Pergamon

Tetrahedron Letters, Vol. 38, No. 41, pp. 7223-7224, 1997

0040-4039/97 $17.00 + 0.00

PII: S0040-4039(97)01721-8

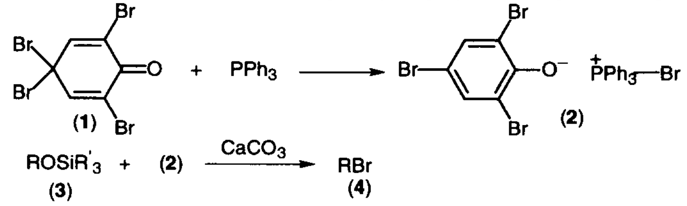
Direct Transformation of Sterically Less Hindered Silyl Ethers to the Corresponding Bromides with Inversion of Configuration

Akira Tanaka[a]* and Takayuki Oritani[b]

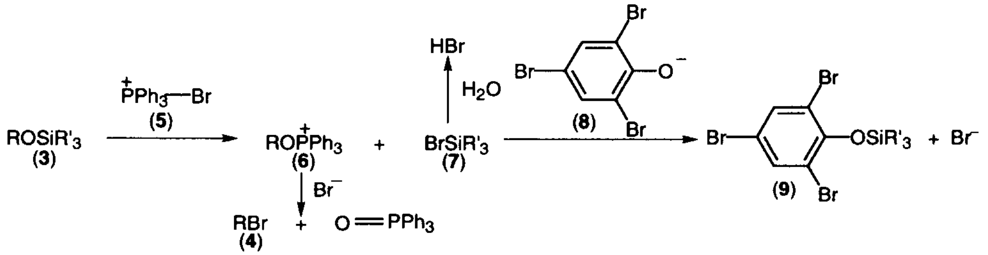
[a] Division of Environmental Bioremediation, Graduate School of Agriculture and [b] Department of Applied Biological Chemistry, Faculty of Agriculture, Tohoku University, 1-1 Tsutsumidori-amamiyamachi, Aoba-ku, Sendai 981, Japan

Abstract**:** The phosphonium salt **2**, generated by adding 2,4,4,6-tetrabromo-2,5-cyclohexadienone**1** to triphenylphosphine in CH_3CN-THF or 1,2-dichloroethane converted sterically less congested silyl ethers directly to the corresponding bromides in high yields. © 1997 Elsevier Science Ltd.

Direct transformation of silyl ethers to the corresponding bromides without deprotection is very attractive because the latter are important and versatile compounds for further manipulation in organic synthesis. In a previous paper, we described that the phosphonium salt **2**, generated by adding 2,4,4,6-tetrabromo-2,5-cyclohexadienone **1** to PPh_3 was a quite effective species converting primary and secondary alcohols and THP ethers to the corresponding bromides in high yields.[1] In continuing efforts to further extend this reagent to other functional group preparation,[2] we found that this salt **2** was also useful for the direct conversion of sterically less hindered silyl ethers to bromides (Scheme 1). Preparation of alkyl bromides from TBDMS, TBDPS and TIPS ethers has been reported to date.[3] In this paper, we examined the reactivity of our newly developed reagent system to five kinds of silyl ethers which had been most frequently employed as the protective group of alcohols.



Scheme 1



Scheme 2

When stearyl TBDMS ether **12** was treated with the salt **2** (3 eq.) in 1,2-dichloroethane at ambient temperature, the corresponding bromide **14** was obtained in 89% yield. However, the reaction mixture exhibited a strongly acidic nature, suggesting the generation of HBr. This can be rationalized by the reaction mechanism illustrated in Scheme 2. Thus, the reaction between the salt **2** and a silyl ether would lead to alkoxytriphenyphosphonium ion **6** and R'_3SiBr **7**, which would result in the formation of an alkyl bromide **4**, the silyl ether **9**[4]of 2,4,6-tribromophenol and triphenylphosphine oxide. A part of the unstable R'_3SiBr **7** would be decomposed with moisture in the solution to generate HBr. Efforts were made to remove the resulting HBr from the reaction mixture. Addition of $NaHCO_3$, pyridine or *N*, *N*-dimethylaniline was not effective, because they reacted slowly with the salt **2**. When propylene oxide, which had been often employed as a scavenger of hydrogen halides was added, the reaction did not proceed at all. The best additive was powdered $CaCO_3$. The usable solvents were CH_3CN-THF and 1,2-dichloroethane. The use of THF, DME or toluene alone was not effective in view of their low ability to solubilize the salt **2**. As can be seen in the Table,[5] the sterically

