1,5-Induction in Reactions between 4-Aminoallylstannanes and Aldehydes promoted by Lewis Acids

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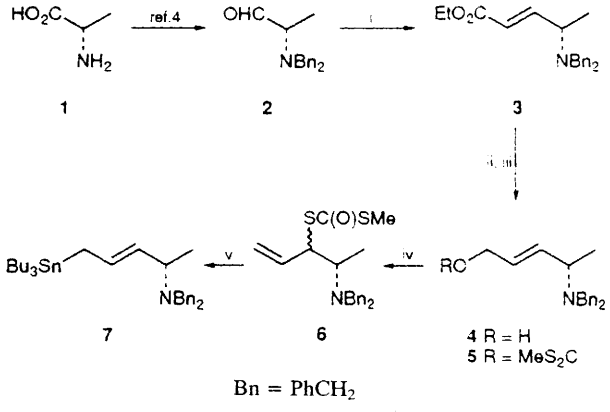
Transmetallation of tributyl[(4S, 2*E*)-4-dibenzylaminopent-2-enyl]stannane **7** by tin(IV) bromide generates an allyltin tribromide which reacts with aldehydes to give 5-aminohex-3-enols **8** with effective 1,5-asymmetric induction.

Hydroxy- and alkoxy-allylstannanes are transmetallated by tin(IV) halides to generate allyltin trihalides which react with aldehydes with excellent 1,5-, 1,6- and 1,7-asymmetric induction.[1–3] We now report that (4-aminoallyl)stannanes also react with aldehydes after transmetallation with tin(IV) bromide or chloride with very effective 1,5-asymmetric induction.

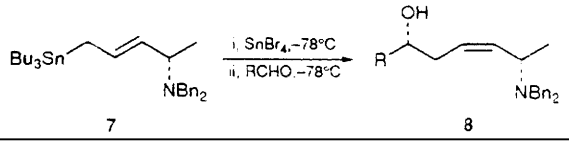
Tributyl[(4*S*,2*E*)-4-dibenzylaminopent-2-enyl]stannane **7** was prepared from (*S*)-(+)-alanine *via* the aldehyde **2**[4] as outlined in Scheme 1. Reactions between the stannane and aldehydes were carried out in dichloromethane by adding a solution of tin(IV) bromide to a solution of the stannane at −78 °C followed, after 10 min, by a solution of the aldehyde. After 1 h, a basic work-up (Et_3N, −78 °C followed by aq. $NaHCO_3$) gave the products which were isolated by flash chromatography. In all cases essentially a single product was obtained which was identified as the 1,5-*syn*-diastereoisomer **8**. Traces of minor products (<3%) were detected in the product mixtures, but these were not isolated or identified. Similar results were obtained using tin(IV) chloride to transmetallate the allylstannane **7**.

The structure of the product **8** (R = Ph) from the reaction with benzaldehyde was established as summarized in Scheme 2. Ozonolysis of its acetate, followed by a reductive work-up, gave (+)-3-acetoxy-3-phenylpropanol **9**, $[\alpha]_D$ + 78.1, corresponding to the (*R*)-enantiomer.[1] The stereochemistry of the product **8** (R = Ph) was also consistent with the relative chemical shifts of the (*R*)- and (*S*)-acetylmandelates **10**.[5] To check that the 1,5-*syn*-product **8** (R = Ph) could be distinguished from its anti-diastereoisomer **12**, the alcohol was converted into its inverted *p*-nitrobenzoate **11** which was hydrolysed to provide the *anti*-amino alcohol **12**. The *syn*- and *anti*-amino alcohols **8** and **12** gave ^1H NMR spectra that were clearly different, although the compounds were inseparable by TLC or flash chromatography. Moreover the *anti*-isomer **12** did not correspond to the minor (2%) product detected in the mixture from the reaction of stannane **7** and benzaldehyde. Similar correlations were used to confirm the structure of the product **8** (R = Pr^i) obtained from the reaction between 2-methylpropanal and the stannane **7**.

