SYNLETT
Spotlight 256

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

Dimethylboron Bromide (Me_2BBr): A Scarcely Recognized Mild and Versatile Reagent with Astonishing Potential

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Benoît Y. Michel was born in 1982 in Annecy, France. After studying for three years at the Ecole Nationale Supérieure d'Ingénieurs de Chimie (ECPM) in Strasbourg, he obtained a chemical engineer diploma as well as a DEA in organic chemistry (MSc degree). This was followed by a six-month internship in the laboratories of Professor Françoise Colobert under the guidance of Dr. Frédéric Leroux, on the total synthesis of the biarylic moiety of vancomycin. He is currently in his third year of PhD studies at the University of Lyon 1 under the direction of Professor Peter Strazewski. His research interest focuses on the total synthesis of carbocyclic puromycin analogues with restricted conformation.

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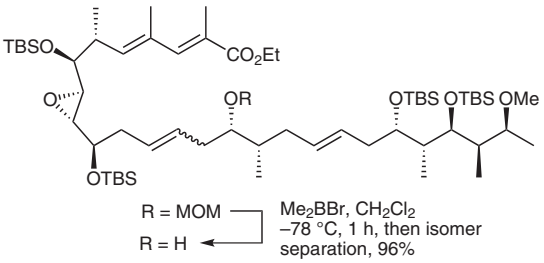
Introduction

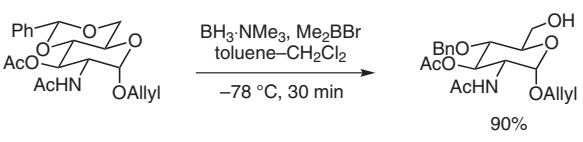
Originally synthesized by Wiberg et al.[1] in 1953, dimethylboron bromide was first used in organic synthesis by Guindon.[2] Over the course of the last decades, several applications have been discovered, such as the cleavage of useful protecting groups (MOM, MEM, Me, PMB, Bn, trityl ethers, miscellaneous ketals and acetals), the regio- and stereoselective ring opening of unsymmetrical epoxides, the reductive alkylation of azides, and the deoxygenation of sulfoxides to sulfides.[2b] Some have been reused in total syntheses of complex natural products during the final steps. Thus, its chemoselectivity and its predictable reactivity make it a noteworthy and useful reagent. Nowadays, Me_2BBr can be purchased at any chemical supplier. However, this reagent remains expensive; it may be therefore preferable to synthesize it on a preparative scale from BBr_3 and $SnMe_4$.[2c] Easily prepared, this colorless pyrophoric liquid (bp 31–32 °C) must be stored in solution in dichloromethane. It can be kept for several months under inert atmosphere in the freezer, without any observed decomposition.

Abstracts

(A) Me_2BBr has been used to perform, under non-acidic and aprotic conditions, an efficient regio- and chemoselective cleavage of useful protecting groups such as PMB,[3a] Bn, Tr,[3b,c] Me,[2a,4] MOM, MEM, MTM,[2c,5] ethers, ketals and acetals[6] in presence of silyl ether, ester, 1,3-diacetylene, 1,4-diene and phosphonate groups preponderantly by an S_N2 mechanism. Recently, this versatile reagent was used at low temperatures for final steps of total syntheses of complex target compounds[5,6] without affecting other functions, such as methyl, cyclic and allylic ethers, epoxides or lactones, in contrast to reagents such as BBr_3, BCl_3 and TMSI.



(B) Guindon et al. developed[7a] an ingenious mixture of Me_2BBr in combination with BH_3·THF for the reductive cleavage of symmetrical and unsymmetrical benzylidene acetals to their corresponding hydroxy benzyl ethers. Ghosh et al. optimized[7b] these conditions in order to achieve the regiocontrolled reductive cleavage of 4,6-*O*,*O*-benzylidene acetals of hexopyranosides to their corresponding 4-*O*-benzyl ethers in excellent yields without affecting neighboring protecting groups, as can happen with LAH.



