Spotlight 385

Hexamethyldisilane
Compiled by Audrey Giros

Audrey Giros was born in 1984 in Conflans Ste Honorine, France. She graduated from the National Polytechnic School of Chemical Engineering and Technology of Toulouse in 2009 and received in the same year her M.Sc. degree in organic chemistry. She is currently working under the supervision of Prof. Luis Blanco and Prof. Sandrine Deloisy. Her Ph.D. research project focuses on organosilicon chemistry for the total synthesis of a sila-analogue of testosterone. She is developing methodologies for the synthesis of a silicon-silicon bond-containing molecules and their use in various reactions such as functionalization or cyclization.

Laboratoire de Synthèse Organique et Méthodologie, ICMMO (UMR 8182-CNRS), Bât 420, Université Paris-Sud 11, 91405 Orsay cedex, France
E-mail: audrey.giros@u-psud.fr

Introduction

Hexamethyldisilane (Me₃SiSiMe₃, CAS: 1450-14-2) is a hygroscopic colorless and odorless liquid which absorbs in the far UV region. In organic chemistry it is often used as an alternative of chlorotrimethylsilane or hexamethyldisilazane silylating agents. Hexamethyldisilane also promotes reduction and can act as a co-catalyst. It was recently revealed to be a key reagent in the anomerization of carbohydrates. Additionally, hexamethyldisilane can be a valuable starting material for the synthesis of sila-substituted organic and biologically active molecules. In the semiconductor industry this oligoorganosilane is employed as a precursor in the Chemical Vapor Deposition process. Hexamethyldisilane is commercially available, but it can be easily synthesized by reaction of chlorotrimethylsilane with an alkali metal in organic solvents (Scheme 1). This method is particularly efficient and cheap.

\[
\text{Me}_3\text{SiSiMe}_3 + \text{MeLi} \rightarrow \text{Me}_3\text{Si} - \text{Li} + \text{Me}_3\text{SiMe}_3
\]

Scheme 1 Efficient preparation of hexamethyldisilane in laboratory

Abstracts

(A) Hexamethyldisilane as a Source of Trimethylsilylanion:
In the stereoselective synthesis of 3-trimethylsilyldihydrocarvone developed by Blay et al., hexamethyldisilane is used as a precursor of the nucleophilic species 1. The Michael addition of Me₃SiLi on (R)-(−)-carvone proceeds in a very high yield (91%). This optimized procedure for the cleavage of a Si–Si bond is carried out under inert atmosphere, using hexamethylphosphoric triamide (HMPA) in a specific proportion with three temperature ranges.

(B) New C–C and C–Bond Activation:
Rhodium-catalyzed silylation of the C–CN bond from arylnitriles and palladium-catalyzed allylic C–H silylation have been performed with hexamethyldisilane assistance. From the allylic substrates, excellent regio- and good stereoselectivities were observed with a high level of functional group tolerance.
(C) A Useful Allylic C–OH Activation:
Szasó and co-workers described an inexpensive procedure for the regioselective synthesis of allylsilanes from allylic alcohols under palladium catalysis. With hexamethyldisilane, the silylation proceeds smoothly under mild conditions (50–60 °C, without an inert atmosphere, no addition of acid or additive). Diverse functional groups (hydroxy-, methoxy- and nitrophenyl, ether and ester) and cyclic scaffolds like 1 are tolerated.

Hexamethyldisilane promotes reduction of alkenes and enones, desulfonation and Mizoroki–Heck-type coupling of arylnitriles to vinylsilanes. The cleaved disilane reacts as a ‘counterattack reagent’ by successive nucleophilic attacks of the resulting Me₃Si– and Me₃SiO– species. Bis(trimethylsilyl)ether is generated as side product. For instance, N-(phenylethylidene)hydroxylamine 2 is formed in good yield (73%).

Indeed the in situ formation of Me₃SiI species leads to the anomeration step by ring opening of a silylated carbohydrate intermediate.

Under mild conditions nitroalkanes can be mono-deoxygenated to ketoximes by treatment of the corresponding nitronate anions with bis(trimethylsilyl)amide. Subsequent nucleophilic substitutions with ethynylmagnesium bromide lead to a trisiladiyne derivative formed in good yield (73%).

Starting from hexamethyldisilane, Tacke and co-workers build silylated carbohydrate intermediates. For instance, N-(phenylethylidene)hydroxylamine 2 is formed in good yield (73%).

Malik et al. demonstrated that the hexamethyldisilane–iodine system leads to the anomeration of alkyl glycoside in quantitative yield. With hexamethyldisilane, the silylation proceeds smoothly under mild conditions (50–60 °C, without an inert atmosphere, no addition of acid or additive). Diverse functional groups (hydroxy-, methoxy- and nitrophenyl, ether and ester) and cyclic scaffolds like 1 are tolerated.

REFERENCES