Chemo and enantioselective addition of grignard reagents to ketones and enolizable ketimines
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Chapter 3:  
On the Configurational Stability and Reactivity of Tertiary Silyloxy Carbanion Derived from Stereoselective Brook Rearrangement

Part of this chapter has been published:  
(* Equal contribution)
3.1. Introduction

As mentioned in the introduction (section 1.3) our group had developed the preparation of chiral alpha tertiary hydroxysilanes 2 via enantioselective catalytic addition to acylsilanes 1 (scheme 1, a).\[1\] We thought that these were excellent substrates to study the configurational stability of the tertiary carbanions formed after Brook rearrangement.\[2\] The methodology allowed the synthesis of both allylic and benzylic hydroxysilanes, and the former are discussed in this chapter while the latter are discussed in chapter 4. The [1,2] Brook rearrangement is defined as the reversible migration of silicon moiety from carbon to oxygen, transforming an α-silyl oxyanion to an α-silyloxy carbanion considered to proceed via a pentacoordinate silicon intermediate (Scheme 1, b). The carbanion that is formed during the rearrangement has been used, by addition of an electrophile in the medium, for tandem carbon-carbon bond forming reactions.\[2,3\]

Enantioselective formation of chiral organometallic species, followed by stereospecific trapping with an electrophile, is a powerful strategy for asymmetric carbon–carbon bond-forming reactions. An important prerequisite for this strategy is the configurational stability of chiral carbanions. Configurational instability can be overcome by trapping the chiral carbanions at very low temperatures or by introducing a carbamoyloxy group, for instance in the case of α-oxygen- or α-nitrogen-substituted chiral organolithiums.\[4\]
The [1,2]-Brook rearrangement is a common strategy in organic synthesis for generating carbanions and although many applications in organic synthesis have been reported, enantiospecific variants of the [1,2]-Brook rearrangement/trapping processes are rare and often proceed through configurationally stable chiral allene intermediates.

The chiral α-tertiary allyl hydroxysilanes 2 derived from enantioselective catalytic addition of Grignard reagents to acylsilanes 1 (Scheme 2, c) are highly interesting substrates to study their configurational stability and reactivity after Brook rearrangement. The Brook rearrangement of chiral allyl hydroxysilanes (Scheme 2a) has been studied for specific substrates that allow intramolecular trapping. More challenging, intermolecular trapping has been achieved almost exclusively via allenyl intermediates. The only example of intermolecular trapping in which allenyl species are not involved was reported by Takeda et al. In this case, thermodynamically stabilized and configurationally labile α-cyano, phosphono or sulfonyl carbanions could trap protons through formal S2′ with a remarkable level of chirality transfer (77%, 96% and 97% ee respectively), while benzyl bromide was trapped by α-cyano carbanion with 22% yield and 39% ee (Scheme 2b). The presence of the carbamoyl moiety in the substrates was necessary for configurational stabilization of the stereolabile carbanion intermediates.

In this work we have developed an stereospecific Brook rearrangement/trapping sequence, initiated by the formation of a Zn-alkoxide from an enantioenriched allyl hydroxysilane, followed by intermolecular trapping with a carbonyl electrophile (Scheme 1c). A remarkable feature of this reaction sequence is the complete transfer of chirality from the Zn-alkoxide to the final product, namely C-tertiary alcohol. Also noteworthy, no electron-withdrawing or configuration stabilizing group in the substrate, nor a pathway via an allenyl species is required for the sequence to occur.
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**Scheme 2.** Stereospecific intermolecular trapping after Brook rearrangement of chiral allylic hydroxysilanes: literature precedence and this work. LDA = Lithium diisopropyl amide.

### 3.2. Results and discussion

We set out to investigate the conditions for the Brook rearrangement of allyl α-hydroxysilane 2, prepared following our previously developed catalytic asymmetric addition reaction of iBuMgBr to acylsilane 1. The thermodynamic and configurational stability of the chiral carbanion formed upon rearrangement is uncertain a priori. Furthermore, whether it can be trapped by a carbon electrophile and, most importantly, whether this will proceed with complete transfer of chirality, are question marks. When allyl hydroxysilanes undergo Brook rearrangement, the chemoselectivity of the trapping of the rearranged product (either the α- or the γ-position) is an additional concern.
To assess the thermodynamic stability of the rearranged product and the chemoselectivity of the trapping process, a racemic experiment was carried out initially. Performing a one-pot sequence consisting of the addition of iBuMgBr to acylsilane 1, followed by quenching of the reaction with water or benzoyl chloride (BzCl) at -78 °C, led only to the recovery of the product 2. Since no Brook rearrangement occurred at -78 °C, the reaction was warmed up to room temperature. Unfortunately, also in this case only the addition product 2 or its O-benzylated adduct were recovered. This result was not surprising, as Brook rearrangement is typically a reversible process between the α-silyl oxyanion and α-silyloxy carbanion (Scheme 1b). The equilibrium is heavily affected by i) the presence of a carbanion-stabilizing group, which is absent in our system, ii) the nature of the counterion (Mg in this case), and iii) the reaction solvent.\cite{2,3}