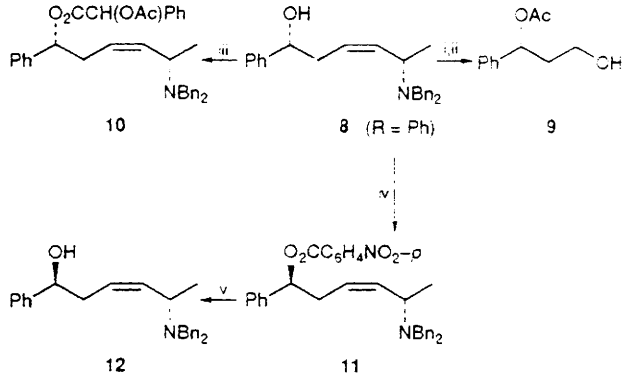
The selective formation of the 1,5-*syn*-products **8** is consistent with transmetallation of the allylstannane **7** to generate the allyltin tribromide **13**.[1–3] This then reacts with the aldehyde *via* the six-membered cyclic transition state **14**. There is a strong preference for the group α to tin to adopt the axial position in the transition state of the reaction between



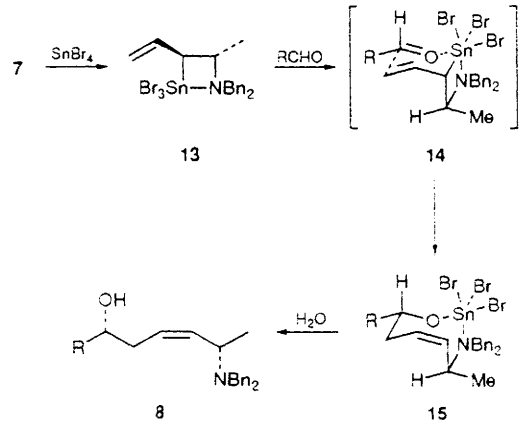
Scheme 1 *Reagents*: i, $(EtO)_2P(O)CH_2CO_2Et$, Bu^{t}OK (82%); ii, DIBAL-H (90%); iii, NaH, CS_2, MeI (85%); iv, 110 °C (96%); v, Bu_3SnH, azoisobutyronitrile (79%)

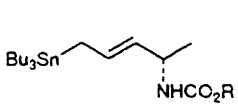


R	Yield (%)
Ph	58
p-ClC_6H_4	59
p-$MeOC_6H_4$	35
Et	30
Pr^i	58

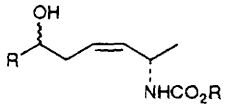


Scheme 2 *Reagents*: i, Ac_2O, Et_3N, 4-dimethylaminopyridine (DMAP) (79%); ii, O_3, then Me_2S followed by $NaBH_4$ (24%); iii, (*R*)- or (*S*)-acetylmandelic acid, dicyclohexylcarbodiimide, DMAP (62–66%); iv, *p*-nitrobenzoic acid, diethyl azodicarboxylate, PPh_3 (45%); v, 1% NaOH, MeOH (63%)





16 (R = Bn,$CH_2CH_2SiMe_3$)



17 (R = Bn,$CH_2CH_2SiMe_3$)

the allyltin tribromide and the aldehyde.[1–3,6] It is this preference together with the selective participation of intermediate **13** in which the methyl and vinyl groups are *trans*-disposed about the 4-membered ring of the chelated tin tribromide which establishes the overall 1,5-*syn*-stereoselectivity.

The alkoxycarbonylaminoallylstannanes **16** were prepared from alanine *via* routes analogous to that shown in Scheme 1. However, the tin(IV) chloride and bromide-promoted reactions of these with benzaldehyde were not stereoselective and gave mixtures of products including the 1,5-*syn*- and 1,5-*anti*-compounds **17**.

The observation of these highly stereoselective reactions between the aminoallylstannane **7** and aldehydes is of interest in the context of remote asymmetric induction.[7] They should be useful for the stereoselective synthesis of amino alcohols and extend the use of allylstannanes for asymmetric synthesis.[8]

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