CHEMISTRY LETTERS, pp. 333 - 336, 1985.

SYNTHESIS OF CYCLOPROPYLDIAMINOOXOSULFONIUM SALTS BY THE REACTION OF DIAMINOOXOSULFONIUM YLIDES WITH ALDEHYDES

Kentaro OKUMA,* Kazuto NAKANISHI, Takumi HONDA, Hiroshi OHTA,
Yoshinobu YOKOMORI,[†] and Kiyotane SEKIDO[†]
Department of Chemistry, Faculty of Science, Fukuoka University, Jonan-ku,
Fukuoka 814-01
[†]Department of Chemistry, The National Defense Academy, Hashirimizu, Yokosuka 239

The title compounds have been synthesized by the reaction of diaminooxosulfonium methylides with aldehydes as isomeric mixtures in good yields. These ylides reacted with aldehydes to give betaines, which formed unusual four-membered cyclic alkoxyoxosulfonium salts. Another methylide further attacked α-carbon of these salts to afford cyclopropyldiaminooxosulfonium salts.

It is well known that oxosulfonium ylides react with carbonyl compounds to give corresponding epoxides.[1] Methods for the preparation of cyclopropylsulfonium salts include the cyclization of 3-chloropropyldiphenylsulfonium fluoroborate with bases[2] and alkylation of corresponding sulfoximines.[3] The reaction of these salts with bases and carbonyl compounds afforded cyclobutanone derivatives, which were widely used for the synthesis of natural products.[4] But there is no report for the one step synthesis of these salts from corresponding sulfonium ylides. In a previous paper, we reported the synthesis of diaminooxosulfonium salts (**1**) and their reactions with benzaldehyde, which gave the corresponding epoxide and rearranged products.[5] In the course of our synthetic research, we showed that the reactions of dimethyloxosulfonium methylide with epoxides gave oxetanes but, the reaction of N,N-dimethylaminophenyloxosulfonium methylide gave oxetanes and cyclopropyl sulfones via intramolecular S_N2 type reaction.[6] We are interested in these anomalous reactivities. If ylides are formed by the reaction of these salts with bases, betaines derived from carbonyl compounds may afford the S^+-attacked products. In this communication, we would like to report a novel synthesis of cyclopropyldiaminooxosulfonium salts (**2**) by the reaction of diaminooxosulfonium methylides (**3**) with aldehydes.

Typical procedure was as follows: To a dichloromethane solution of **1a** (3.92 g, 11 mmol) was added a dichloromethane solution of 1,8-diazabicyclo[5,4,0] undecene-7 (1.68 g, 11 mmol) (DBU). After stirring for 30 min, a dichloromethane solution of benzaldehyde (0.54 g, 5 mmol) was added to this solution. After refluxing for 3 h, the reaction mixture was treated with water. The dichloromethane solution was washed with 5% aq. HCl solution and dried over magnesium sulfate and evaporated to give corresponding **2a** (2.10 g, 88%). In a similar manner, various **2** were obtained in high yields as shown in Table 1.