To study the effect of the counterion and the solvent on the overall process, we decided to explore the Brook rearrangement of isolated, racemic allyl α-hydroxysilane 2. A variety of metal bases were evaluated in THF. Adding MeMgBr to 2 at -78 °C, followed by addition of benzoyl chloride and warming up to 45 °C in THF, led to undesired product 4 (Table 1, entry 1). Similarly, no conversion to the desired product 3a was observed when adding nBuLi, and instead a complex mixture of decomposition products was detected (Table 1, entry 2). This observation indicates that both with the Mg and the Li counterion the equilibrium of Brook rearrangement lies predominantly on the side of α-silyl oxyanions rather than on the side of the corresponding α-silyloxy organomagnesium or organolithium species, most likely due to their low thermodynamic stability. Interestingly, this is in stark contrast with the results obtained with benzylic α-hydroxysilanes (Chapter 4). Next we studied the effect of a Zn base. We were pleased to see that replacing the Mg or Li base by Et2Zn finally led to the desired product 3a, derived from Brook rearrangement and subsequent trapping with BzCl at the α-position (Table 1, entry 3). Intriguingly, we found that if the benzoyl chloride was added after warming up the reaction mixture to 45 °C, rather than shortly after the deprotonation, decomposition product 4 was again predominant. This result indicates that the electrophile must be in the medium from the beginning of the reaction for the complete sequence to take place. Keeping this in mind, we focused next on optimizing the reaction with Et2Zn.
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Table 1. Selected optimization results.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Metal base</th>
<th>Solvent</th>
<th>Conversion (%)&lt;sup&gt;[a]&lt;/sup&gt; 3a:4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MeMgBr</td>
<td>THF</td>
<td>0 : 100</td>
</tr>
<tr>
<td>2</td>
<td>nBuLi</td>
<td>THF</td>
<td>0 : 0&lt;sup&gt;[b]&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>Et₂Zn</td>
<td>THF</td>
<td>55 : 0&lt;sup&gt;[c]&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>Et₂Zn</td>
<td>MeCN</td>
<td>100 : 0</td>
</tr>
</tbody>
</table>

[a] Determined by <sup>1</sup>H NMR spectroscopy. [b] Decomposition products were observed regardless of the electrophile. [c] 45% of starting material was recovered together with side product derived from the attack of THF to benzoyl chloride.

Together with the desired product 3a, the reaction with Et₂Zn also furnished a considerable amount of a side product derived from the attack of THF to benzoyl chloride (Table 1, entry 3). This side product was identified as 4-chlorobutyl benzoate, and we believe that it is formed after the attack of THF to benzoyl chloride, activated by the Lewis acidic Et₂Zn. In order to suppress this side reaction, different solvents were tested. Dioxane or dichloroethane favored the attack of Et₂Zn to BzCl while Me-THF did not give any desired product, and starting material was recovered together with other side products. In apolar toluene, as well as in dimethoxyethane and tert-butyl methyl ether, many side reactions took place. However, when conducting the reaction in acetonitrile (Table 1, entry 4) all side reactions were effectively suppressed and product 3a was obtained exclusively. The positive outcome when using THF or acetonitrile can be explained by their destabilising effect on Zn-alkoxide, thus shifting the Brook rearrangement equilibrium to the organozinc species.<sup>[2b,3]</sup> Intrigued by the role of the metal we carried out a transmetalation experiment: We first deprotonated the substrate with nBuLi at -20 °C, then added ZnCl<sub>2</sub> and warm up to room temperature to ease transmetalation. Next, BzCl was added and the experiment run in same reaction conditions. However, neither Brook rearrangement nor decomposition took place.
Having established the optimal counterion and solvent for the Brook rearrangement/trapping sequence, the next important question to address was the stereoselectivity of the overall process. It has been shown earlier that unstabilized sp³ alkyl lithium and magnesium reagents have low configurational stability,⁴,⁷ that sp³ alkyl zinc species are usually only configurationally stable at temperatures up to 25 °C,⁸ and that allenylzinc species are configurationally stable.⁹ Although the configurational stability of allyl-Zn species is not known, we expected it to be low, especially under heating to 45 °C, because of the absence of typical stabilizing groups present in the molecule (e.g., carbamoyl).

