SYNLETT
Spotlight 37

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

Diisobutylaluminun Hydride (DIBAL-H)

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Introduction

Among reducing agents, diisobutylaluminun 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, sulfonyl, 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

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Reagent</th>
<th>2:3 Ref.</th>
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</thead>
<tbody>
<tr>
<td>OH</td>
<td>DIBAL</td>
<td>95:5 (4)</td>
<td></td>
</tr>
<tr>
<td>NH₂</td>
<td>ZnCl₂</td>
<td>99:1 (5)</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>DIBAL</td>
<td>95:5 (6)</td>
<td></td>
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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.

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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. Different iodoalkynylacetals 7 (X = O, R₂ = OBu) and iodoalkynes 7 (X = CH₂, R₂ = H) are employed, to obtain the corresponding tetrahydropyran (X = O) or carbocycle (X = CH₂) 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