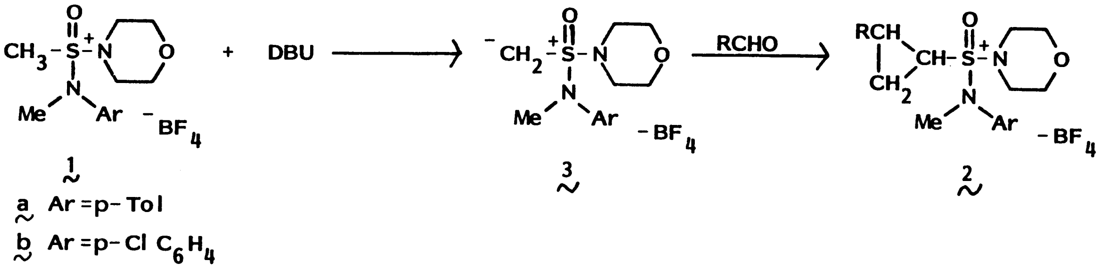
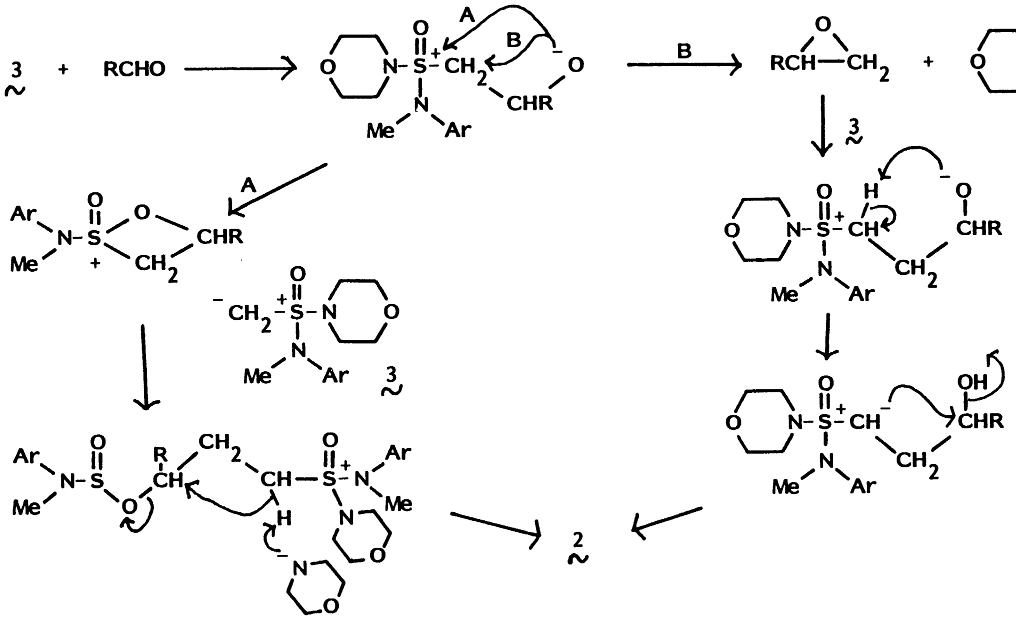


Table 1. Reaction of 1 with aldehyde in the presence of bases

Entry	Ylide	Base	RCHO	Temperature/°C	Solvent	Excess of 1/%	Yield of 2[a)]/%
1	3a	n-BuLi	Ph	0	THF	10	2a 22[b)]
2	3a	t-BuOK	Ph	50	t-BuOH	10	2a 18[b)]
3	3a	t-BuOK	Ph	50	t-BuOH	110	2a 23[b)]
4	3a	DBU	Ph	reflux	CH_2Cl_2	10	2a 37[c)]
5	3a	DBU	Ph	reflux	CH_2Cl_2	110	2a 84
6	3a	DBU	$p-ClC_6H_4$	reflux	CH_2Cl_2	110	2b 88
7	3a	DBU	$p-MeC_6H_4$	reflux	CH_2Cl_2	110	2c 90
8	3a	DBU	$p-NO_2C_6H_4$	reflux	CH_2Cl_2	110	2d 90
9	3a	DBU	$n-C_6H_{13}$	reflux	CH_2Cl_2	110	2e 80
10	3a	DBU	PhCH=CH	reflux	CH_2Cl_2	110	2f 87
11	3b	DBU	$p-ClC_6H_4$	reflux	CH_2Cl_2	110	2g 90
12	3b	DBU	$p-MeC_6H_4$	reflux	CH_2Cl_2	110	2h 85

a) Salts 2 were obtained as isomeric mixtures.
b) Epoxides and rearranged products were obtained as side products in 25 and 18%, 22 and 15%, and 24 and 42% yields, respectively.
c) Benzaldehyde was recovered in 35% yield.