To assess the stereoselectivity of the Brook rearrangement and trapping sequence, we performed the same experiments using enantioenriched 2 with an initial ee of 88% (Scheme 3). Due to its highly apolar character, the silylated alcohol product 3a could not be separated by chiral HPLC, and thus deprotection using TBAF was carried out to furnish the corresponding deprotected alcohol in good yield. To our delight, performing the tandem reaction in acetonitrile furnished the product 5a with 71% yield and 88% ee, meaning full transfer of chirality. Absolute configuration of products are based on literature data.¹⁰ For ease of handling, the Brook rearrangement/trapping/deprotection sequence was also done as a one-pot procedure, providing product 5a with similar yield and same enantioselectivity.

When an activated acyl chloride (4-(trifluoromethyl)benzoyl chloride) was used, the Brook rearrangement and subsequent trapping product 5b was isolated, again with full transfer of chirality. We were pleased to find that p-CF₃-benzaldehyde was also an amenable substrate and product 5c was obtained with full retention of enantioselectivity as a mixture of diastereoisomers (3:1). Activated ketones were also tested as electrophiles, but unfortunately they did not react, presumably due to increased steric hindrance. Ethyl chloroformate, on the other hand, was too reactive and gave many different products. Other electrophiles not bearing a carbonyl moiety such as iodine, allyl bromide or methyl iodide were also investigated, but no reaction took place.
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Scheme 3. a) One-pot Brook rearrangement/trapping/deprotection sequence and b) Scope of electrophiles.

In the course of the submission of our work Marek et al. reported similar results (with broader substrate scope) including mechanistic rational based on the computational and experimental data. The main differences between our and their report is the reaction medium and proposed initial steps in the reaction sequence. In THF (solvent used by Marek et al.) we were unable to obtain clean conversion of the substrate to the product due to side reaction derived from the attack of THF to benzoyl chloride. To avoid the side product formation we had to use MeCN as a solvent. Furthermore, we were unable to obtain some of the products that he reported: Replacement of cyclohexyl by methyl in 2 led in our case not to the Brook rearrangement/trapping sequence but to an unknown product that we could not characterize.

The results from the electrophile trapping cannot be understood when only the electrophilicity of the reagents is considered. Only carbonyl electrophiles are trapped, which might indicate that this moiety is needed to trigger the Brook rearrangement. Furthermore, as noted above, the carbonyl electrophile must be in the medium from the beginning of the Brook rearrangement for the complete sequence to take place. Thus, we hypothesize that carbonyl-based electrophiles are...
involved in the transition state through an activation of the silicon via penta- or hexa-coordinated species (Scheme 4). In order to determine whether the presence of an external carbonyl group could facilitate the trapping of other electrophiles, DMF was added together with allyl bromide, Me₂SO₄ or iBuOH. This did not have the pursued effect, leading to decomposition products only.

To rationalize the experimental results we propose a concerted mechanism with three steps for our reaction sequence. First, the carbonyl electrophile triggers the Brook rearrangement by activation of the silicon atom (A, Scheme 4). Second, a migration of the Zn atom to the γ-position takes place (B, Scheme 4), which could be stabilized by coordination with the silyloxy moiety. Finally, trapping of the carbonyl electrophile at the α-position through a chair-like transition state (C, Scheme 4) gives rise to the chiral alcohol with a tetrasubstituted stereocenter. In no case we observed trapping in the γ-position (formal Se2′ product). The product obtained in our reaction sequence can be regarded as the result of the formal Se2 pathway.

Scheme 4. Mechanistic hypothesis.

