

SYNLETT Spotlight 37

Diisobutylaluminum Hydride (DIBAL-H)

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This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research

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Introduction

Among reducing agents, diisobutylaluminum hydride (DIBAL-H) stands out, having been extensively used for a broad variety of reductive transformations in organic chemistry. It is easy to use and reduces many functional groups under mild reaction conditions.¹ Aldehydes, ketones, acids, esters, acid chlorides, amides, nitriles, isocyanates, nitro compounds, and disulfides are examples of suitable substrates, whereas alkyl halides are unreactive towards DIBAL-H. Usually, reactions are strongly solvent and/or temperature dependent and as an example, sulfides, sulfones, and sulfonic acids are unreactive in toluene at 0 °C.²

Along with the reductive capability of DIBAL-H, its Lewis acid properties extend the scope of transformations, and the combination of these two properties has been used in the stereoselective synthesis of valuable products in chemistry, like pharmaceuticals.³

DIBAL-H is commercially available pure or in solution of alkanes, ethers, dichloromethane, toluene, etc.

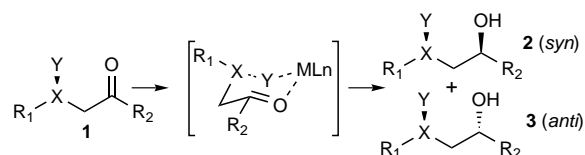
Precautions: Neat DIBAL-H is a pyrophoric liquid and its solutions react violently with water, oxygen and related compounds. It is necessary to work in a fume hood, using anhydrous solvents, under inert atmosphere (argon or nitrogen).

Abstracts

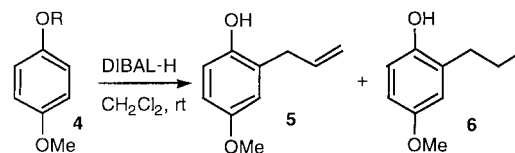
A) Considerable attention has been paid to the application of DIBAL-H, alone or in the presence of ZnCl₂ in asymmetric synthesis for the stereoselective reduction of hydroxyketones,⁴ aminoketones,⁵ and β-ketosulfoxides.⁶ These reactions yield preferably 1,3-*syn* diols (Table 1), through a six-membered ring complex between the Al or Zn atom and the 1,3-difunctional substrate, whose keto group then undergoes hydride attack at the less sterically hindered face, due to the large volume occupied by DIBAL-H. In general, these reactions are solvent dependent, and the best results have been found in THF.

Table

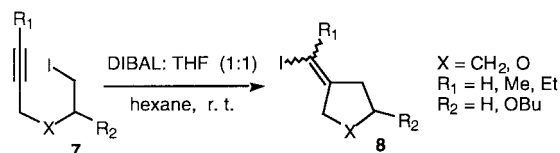
X	Y	Reagent	2:3	Ref.
C	OH	DIBAL	95:5 (4)	
C	NHR	DIBAL/ZnCl ₂	99:1 (5)	
S	O	DIBAL/ZnCl ₂	95:5 (6)	



B) Sharma et al⁷ have used the Lewis acid character of DIBAL-H to effect Claisen rearrangements, a valuable synthetic tool for the formation of carbon-carbon bonds,⁸ in allyl aryl ethers (4). DIBAL-H was found to be very effective for exclusive migration to give ortho Claisen product (5) under mild reaction conditions, although the formation of compound 6 is also observed in small quantities (13:1), through a hydro-alumination and hydrolysis reactions.



C) The combination of DIBAL-H/THF in a 1:1 ratio provides an efficient method for iodine transfer cyclizations for the formation of five-membered rings.⁹ Different iodoalkynylacetals **7** ($X = O$, $R_2 = OBU$) and iodoalkynes **7** ($X = CH_2$, $R_2 = H$) are employed, to obtain the corresponding tetrahydrofuran ($X = O$) or carbocycle ($X = CH_2$) **8** in good yield (60–90%). The cyclization proceeds by a radical pathway and no trace of the fragmentation of the starting material into the propargylic alcohol or enol ether is observed. In all cases, the two isomers *Z*, *E* for the vinyl iodides were obtained.



References

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