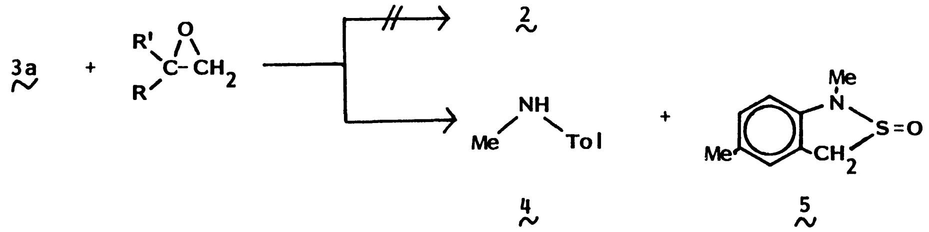
When ylide 3a was treated with an equimolar amount of benzaldehyde, the yield of 2 was low and the aldehyde was recovered in about 35% yield (entry 4). When n-BuLi and t-BuOK were used as bases, yields of 2 were quite low, while epoxides and rearranged products were obtained (entries 2,3). As to the formation of 2, the following two mechanisms are possible.[7)]



We first thought that the reaction proceeded through epoxide as intermediate (route B). To confirm this mechanism, the reaction of 3 with epoxides was carried out (Table 2).

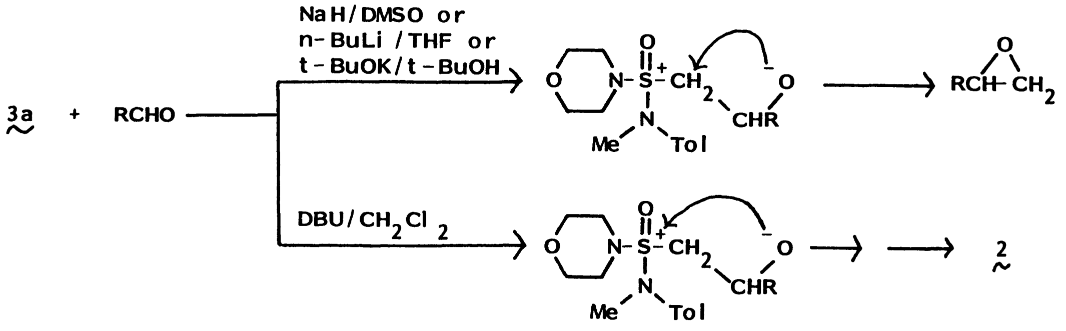
Table 2. The Reaction of 3a with Epoxides

Ylide	Base	Epoxide R	R'	Temperature/°C	Solvent	Products Yield/% 2	4	5
3a	DBU	Ph	H	reflux	CH_2Cl_2	0	32	33
	t-BuOK	Ph	H	50	t-BuOH	0	26	35
	n-BuLi	Ph	H	0	THF	0	15	45
	CH_3SOCH_2Na	Ph	H	40	DMSO	0	32	15
	DBU	Ph	Ph	reflux	CH_2Cl_2	0	30	32
	DBU	p-ClC_6H_4	H	reflux	CH_2Cl_2	0	30	24



As shown in Table 2, salts 2 could not be obtained under several conditions. These results suggest that the correct route is not B but A. Recently, we have shown that the reaction of (aryloxy)oxosulfonium ylides with carbonyl compounds proceeds by an intramolecular S_N2 mechanism to give β-aryloxysulfones and α,β-unsaturated sulfones.[8] The reaction of aminooxosulfonium methylide with epoxides also proceed by an intramolecular S_N2 mechanism to give cyclopropyl sulfones. Durst et al. and Nozaki et al. also proposed a similar mechanism for the reaction of β-hydroxysulfoxide with N-halo compounds.[9] The reaction of 3 with aldehydes afforded four-membered cyclic oxosulfonium intermediates by a similar mechanism. Another methylide further attacked α-carbon of these salts to give 2. This is the first one-step synthesis of cyclopropyloxosulfonium salts from the corresponding methylides.