In the latter, the Brook rearrangement and intermolecular trapping, which occurs at the γ-carbon, are facilitated by the thermodynamic stabilization brought by the CN-group at the same carbon and the carbamoyl moiety, which is needed to fix the stereochemistry of the whole process (Scheme 2b). [5e,f]
3.3. Conclusion

We have shown that allyl α-hydroxysilanes, upon treatment with a Zn base, undergo stereospecific Brook rearrangement to form unprecedented, configurationally stable carbanions (allyl-Zn species). These can be trapped with several carbonyl electrophiles to form C-tertiary alcohols with full retention of the enantiomeric excess. A concerted mechanism involving the carbonyl electrophile in all stages is proposed as responsible for the total stereospecificity observed in the Brook rearrangement/trapping sequence. As a general remark, we found the chemistry of allyl hydroxysilanes highly susceptible to even minor changes in the reaction conditions, sometimes leading to very different products: apart from the 1,2-Brook rearrangement/trapping products described above other rearrangements and transformations took place, making not only difficult the characterization, but also the rationalization of how could the product have been formed.

3.4. Experimental section

3.4.1. General information

All reactions using oxygen- and/or moisture-sensitive materials were carried out with anhydrous solvents (vide infra) under a nitrogen atmosphere using oven dried glassware and standard Schlenk techniques. Analytical thin-layer chromatography was performed on precoated aluminium-backed plates (Silica Gel 60 F₂₅₄; Merck), and visualized using UV light (254 nm). Preparative layer chromatography was performed on precoated glass-backed plates (Silica Gel 60 F₂₅₄ 1mm; Merck). Flash column chromatography was carried out using Merck silica gel 60, 230-400 mesh. Cooling of reaction mixtures to -78 °C was achieved using a Julabo FT902 immersion cooler. ¹H-, ¹³C- and ¹⁹F- NMR spectra were recorded on a Varian AMX400 (400, 101 and 376 MHz respectively) using CDCl₃ as solvent at room temperature. Chemical shift values are reported in ppm with the solvent resonance as the internal standard (CDCl₃: δ 7.26 for ¹H, δ 77.16 for ¹³C). Data are reported as follows: chemical shifts, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), and integration. Exact mass spectra were recorded on a LTQ Orbitrap XL apparatus with ESI. Enantiomeric excesses were determined by HPLC analysis using a Shimadzu LC-10ADVP HPLC equipped with a Shimadzu SPD-M10AVP diode array detector. Dry tBuOMe, THF, Et₂O and toluene were collected fresh from solvent purification system. Me-THF, DME,
dioxane, DCE and MeCN were purchased from Sigma-Aldrich. Commercially available reagents were purchased from Sigma-Aldrich, Acros or ABCR. Acyl silanes as well as α-hydroxysilanes were synthesized according to the literature procedure.[1]

3.4.2. General procedure for the Brook rearrangement-trapping of allyl α-hydroxysilanes

In a flame-dried Schlenk flask 0.05 mmol (1 equiv.) of hydroxysilane 2 were dissolved in 1 mL of acetonitrile, under N\textsubscript{2} atmosphere. Et\textsubscript{2}Zn (1.2 equiv.) was added and, after stirring at room temperature for 30 minutes, the electrophile (2 equiv.) was added. It was then warmed up to 45 °C and stirred at that temperature for 16 h. Then, a solution of TBAF in THF was added (5 equiv.) and the mixture was stirred for an additional 4 hours at 45 °C. It was then quenched with saturated NH\textsubscript{4}Cl (2 mL) and the organic phase extracted with Et\textsubscript{2}O (3x4 mL). The combined organic phases were dried with MgSO\textsubscript{4} and solvent was evaporated under reduced pressure. Purification was performed by flash chromatography on silica gel using different mixtures pentane:Et\textsubscript{2}O as the eluent and the enantiomeric excess was determined by chiral HPLC analysis.

\textit{(E)}-1-Cyclohexyl-2,5-dimethyl-3-(methyldiphenylsilyl)hex-1-en-3-ol (2)

\[
\text{HO} \quad \text{Cy} \quad \text{SiPh}_2\text{Me}
\]

The reaction was performed according to the literature procedure [91 % yield, 88 % ee]. The analytical data were found to be in accordance with those reported in the literature.[1]

