

AN ASYMMETRIC HYDROGEN EQUIVALENT: USE OF THE 1-NAPHTHYLPHENYLMETHYL-SILYL GROUP IN THE PREPARATION OF OPTICALLY ACTIVE ALLYL ALCOHOLS AND (S) 1-PHENYL-1,2-BUTADIENE.¹

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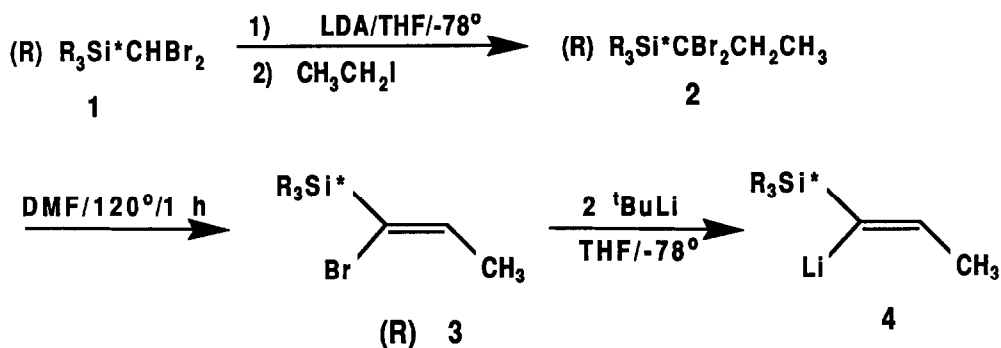
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Summary: *The potential of using a chiral organosilane as a single antipode at silicon in the preparation and separation of diastereomers has been demonstrated.*

Very little success has been encountered in the relatively few attempts to utilize organosilanes, as a single antipode at silicon, in asymmetric syntheses.³ The most successful diastereoselectivity in such a system is that reported by Brook and coworkers,⁴ who found that carboxylation of precipitated (1-naphthylphenylmethyl-silyl)benzylithium gave an 87:13 mixture of in separable diastereomeric α -silyl acids.

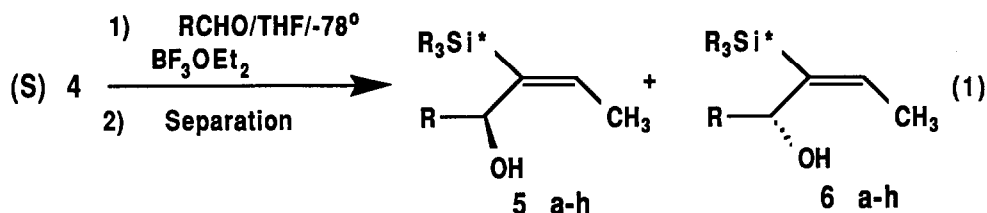
It occurred to us that it should be possible to prepare organosilicon-containing organometallic reagents, wherein the silicon moiety is an optically discrete 1-naphthylphenylmethylsilyl group, and to react these reagents with prochiral carbonyl species to provide diastereomers. The separation of these diastereomers,⁵ followed by desilylation would leave an optically active, silicon-free product.

We wish to report herein on our initial attempts to test this concept employing reagent **4**.⁶ Deprotonation ethylation of **17** (i. LDA/THF/-78° ii. EtI) provided **2** (mp 106-108°; $[\alpha]_D$ -4.97°) in 97 % yield. Thermolysis of **2** in DMF (120°/1h) gave bromide **3** (99%; mp 64-66°; $[\alpha]_D$ +4.13°). Lithium reagent **4** could be prepared in low yield with n-butyllithium or in moderate yield with sec-butyllithium, but was best prepared by treatment of **3** with 2 equivalents of tert-butyllithium in THF. (Scheme I)



SCHEME I

The reaction of the sterically demanding lithium reagent **4** with benzaldehyde in the presence of boron fluoride etherate⁸ at -78°C produced an equimolar mixture of diastereomers **5a** and **6a** in 48 % yield. (eq 1) These diastereomers could be separated by simple silica gel or by thick layer rotary chromatography.⁹ Fortunately, the less mobile diastereomer **5a** provided suitable crystals for x-ray analysis. This showed the structure to be the (R) Si, (S) C material as illustrated.¹⁰ The results of the reaction of **4** with benzaldehyde and other aldehydes are given in Table I. As the data indicate, these condensations proceed in a nearly stereorandom manner. Separation of the diastereomers formed, on the other hand, proved feasible in several cases. The reaction with p-nitrobenzaldehyde and anisaldehyde gave complex mixtures of products.



