eq 5–7):

$$2ArH + 2NO^+ \rightarrow ArAr + 2NO + 2H^+ \qquad (5)$$

$$2NO + 2H^+ + 0.5O_2 \rightarrow 2NO^+ + H_2O \qquad (6)$$

$$2ArH + 0.5O_2 \rightarrow ArAr + H_2O \qquad (7)$$

Note that by replacing NO + $^1/_2O_2$ with NO_2 in eq 6, one possible explanation for the catalytic action of NO_2 emerges.

Biaryl coupling is only one of the possible side reactions in aromatic nitration that can be initiated by NO^+. Another example is nitrous acid catalyzed nitration and since nitroaromatics can be formed via this route, great care must be taken when analyzing data from the EAN of aromatics easier to oxidize than mesitylene. We therefore

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(7) Ross, D. S.; Moran, K. D.; Malhotra, R. *J. Org. Chem.* **1983**, *48*, 2120.

(8) Elsenbaumer, R. L. *J. Org. Chem.*, in press.

(9) $E°$ for the NO^+/NO couple is 1.51 V vs NHE in CH_3NO_2 (Cauquis, G.; Serve, D. *C.R. Séances Acad. Sci., Ser. C* **1968**, *267*, 460). In CH_2Cl_2/sulfolane rapid ET from pyrene ($E°$ = 1.60 V) was observed whereas in the case of mesitylene ($E°$ = 2.43 V) no ET occurred.[6a]

(10) Bandlish, B. K.; Shine, H. J. *J. Org. Chem.* **1977**, *42*, 561.

(11) (a) Hunziker, E.; Penton, J. R.; Zollinger, H. *Helv. Chim. Acta* **1971**, *54*, 2043. (b) Milligan, B. *J. Org. Chem.* **1983**, *48*, 1495.

(12) These CT complexes do not undergo[13] light-induced internal ET with subsequent radical coupling in the way the corresponding ArH–$C(NO_2)_4$ CT complex does.[14]

(13) Radner, F., unpublished results.

(14) Sankararaman, S.; Kochi, J. K. *Recl. Trav. Chim. Phys-Bas* **1986**, *105*, 278.

(15) Morkovnik, A. S.; Okhlobystin, O. Y. *J. Gen. Chem. USSR (Engl. Transl.)* **1985**, *55*, 616.

(16) The effect of acidity on the oxidizing power of NO^+ has been under discussion for some time, see ref 4.

(17) With naphthalene the following results were obtained after 1 h (% CF_3COOH, % consumed ArH): 0, 0; 20, 40; 80, 78; 100, 100. The yields and material balances were determined by GC (2.5 m, 5% OV 1701 on Chrom WHP; $C_{18}H_{38}$ internal standard) unless otherwise noted.

(18) 2ArH + $2NO^+$ → ArAr + 2NO; ArAr + NO^+ → oligomeric products; ArAr = 4,4′-di-X-1,1′-dinaphthyl. With X = H, i.e., naphthalene, solely polymeric products were formed.

(19) Yield based on NO^+ defined as (mmol ArAr formed)/(mmol NO^+ added) × 100.

(20) The detrimental effect of neat oxygen was decreased when the reaction was performed on a larger scale. Treatment of 10 mmol ArH, X = OCH_3, with 0.1 mmol of $NOBF_4$ in 80 mL of CH_2Cl_2/20 mL of CF_3COOH in a flask equipped with an oxygen-filled balloon for 24 h resulted in complete conversion and gave, after workup, ArAr in 70% yield (3500% based on NO^+). Also note that some ArH may be lost via other routes as well; e.g., reaction of $ArH^{\bullet+}$ with O_2. We are presently investigating this possibility.

(21) NO_2/N_2O_4 dissociates ionically to NO^+/NO_3^- in dilute solutions of strong acids (Addison, C. C. *Chem. Rev.* **1980**, *80*, 21). $[NO_2]$ is probably very low in experiments 5 and 6, Table II, since no nitromethoxynaphthalenes were detected. (For the formation of $ArNO_2$ from ArH + NO_2 or $ArH^{\bullet+}$ to NO_2, see ref 4, 6b,c, and 14.)

(22) Other reagents for oxidative biaryl coupling include (apart from electrochemical methods[23a]) $FeCl_3$,[23b] $Tl(OCOCF_3)_3$,[23c] and $Ru(OCOCF_3)_4$.[23d] These reagents generally have a greater oxidizing power and are hence applicable to a larger number of substrates. The present method appears advantageous for the more readily oxidizable substrates.