\textsuperscript{1}H NMR (CDCl\textsubscript{3}, 400 MHz): δ 7.71 – 7.66 (m, 4H), 7.41 – 7.29 (m, 6H), 5.15 (d, J = 9.0 Hz, 1H), 2.19 – 2.11 (m, 1H), 1.97 – 1.91 (m, 1H), 1.77 – 1.52 (m, 8H), 1.38 (s, 3H), 1.29 – 1.15 (m, 3H), 1.09 – 0.99 (m, 2H), 0.93 (d, J = 6.0 Hz, 3H), 0.83 (d, J = 6.2 Hz, 3H), 0.63 (s, 3H). \textsuperscript{13}C NMR (CDCl\textsubscript{3}, 101 MHz): δ 135.9, 135.8, 135.7, 135.6, 135.3, 129.5, 129.5, 129.3, 127.8, 127.7, 75.6, 43.6, 37.2, 33.4, 33.2, 26.3, 26.3, 26.3, 25.1, 24.7, 23.8, 15.3, -5.1. The enantiomeric ratio was determined by chiral HPLC analysis, Chiralcel ADH column, n-heptane/iPrOH 99.5:0.5, 0.5 mL/min, detection at 240 nm. Retention times 8.2 min (minor) and 9.0 min (major).
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(E)-2-(1-cyclohexylprop-1-en-2-yl)-2-hydroxy-4-methyl-1-phenylpentan-1-one (5a)

Following general procedure, the reaction was performed with 2 (20 mg, 0.05 mmol), Et₂Zn (60 μL, 0.06 mmol, 1 M in hexane), benzoyl chloride (12 μL, 0.1 mmol) and TBAF (250 μL, 0.25 mmol, 1 M in THF) in 1 mL of acetonitrile. Product 5a was obtained as an oil after column chromatography (SiO₂, pentane:Et₂O 10:1), [11.2 mg, 71 % yield, 88 % ee].

¹H NMR (CDCl₃, 400 MHz): δ 8.10 (d, J = 7.6 Hz, 2H), 7.53 (t, J = 7.4 Hz, 1H), 7.39 (t, J = 7.7 Hz, 2H), 5.67 (d, J = 9.0 Hz, 1H), 4.56 (s, 1H), 2.32 – 2.23 (m, 1H), 2.10 – 2.01 (m, 2H), 1.75 – 1.65 (m, 7H), 1.52 (d, J = 0.9 Hz, 3H), 1.31 – 1.11 (m, 4H), 0.95 (d, J = 6.6 Hz, 3H), 0.61 (d, J = 6.7 Hz, 3H). ¹³C NMR (CDCl₃, 101 MHz): δ 203.3, 135.2, 134.4, 133.7, 130.0, 125.4 (q, J = 3.8 Hz, 1H), 123.6 (q, J = 272.8 Hz), 83.8, 44.9, 37.3, 32.7, 32.4, 26.2, 26.05, 25.96, 24.7, 24.5, 24.3, 13.0. ¹⁹F NMR (CDCl₃, 376 MHz): δ -63.3. HRMS (ESI+, m/z) calc. for 313.21621 [M-H]⁺, found 313.21667. The enantiomeric ratio was determined by chiral HPLC analysis, Chiralcel OD-H column, n-heptane/iPrOH 97:3, 0.5 mL/min, detection at 254 nm. Retention times 7.4 min (minor) and 8.3 min (major).

(E)-2-(1-cyclohexylprop-1-en-2-yl)-2-hydroxy-4-methyl-1-(4-(trifluoromethyl)phenyl)pentan-1-one (5b)

Following general procedure, the reaction was performed with 2 (20 mg, 0.05 mmol), Et₂Zn (60 μL, 0.06 mmol, 1 M in hexane), 4-(trifluoromethyl)benzoyl chloride (15 μL, 0.1 mmol) and TBAF (250 μL, 0.25 mmol, 1 M in THF) in 1 mL of acetonitrile. Product 5b was obtained as an oil after column chromatography (SiO₂, pentane:Et₂O 10:1), [11.2 mg, 71 % yield, 88 % ee].

¹H NMR (CDCl₃, 400 MHz): δ 8.19 (d, J = 8.2 Hz, 2H), 7.66 (d, J = 8.2 Hz, 2H), 5.68 (d, J = 9.1 Hz, 1H), 4.19 (s, 1H), 2.33 – 2.23 (m, 1H), 2.08 (dd, J = 14.3, 6.3 Hz, 1H), 1.98 (dd, J = 14.3, 5.6 Hz, 1H) 1.76 – 1.54 (m, 5H), 1.53 (d, J = 1.2 Hz, 3H), 1.36 – 1.07 (m, 6H), 0.95 (d, J = 6.7 Hz, 3H), 0.65 (d, J = 6.7 Hz, 3H). ¹³C NMR (CDCl₃, 101 MHz): δ 202.7, 152.3, 134.7, 134.4 (q, J = 32.6 Hz), 133.7, 130.0, 125.4 (q, J = 3.8 Hz), 123.6 (q, J = 272.8 Hz), 83.8, 44.9, 37.3, 32.7, 32.4, 26.2, 26.05, 25.96, 24.7, 24.5, 24.3, 13.0. ¹⁹F NMR (CDCl₃, 376 MHz): δ -63.3. HRMS (ESI+, m/z) calc. for 405.20119 [M+Na]⁺, found 405.20056. The enantiomeric ratio was determined by chiral HPLC analysis,
Chiralcel OD-H column, n-heptane/iPrOH 99.5:0.5, 0.5 mL/min, detection at 236 nm. Retention times 11.1 min (major) and 12.2 min (minor).