Previously, we showed that diaminooxosulfonium ylides reacted with benzaldehyde to give styrene oxide and rearranged products using DMSO as solvent.[6] We further treated 3a with 4-t-butylcyclohexanone, which resulted in the formation of corresponding epoxide in 97% yield (n-BuLi/THF at 0 °C). These results suggest that the reaction of 3 with carbonyl compounds proceeds not only by an intramolecular S_N2 mechanism but also by a methylene transfer one.



In summary, the reaction of diaminooxosulfonium ylides with carbonyl compounds gave cyclopropyldiaminooxosulfonium salts in good yields.

We are now investigating the exact structure and synthetic applications of **2**.

References

1) E.J. Corey and M. Chaykovsky, J. Am. Chem. Soc., **87**, 1353 (1965). For reviews, see: B. M. Trost and L. S. Melvin, Jr., "Sulfur Ylides," Academic Press, New York (1975); E. Block, "Reactions of Organosulfur Compounds," Academic Press, New York (1978); "The Chemistry of The Sulphonium Group," ed by C. J. M. Stirling, Wiley, New York (1981).

2) B. M. Trost and M. J. Bogdanowicz, J. Am. Chem. Soc., **93**, 3773 (1971)

3) C. R. Johnson, G. F. Katekar, R. F. Huxol, and E. R. Janiga, J. Am. Chem. Soc., **93**, 3771 (1971).

4) B. M. Trost and M. J. Bogdanowicz, J. Am. Chem. Soc., **95**, 5307 (1973); C. R. Johnson and E. R. Janiga, J. Am. Chem. Soc., **95**, 7692 (1973).

5) K. Okuma, N. Higuchi, H. Ohta, and M. Kobayashi, Chem. Lett., **1980**, 1503.

6) K. Okuma, Y. Tanaka, S. Kaji, and H. Ohta, J. Org. Chem., **48**, 5133 (1983); K. Okuma, K. Nishimura, and H. Ohta, Chem. Lett., **1984**, 93.

7) Epoxides might be produced by a methylene transfer reaction.

8) K. Okuma, K. Nakanishi, and H. Ohta, J. Org. Chem., **49**, 1402 (1984)

9) T. Durst, K. C. Tin, and J. M. Marcil, Can. J. Chem., **51**, 1704 (1973); H. Taguchi, H. Yamamoto, and H. Nozaki, Tetrahedron Lett., **1973**, 2463.

10) Satisfactory values of elemental analysis were obtained for all new compounds. **2a**: mp 172-173 °C; ^{1}H NMR (DMSO-d_6) δ1.87 (2H, m, CH_2), 2.16 (3H, s, Tol-Me), 2.52-2.80 (1H, m, PhCH), 3.35 (3H, s, N-Me), 3.64-3.94 (9H, m, S-CH and morpholine),6.83-7.58 (9H, m, aromatic). **2a'**: ^{1}H NMR ($CDCl_3$) δ1.87 (2H, m, CH_2), 2.37 (3H, s, Tol-Me), 2.73 (1H, m, PhCH), 3.45-3.64 (12H, m, N-Me, S-CH, and morpholine), 6.83-7.43 (8H, m, aromatic). **2b**: mp 204-205 °C; ^{1}H NMR ($CDCl_3$) δ1.85 (2H, m, CH_2), 2.17 (3H, s, Tol-Me), 2.49 (1H, m, PhCH), 3.35 (3H, s, N-Me), 3.63-3.93 (9H, m, S-CH and morpholine), 6.73-7.95 (8H, m, aromatic). **2b'**: mp 183 °C (dec. as $^-BPh_4$ salt); ^{1}H NMR δ1.85 (2H, m, CH_2), 2.38 (3H, s, Tol-Me), 2.80 (1H, m, PhCH), 3.35-3.65 (12H, m, N-Me, S-CH, and morpholine), 6.69-7.64 (8H, m, aromatic). Structures of **2** and **2'** were assumed E and Z-forms, respectively, by the analysis of their NMR spectra.

11) This work was partly supported by the Central Research Institute of Fukuoka University.

(Received December 3, 1984)