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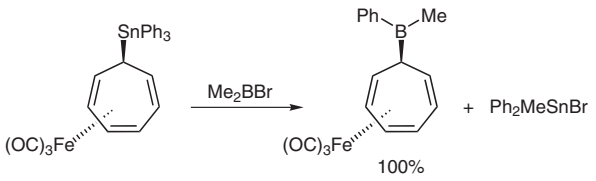
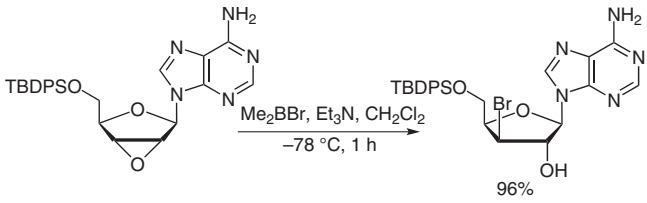
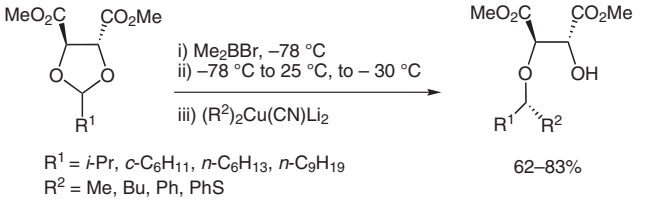
(C) Gridnev and Del Rosario reported[8] that the smooth transmetallation of irontricarbonyl complex of cycloheptatrienyl(triphenyl)tin with two equivalents of Me_2BBr yielded quantitatively a phenyl(methyl)borane complex and bromodiphenyl(methyl)tin. The resulting complex exhibited [1,7]-B + [1,2]-Fe diatropic migrations.



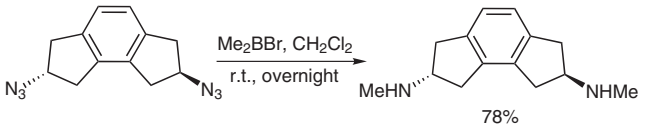
(D) Dimethylboron bromide was used at –78 °C for the regio- and stereoselective ring-opening of a furanosidic 2′,3′-*ribo*-epoxide to provide the corresponding bromohydrin *xylo* derivative in an excellent yield.[9] In fact, bromide approach occurs at the less hindered side of the epoxide which is consistent with an S_N2-type mechanism.



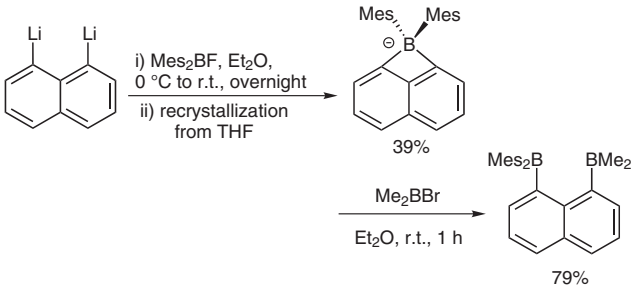
(E) Highly enantioenriched secondary alcohols (er >30:1) were prepared from various tartrate acetals of the corresponding aldehydes.[10] The key step involves the opening of the Johnson-type acetals with Me_2BBr, followed by highly diastereoselective cuprate substitutions of the intermediate α-bromo ethers. The auxiliary was easily removed via reduction with SmI_2 or by an addition–elimination protocol using NaOMe.



(F) The azide function can undergo a reductive alkylation by treatment with Me_2BBr to afford the corresponding *N*-methylamine compounds.[11]



(G) Hoefelmeyer and Gabbaï reported[12] on the synthesis of unsymmetrical α,α′-naphthyl diboranes which were generated through the ring-opening of an uncommon dimesityl(1,8-naphthalenediyl)borate salt. Such electrophilic bidentate naphthalenes are used in molecular and anion recognition, as well as in catalysis.



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