(E)-2-(1-cyclohexylprop-1-en-2-yl)-4-methyl-1-(4-(trifluoromethyl)phenyl)pentane-1,2-diol (5c)

Following general procedure, the reaction was performed with 2 (20 mg, 0.05 mmol), Et2Zn (60 μL, 0.06 mmol, 1 M in hexane), 4-(trifluoromethyl)benzaldehyde (14 μL, 0.1 mmol) and TBAF (250 μL, 0.25 mmol, 1 M in THF) in 1 mL of acetonitrile. Product 5c was obtained as an oil after column chromatography (SiO2, pentane:Et2O 10:1) as a mixture of diasteroisomers (3:1) [12.8 mg, 71 % yield, 88 and 88 % ee]. These could be separated by PLC (pentane:AcOEt 10:1).

**Major diasteroisomer:** 1H NMR (CDCl3, 400 MHz): δ 7.60 (d, J = 8.1 Hz, 2H), 7.48 (d, J = 8.0 Hz, 2H), 5.64 (d, J = 9.0 Hz, 1H), 4.64 (s, 1H), 2.35 – 2.25 (m, 2H), 1.85 – 1.54 (m, 6H), 1.72 (s, 3H), 1.37 – 1.08 (m, 6H), 0.81 (s, 3H), 0.79 (s, 3H). 13C NMR (CDCl3, 101 MHz): δ 143.6, 135.0, 134.1 (q, J = 7.1 Hz), 132.8, 128.8, 124.89 (q, J = 3.8 Hz), 124.4 (q, J = 271.8 Hz), 80.6, 76.6, 43.6, 37.4, 33.4, 33.0, 26.2, 26.1, 24.8, 24.5, 23.7, 13.7. 19F NMR (376 MHz, CDCl3) δ -62.5. HRMS (ESI+, m/z) calc. for 407.21684 [M+Na]+, found 407.21516. The enantiomeric ratio was determined by chiral HPLC analysis, Chiralcel OD-H column, n-heptane/iPrOH 97:3, 0.5 mL/min, detection at 240 nm. Retention times 12.8 min (major) and 16.0 min (minor).

**Minor diasteroisomer:** The enantiomeric ratio was determined by chiral HPLC analysis, Chiralcel OD-H column, n-heptane/iPrOH 97:3, 0.5 mL/min, detection at 220 nm. Retention times 17.7 min (minor) and 20.2 min (major).

(E)-1-cyclohexyl-2,5-dimethylhex-1-en-3-one (4)

1H NMR (CDCl3, 400 MHz): δ 6.39 (d, J = 9.1 Hz, 1H), 2.50 (d, J = 7.0 Hz, 2H), 2.42 – 2.33 (m, 1H), 2.18 – 2.08 (m, 1H), 1.78 (d, J = 1.4 Hz, 3H), 1.75 – 1.64 (m, 2H), 1.37 – 1.10 (m, 8H), 0.92 (s, 3H), 0.90 (s, 3H). 13C NMR (CDCl3, 101 MHz): δ 202.6, 147.6, 135.9, 46.2, 38.2, 32.2, 26.1, 25.8, 25.8, 22.9, 11.5. HRMS (ESI+, m/z): calc. for 209.18999 [M+H]+, found 209.18989.
3.5. References


“Sal, we gotta go and never stop going 'till we get there.”

“Where we going, man?”

“I don’t know but we gotta go.”

Jack Kerouac, *On the road*

In this chapter the Brook rearrangement of chiral, tertiary benzylic α-hydroxysilanes is investigated. Lacking any stabilization of the carbanion the trapping of electrophiles after Brook rearrangement proceeds with loss of chirality. Interestingly, Brook rearrangement itself (trapping of proton) is highly enantiospecific, which is hypothesized to proceed via a concerted mechanism. A catalytic amount of base is not only sufficient, but beneficial for the enantiospecificity of the process.