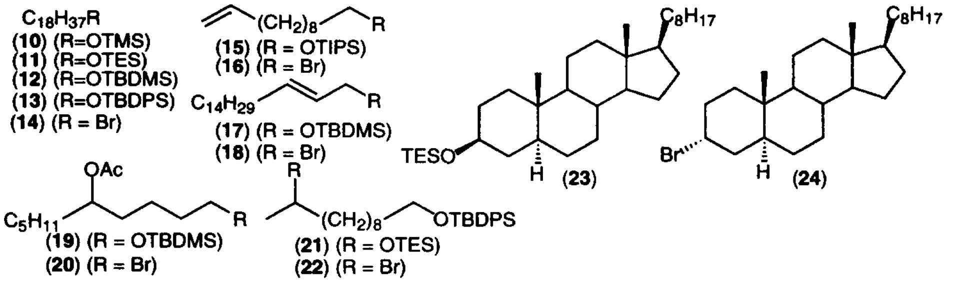


Table.

Entry	Silyl ether	Solvent[a]	Time(h)	Yield(%)	Product
1	**10**	A	3	97	**14**
2	**11**	A	2	92	**14**
3	**12**	B	3.5	99	**14**
4	**13**	A	24	0[b]	**14**
5	**15**	A	24	47[c]	**16**
6	**17**	B	3	84	**18**
7	**19**	B	1.5	76	**20**
8	**21**	A	6	75	**22**
9	**23**	A	5	86	**24**

a) A: CH_3CN-THF. B: 1,2-dichloroethane. b) The starting material was recovered unchanged. c) The starting material (31%) was recovered.

less congested TMS, TES and TBDMS ethers reacted smoothly, while, in the cases of the highly hindered TBDPS ethers, the reaction hardly proceeded(entry 4), allowing only TES ether to be brominated in the presence of a TBDPS ether (entry 8). The reaction between the salt **2** and the TIPS ether **15** was very slow and a considerable quantity of the starting material was recovered even after 24 hr (entry 5). Inversion of configuration in this reaction is evident from the result obtained in the steroid case (entry 9).

In summary, it was demonstrated that the salt **2**, generated by adding 2,4,4,6-tetrabromo-2,5-cyclohexadienone to PPh_3 in CH_3CN-THF or 1,2-dichloroethane, was an effective species converting sterically less hindered silyl ethers to the corresponding bromides in excellent yields. Further application of this reagent to other functional group preparation is now under investigation.

REFERENCES AND NOTES

1. Tanaka, A.; Oritani, T. *Tetrahedron Lett.* **1997**, *38*, 1955-1956.
2. For azide formation from alcohols with this reagent and $Zn(N_3)_2 \cdot 2Py$, Saito, A.; Saito, K.; Tanaka, A.; Oritani, T. *Tetrahedron Lett.* **1997**, *38*, 3955-3958.
3. (a)Aizpurua, J. M.; Cossio, F. P.; Palomo, C.*J. Org, Chem.* **1986**, *51*, 4941-4943.(b)Mattes, H.; Benezra, C. *Tetrahedron Lett.* **1987**, *28*, 1697-1698.(c)Kim, S.; Park, H.*J. Org. Chem.* **1988**, *53*, 3111-3113.
4. This silyl ether could not be isolated, probably because of its unstable nature.
5. General experimental procedure is as follows: To an ice-cooled solution of PPh_3 (1.5 mmol) in CH_3CN or 1,2-dichloroethane (3 ml) was added **1** (1.5 mmol) and after complete disappearance of the yellow color, powdered $CaCO_3$ (0.9 mmol) was added. To this mixture was then added a solution of a silyl ether (0.5 mmol) in THF or 1,2-dichloroethane (1 ml) and stirring was continued for an appropriate time at ambient temperature. The reaction mixture was quenched with H_2O, filtered through a celite pad and extracted with ether in the usual way. Purification of the crude product by SiO_2 column chromatography led to an alkyl bromide.

(*Received in Japan* 15 *July* 1997; *revised* 13 *August* 1997; *accepted* 18 *August* 1997)