SYNLETT
Spotlight 183

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

Tributyltin Hydride (Bu_3SnH)

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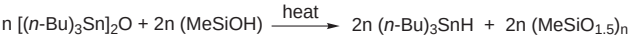
Introduction

The realization of compatibility of radical methods with a range of functional groups without further protection has led to an increased interest in the use of radicals in organic synthesis. Bu_3SnH is a well-known radical reagent because of its relatively weak and nonionic bond interaction between tin and hydrogen that can be cleaved homolytically.[1] Thus it has been explored extensively in reductive cleavage,[2a] radical dehalogenation, deoxygenation[2b] and intramolecular radical cyclization[2c] as well as in the synthesis of various heterocyclic compounds, natural products and many pharmaceutically important drugs.[2d–j]

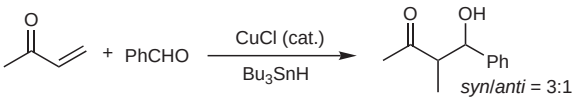
Bu_3SnH is commercially available as a colourless liquid and can be stored under refrigeration. It can be prepared via reduction of tributyltin oxide with hydrosiloxane.[3a] It can also be generated easily in situ by the action of $NaBH_4$ or Et_3SiH on Bu_3SnCl.[1,3b]



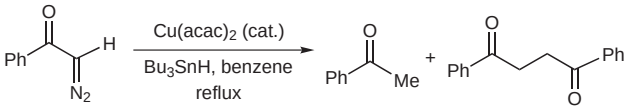
The problems associated with this reagent are that it is highly toxic and removal of tin impurities from the product is often very difficult. This has been overcome recently by using a mixture of KF and silica gel as the stationary phase in column chromatography to reduce the level of tin impurities in the product to 30 ppm.[3c]

Abstracts

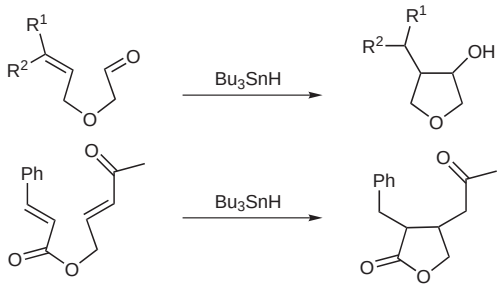
A) Bu_3SnH has been used in the preparation of β-hydroxy ketones in a single step via hydrostannylation of α,β-unsaturated ketones in the presence of CuCl followed by aldol reaction of the resulting tin enolates with aldehydes.[4]



B) Bu_3SnH was explored for the reduction of the diazo group of α-diazocarbonyl compounds to the corresponding methylene group in the presence of $Cu(acac)_2$. It is an efficient methodology to transform a carboxylic acid into a methyl or an ethyl ketone under mild conditions.[5]



C) Radical cyclization of unsaturated ethers bearing an aldehyde or an α,β-unsaturated ketone moiety has been effected using Bu_3SnH to synthesize tetrahydrofurans, chromanols and butyrolactones in good yields. The reaction proceeded through the addition of the tributyltin radical to the carbonyl double bond followed by intramolecular addition of the resultant *O*-stannyl ketyl radical to electron-rich double bonds.[6]



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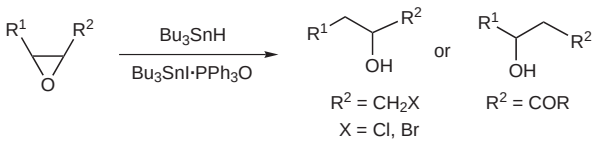
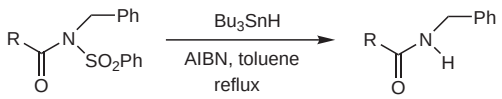
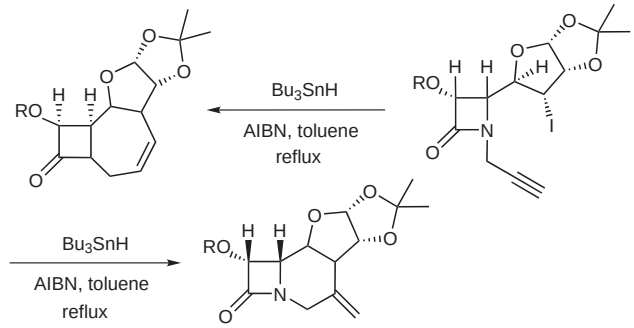
D) A combination of Bu_3SnH with $Bu_3SnI{\cdot}PPh_3O$ has been used as a mild reagent for the reduction of functionalized epoxides to the corresponding alcohols in high chemo- and regioselectivities via nucleophilic attack of the Sn–I bond on the epoxy ring.[7]



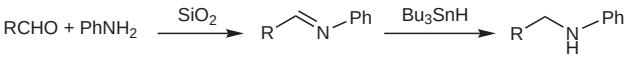
E) Bu_3SnH has been used to deprotect highly stable *N*-sulfonamides to the respective amides under mild reaction conditions in very good yields and with good chemoselectivity. *N*-Benzyl and phenyl derivatives showed excellent reactivity, whereas *N*-acetyl amides were non-reactive under the same conditions.[8]



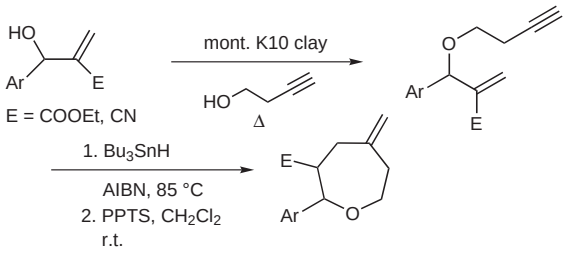
F) Bu_3SnH has also been utilized in the intramolecular radical cyclization of N-propargyl-substituted azetidin-2-ones. The cyclization is highly stereospecific and gives either the 6-*exo-dig* or the 7-*endo-dig* cyclized compound.[9]



G) Reduction of imines generated in situ from aldehydes and anilines was achieved with Bu_3SnH on silica gel under solvent-free conditions to provide the corresponding amines in good yield. This methodology is unsuccessful on aliphatic amines since they are stronger bases compared to anilines and thus reduce the availability of reaction sites on silica gel.[10]



H) Bu_3SnH-mediated stereoselective radical cyclization of Baylis–Hillman adducts provides pharmaceutically important tri- and tetra-substituted oxepanes in a short route.[11]



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