(23) (a) Nyberg, K. In *Organic Electrochemistry*; Baizer, M., Ed.; Marcel Dekker: New York, 1972; Chapter 20. Anderson, J. T.; Stocker, J. H. In *Organic Electrochemistry*; Baizer, M., Lund, H., Eds.; Marcel Dekker: New York, 1983; Chapter 21. (b) Nyberg, K. *Chem. Scr.* **1974**, *5*, 115, 120. Jempty, T. C.; Gogings, K. A. Z.; Mazur, Y.; Miller, L. L. *J. Org. Chem.* **1981**, *46*, 4545. (c) McKillop, A.; Turell, A. G.; Young, D. W.; Taylor, E. C. *J. Am. Chem. Soc.* **1980**, *102*, 6504, 6513. (d) Landlais, Y.; Lebrun, A.; Robin, J. P. *Tetrahedron Lett.* **1986**, *27*, 5377.

suggest that in all reports on nitration of reactive aromatics, a description of the method of removal of lower NO_x species should be included. For nitronium salt nitrations the method of Elsenbaumer[8] is recommended whereas with the HNO_3-based reagents NaN_3 may be the scavenger of choice.[24] Note that urea normally is not powerful enough as NO_x scavenger under these circumstances.

Finally, it may be noted that the present catalytic system in principle can be used for other applications, e.g. according to the scheme

$$2ArH + O_2 + 2HX \xrightarrow{NO^+} 2ArX + 2H_2O$$

We are presently investigating the scope and utility of these reactions.

Acknowledgment. I thank Professor Lennart Eberson for stimulating discussions, Dr. Roland L. Elsenbaumer for kindly providing a preprint, and the Swedish Natural Science Research Council for financial support.

Registry No. 1-$BrC_{10}H_7$, 90-11-9; 1-$HC_{10}H_7$, 91-20-3; 1-$CH_3C_{10}H_7$, 90-12-0; 1-$OCH_3C_{10}H_7$, 2216-69-5; $NOBF_4$, 14635-75-7; NO_2, 10102-44-0; N_2O_4, 10544-72-6; 4,4′-dibromo-1,1′-binaphthyl, 49610-35-7; 4,4′-dimethyl-1,1′-binaphthyl, 19224-41-0; 4,4′-dimethoxy-1,1′-binaphthyl, 19817-09-5; 1,2,4-trimethoxybenzene, 135-77-3; 2,2′,4,4′,5,5′-hexamethoxybiphenyl, 14262-07-8.

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[24] See, e.g.: Clemens, A. H.; Ridd, J. H.; Sandall, J. B. P. *J. Chem. Soc., Perkin Trans. 2* **1985**, 1227. Fitzpatrick, J.; Meyer, T. A.; O'Neill, M. E.; Williams, D. L. H. *Ibid.* 1984, 927.

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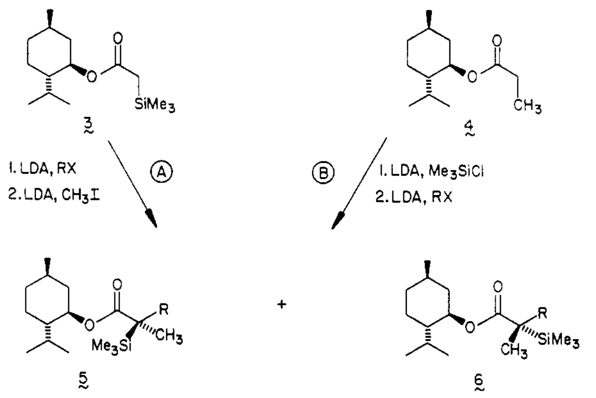
Optically Enriched Alkyltrimethylsilanes by Haller–Bauer Cleavage of Optically Active, Nonenolizable α-Silyl Phenyl Ketones

Summary: Conversion of *l*-menthyl ester **5** to phenyl ketones **7** and Haller–Bauer cleavage (MNH_2, C_6H_6, Δ) delivers the tertiary silanes **8** with 88–92% retention of configuration. The intermediate α-silyl carbanions are therefore generated in chiral condition and protonated almost exclusively on that surface from which benzamide is departing. The cyclic phenyl ketone (−)-**12** also undergoes C–C bond cleavage with excellent (96–98%) levels of configurational retention.

Sir: Optically active C-centered organosilanes[1] are rapidly gaining interest in their own right[2] and as important mechanistic probes.[3] However, progress in this area has been hampered by the unavailability of a *general* synthetic method capable of reliably delivering silanes of known absolute configuration. Herein, we outline a relatively simple protocol capable of realizing this objective.