In order to further understand the capabilities of these separated diastereomers, we looked into the chemistry of **5a** and **6a**. Protodesilylation⁶ of **5a** (TBAF/DMSO/0.5h/25 $^\circ$) gave **7a** (87%; $[\alpha]_D -157.5^\circ$) whereas **6a** provided **8a** (92%; $[\alpha]_D +135.1^\circ$) under the same conditions. (eq 2) A chiral shift reagent ¹H NMR analysis of these materials with (+) Eu(hfbc)₃ showed **7a** to have 88% ee and **8a** to have 76% ee. The lower optical purity in the protodesilylated materials is attributed to the dual allylic and benzylic nature of the product alcohols, since the starting silylated allyl alcohols were optically pure by NMR analysis.

Although the acetylation of alcohol **6a** proceeded without problem it proved impossible to carry out a β elimination of the resulting acetate to the desired allene. The only product resulting from all attempts at

elimination resulted in protodesilylation to the allyl acetate. Fortunately, trifluoroacetylation of **6a** (99%; Ac₂O/DMAP) produced ester **9**, which when treated with tris(dimethylamino)sulfur trimethylsilicon difluoride (TAS-F)¹¹ gave (S) 1-phenyl-1,2-butadiene **10** (50%; [α]_D -37°)¹². These results are consistent with a trans elimination of the silicon and trifluoroacetate groups and to our knowledge represents the first unambiguous confirmation of the stereochemistry of this elimination process.

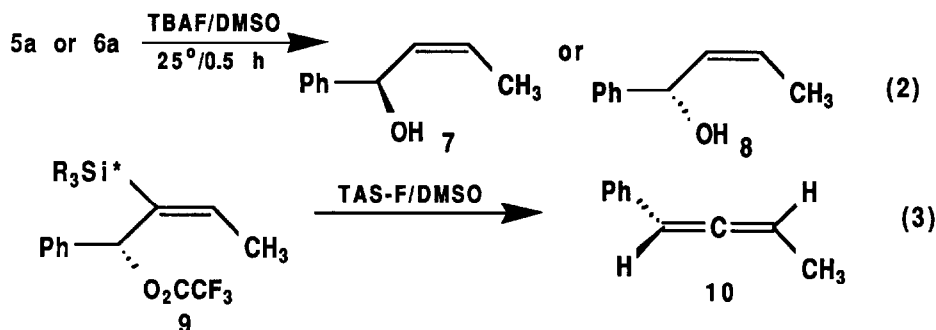


TABLE I: Reaction of **1** with Aldehydes^a

Entry	RCHO	Product s	% Yield	Diastereomeric Ratio ^b	Separation
1	PhCHO	5a, 6a	47	1:1	c, d
2	p-MeC ₆ H ₄ CHO	5b, 6b	48	1:1	c
3	p-BrC ₆ H ₄ CHO	5c, 6c	10	1:1	d
4	c-C ₆ H ₁₁ CHO	5d, 6d	40	1:1	d
5	iPrCHO	5e, 6e	47	1:1	d
6	CH ₃ CHO	5f, 6f	22	1:1	e
7	1-C ₁₀ H ₇ CHO	5g, 6g	60	1.2:1	e
8	o-MeC ₆ H ₄ CHO	5h, 6h	57	1.2:1	e

a. According to eq. 1. b. Determined by ¹H NMR on crude product mixture. c. silica gel chromatography. d. Thick layer rotary chromatography. e. These diastereomers resisted separation.

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b. University of Puerto Rico and Petrarch Systems. Address correspondence to this author at Petrarch Systems.
c. University of Virginia.
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