Tetrahedron Letters, Vol.31, No.25, pp 3595-3596, 1990
Printed in Great Britain

0040-4039/90 $3.00 + .00
Pergamon Press plc

ACTIVATION AND SYNTHETIC APPLICATIONS OF THIOSTANNANES. EFFICIENT CONVERSION OF THIOL ACETATES INTO DISULFIDES

Tsuneo Sato, Junzo Otera,* and Hitosi Nozaki
Department of Applied Chemistry, Okayama University of Science
Ridai-cho, Okayama 700, Japan

Summary: Thiostannanes are obtained by treating alkoxystannanes with thiol acetates. Coupled with this reaction, the thiostannane methodology enables one-pot synthesis of disulfides from thiol acetate.

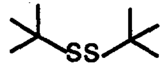
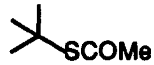
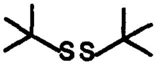
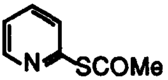
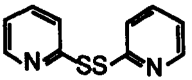
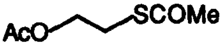
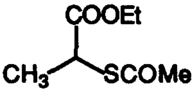
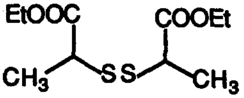
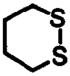
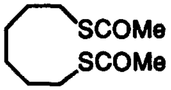
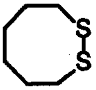
In the preceding paper, we disclosed a novel methodology for oxidation of thiols into disulfides.1) Thiols, however, are relatively labile under ambient atmosphere and thus the process is highly desired in which protected thiols are directly converted to disulfides. This is also important in view of deprotection especially in peptide chemistry2) since the disulfides once formed are readily reduced to parent thiols, and in fact, acid-sensitive protective groups served to some extent thus far.3) If we succeed in transforming protected thiols into thiostannanes, then the desired procedure would be accessible with recourse to the thiostannane methodology. In this letter, we report such strategy is indeed the case by using thiol acetates, the simplest and most convenient protected thiol derivatives.

Thioalkoxystannanes are generally prepared by treating thiols with alkoxystannanes or organotin halides but no preparative methods employing protected thiols have been available.4) We have found that treatment of thiol acetates with alkoxystannanes at 50 °C is sutable to this end. Strong thiophilicity of tin is probably responsible for the transesterification. More preferably, the reaction can be conducted at lower temperature by use of a catalytic amount of CsF (**2**) as a promotor.5)

With this new reaction in hand, we have succeeded in the one-pot conversion of thiol acetates into disulfides (eq 1): a THF solution of phenylsulfenyl acetate (1 equiv), $Bu_2Sn(OMe)_2$ (**1a**) (0.65 equiv), and **2** (0.1 equiv) was stirred at room temperature for 1 h. Then, $FeCl_3$ (**3**) (1.3 equiv) was added to this solution. The reaction mixture was stirred at room temperature for 2 h. After workup, GLC analysis showed formation of diphenyl disulfide in 88% yield. The results with other thiol acetates are summarized in Table 1. Of course, step 1 is accomplished by thermal reaction without **2** (entry 3) although the CsF-promoted reaction proceeds under milder conditions.6) Moreover, the CsF promotion is indispensable for the thiol acetates which resist to the thermal transesterification (entries 4 and 5).

$$2\ \mathrm{RSCOMe} + \mathbf{1a}\ \xrightarrow[\substack{\mathrm{THF}\\ (\text{step 1})}]{\mathbf{2}}\ \xrightarrow[(\text{step 2})]{\mathrm{FeCl_3}\ (\mathbf{3})}\ \mathrm{RSSR} \qquad (1)$$

Table 1. Conversion of Thiol Acetates into Disulfides.[a]

		reactn conditions			yield, %	
		temp, °C/time, h				
entry	RSCOMe	step 1	step 2	RSSR	GLC	isolated[b]
1	n-$C_6H_{13}SCOMe$	50/3	rt/2	n-$C_6H_{13}SS$-n-C_6H_{13}	66	
2	PhSCOMe	rt/1	rt/2	PhSSPh	88	72
3	PhSCOMe	50/2.5[c]	rt/5	PhSSPh	100	
4		50/2	rt/2		83	
5		50/2.5[c]	rt/2		18[d]	
6		rt/1.5	rt/2		75	82
7		rt/1.5	rt/5		98	85
8		50/2[e]	rt/2			77
9		50/1.5[f]	rt/2			98
10		50/1.5[f]	rt/2			58

a) RSCOMe:**1a**:**2**:**3** = 1.0:0.65:0.1:1.3. b) After column chromatography on silica gel. c) CsF was not used. d) The thiol acetate remained unchanged (59%). e) $Bu_2Sn(OEt)_2$ was used in place of **1a**. f) $Bu_2Sn(OMe)_2$: 1.3 equiv; $FeCl_3$: 2.6 equiv.

References

1) T. Sato, J. Otera, and H. Nozaki, Tetrahedron Lett., preceding paper in this issue.

2) Y. Wolman, "The Chemistry of the Thiol Groups", ed. by S. Patai, John Wiley & Sons, London, 1974, Chapter 14. M. Bodanszky, "Principles of Peptide Synthesis", Springer-Verlag, Berlin, 1984, Chapter 4.

3) B. Kamber and W. Rittel, Helv. Chim. Acta, **51**, 2061 (1968). J. J. Pastuszak and A. Chimiak, Roczniki Chem., **51**, 1567 (1977). R. G. Hiskey and W. P. Tucker, J. Am. Chem. Soc., **84**, 4794 (1962).

4) H. Schumann, I. Schumann-Ruidisch, and M. Schmidt, "Organotin Compounds", ed. by A. K. Sawyer, Marcel Dekker, Inc., New York, 1971, vol. 2, Chapter 6.

5) For activation of (thio)alkoxystannanes with CsF: N. Nagashima and M. Ohno, Chem. Lett., **1987**, 141. D. N. Harpp and M. Gingras, Tetrahedron Lett., **28**, 4373 (1987). M. Gingras and D. N. Harpp, Ibid., **29**, 4669 (1988). D. N. Harpp and M. Gingras, J. Am. Chem. Soc., **110**, 7737 (1988). T. Sato, J. Otera, and H. Nozaki, Tetrahedron Lett., **30**, 2959 (1989).

6) Bu_4NF resulted in poorer yileds.

(Received in Japan 13 March 1990)