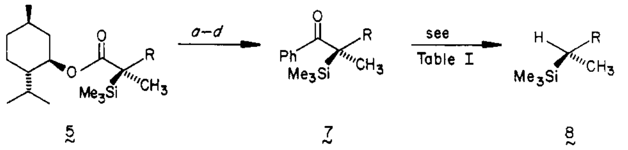
Scheme I[a]



R	route A initial 5	route A initial 6	route A purified[c] 5	route B initial 5	route B initial 6	route B purified[c] 6
a, CH_2Ph	55[a]	45	>99% de	31	69	20:80
b, $CH_2CH{=}C(CH_3)_2$	55	45	82% de	38	62	10:90
c, CH_2CH_2Ph	55[b]	45	>99% de	25	75	8:92
d, $(CH_2)_4CH_3$	50	50	89% de	38	62	10:90

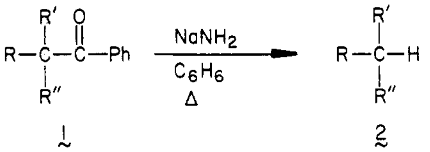
[a] Obtained as colorless crystals, mp 68 °C, $[\alpha]^{23}_D$ −56.6° (*c* 1.4, $CHCl_3$). [b] Obtained as colorless crystals, mp 60.5 °C, $[\alpha]^{23}_D$ +3.1° (*c* 2.2, $CHCl_3$). [c] These figures apply to 40–50% mass return of the starting mixture after one chromatographic separation.

Scheme II[a]



[a] (a) Dibal, CH_2Cl_2, 0 °C; (b) Ag_2CO_3, Celite; (c) PhLi; (d) $CrO_3 \cdot py_2$.

The cleavage of nonenolizable ketones by amide ion (e.g., **1** → **2**, the Haller–Bauer reaction)[4] is recognized to fail if at least one of the R groups cannot assist in stabilization of the intermediate carbanion. Thus, while the reaction works well when R = phenyl[5] or cyclopropyl,[6] alkyl substitution alone curtails debenzoylation.[4a] Since Me_3Si substituents stabilize carbanions quite effectively,[7] we have proceeded to examine the fate of optically active α-silyl ketones under Haller–Bauer conditions. Relevantly, *bond scission in these systems proceeds invariably with high levels of configurational retention.* These observations, when coupled with a new asymmetric synthesis of func-



$$R-\overset{R'}{\underset{R''}{C}}-\overset{O}{\overset{\|}{C}}-Ph \xrightarrow[C_6H_6,\ \Delta]{NaNH_2} R-\overset{R'}{\underset{R''}{C}}-H$$

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[1] Hathaway, S. J.; Paquette, L. A. *J. Org. Chem.* **1983**, *48*, 3351.

[2] (a) Hayashi, T.; Konishi, M.; Ito, H.; Kumada, M. *J. Am. Chem. Soc.* **1982**, *104*, 4962. (b) Hayashi, T.; Kabeta, K.; Yamamoto, T.; Tameo, K.; Kumada, M. *Tetrahedron Lett.* **1983**, *24*, 5661. (c) Hayashi, T.; Konishi, M.; Okamoto, Y.; Kabeta, K.; Kumada, M. *J. Org. Chem.* **1986**, *51*, 3772. (d) Hayashi, T.; Yamamoto, A.; Iwata, T.; Ito, Y. *J. Chem. Soc., Chem. Commun.* **1987**, 398. (e) Coppi, L.; Ricci, A.; Taddei, M. *Tetrahedron Lett.* **1987**, *28*, 965.

[3] (a) Hayashi, T.; Ito, H.; Kumada, M. *Tetrahedron Lett.* **1982**, *23*, 4605. (b) Hayashi, T.; Konishi, M.; Kumada, M. *J. Am. Chem. Soc.* **1982**, *104*, 4963. (c) Wetter, H.; Scherer, P. *Helv. Chim. Acta* **1983**, *66*, 118. (d) Hayashi, T.; Okamoto, Y.; Kabeta, K.; Hagihara, T.; Kumada, M. *J. Org. Chem.* **1984** *49*, 4224. (e) Coppi, L.; Mordini, A.; Taddei, M. *Tetrahedron Lett.* **1987**, *28*, 969. (f) Hayashi, T.; Matsumoto, Y.; Ito, Y. *Organometallics* **1987**, *6*, 884. (g) Russell, A. T.; Procter, G. *Tetrahedron Lett.* **1987**, *28*, 2041, 2045.

[4] (a) Hamlin, K. E.; Weston, A. W. *Org. React. (N.Y.)* **1957**, *9*, 1. (b) Kaiser, E.; Warner, C. D. *Synthesis* **1975**, 395.

[5] Paquette, L. A.; Gilday, J. P.; Ra, C. S. *J. Am. Chem. Soc.* **1987**, *109*, 6858 and references cited therein.

[6] Paquette, L. A.; Uchida, T.; Gallucci, J. C. *J. Am. Chem. Soc.* **1984**, *106*, 335 and relevant references cited therein.

[7] Schleyer, P. v. R.; Clark, T.; Kos, A. J.; Spitznagel, G. W.; Rohde, C.; Arad, D.; Houk, K. N.; Rondan, N. G. *J. Am. Chem. Soc.* **1984**, *106*, 6467 and references cited therein.

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