Tetrahedron Letters Vol.21, pp2725-2728
0040-4039/80/0708-2725$02.00/0

ASYMMETRIC INDUCTION BY THE STEREOMUTATION OF RACEMIC METHYL PHENYL SULFOXIDE WITH OPTICALLY ACTIVE ACIDS

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Summary Direct conversion of racemic methyl phenyl sulfoxide into optically active form (maximum 6.1% e.e.) by heating with optically active acids has been observed.

Stereomutation involving the racemization of sulfoxides at the pyrimidal sulfur atom has been thoroughly studied.[1,2] Kagan and coworkers reported the first example that the irradiation of racemic methyl p-tolyl sulfoxide in the presence of optically active sensitizer gave the sulfoxide with 2.25% e.e..[3] However, a negligible asymmetric induction was reported when racemic methyl α-naphthyl sulfoxide was irradiated in a cholesteric liquid crystal medium.[4] Although it was stated that[5] in similar media the interconversion of racemic sulfoxides took place thermally to yield 0-9% excess of one enantiomer, the details of experimental methods were important for reproducing these results.[4] We now wish to report an easily reproducible way of asymmetric induction for sulfoxides by the stereomutation with optically active acids.

The pioneered work done by Mislow and coworkers has shown that optically active sulfoxides racemize at high temperature and/or in the presence of acid, and in many cases it accompanies with reduction or decomposition.[1a] It would then be highly possible to convert a racemic sulfoxide into optically active form had the acidic medium be also an optically active one. Indeed, heating of racemic methyl phenyl sulfoxide (1) with (+)-camphorsulfonic acid (2) in

aqueous ethanol results in an asymmetric induction with maximum optical yield of 6.1%.

Two millimoles of 1 and 30 mmol of 2 were dissolved in 5 ml of an oxygen-free solvent, and the solution was sealed in an ampule under nitrogen. It was then heated at certain temperature for certain length of time. The sulfoxide was extracted with benzene, analyzed by gas chromatography (Carbowax 20M), and isolated by column chromatography (silica gel). The optical rotation of the recovered 1 was measured, and the percent enantiomeric excess was calculated. Pertinent data are listed in Table 1.

Table 1. Asymmetric Induction of Methyl Phenyl Sulfoxide with (+)-Camphersulfonic Acid

Solvent	Temp, °C	Time, day	$[\alpha]_D$ of recovered 1[a]	E.e., %[b]
EtOH	100	2	-3.58°	2.0
95% EtOH	100	2.5	-10.87°	6.1
	90	5	-6.82	3.9
	80	11	-5.85	3.3
80% EtOH	100	3	-6.51	3.7
H_2O	100	2	-1.36	0.8

[a] In chloroform. [b] Based on the highest reported specific rotation, see U. Folli, D. Iarossi, F. Montanari, and G. Torre, J. Chem. Soc. (C), 1317 (1968).

The most suitable condition for this conversion is likely to be the use of 2 in 95% ethanol at 100°C for 60 hours. Enantiomeric excess of greater than 6.1% would not be found even if more 2 or less solvent was employed. The use of less 2 led to lower extent of conversion. Heating of 1 alone in a neutral chiral medium, such as (-)-2-methyl-1-butanol or (-)-menthyl methyl ether, afforded only a negligible enantiomeric excess. Consequently, a chiral acid is essential for this stereomutation. Reaction at higher temperature caused

considerable amount of decomposition. Moreover, the yield of the enriched (S)-(-)-1 gradually decreased with prolong heating (Table 2). Obviously the observed enrichment of (S)-1 is not due to the enantioselective destruction of (R)-1. On the contrary, the S isomer decomposed more rapidly than the R isomer did in the presence of 2, for the treatment of the optically active (S)-1 (3.3% e.e.) under the same conditions brought about a nearly complete racemization. A similar phenomenon was also noted when an optically active sulfoxide was irradiated in cholesteric medium.[4]

Table 2. Stability of Methyl Phenyl Sulfoxide in the Presence of (+)-Camphorsulfonic Acid[a]

Sulfoxide	Time, day	E.e. of 1, %	Recovery of 1, %[b]
±1	1	3.4	98
	2	5.2	96
	2.5	6.1	95
	3	4.6	93
-1[c]	2.5	0.0	93

[a] In 95% ethanol at 100°C. [b] GC analysis. [c] E.e. 3.3%.

Evidently, these results indicate a new type of asymmetric induction, in which the racemic 1 is directly converted into an enantiomerically enriched one upon interacting with an optically active acid at elevated temperature. In addition, our preliminary data also suggest that the configuration of the resultant 1 might depend on the configuretion of the chiral acid employed. For example, the use of (2R, 3R)-(+)-tartaric acid led to the (S)-(-) isomer of 4.6% e.e. similar to the case in which (R)-(+)-camphorsulfonic acid was employed, whereas the use of (2S, 3S)-(-)-tartaric acid led to the (R)-(+) isomer of 4.4%e.e.. This is similar to the stereochemical consequence found in our previous work on the asymmetric oxidation of sulfides to sulfoxides.[6] Further study in this respect is in progress.

Acknowledgement

We are indebted to the National Science Council for financial support, and to Professor Kung-Tsung Wang for providing the polarimeter for this study.

References

1. For review see (a) K. Mislow, Record Chem. Progr., 28, 217 (1967); (b) J. G. Tillett, Chem. Rev., 76, 747 (1976).
2. For example of recent work, see E. Ciuffaein and S. Gambarotta, J. Chem. Res. (S), 274 (1978).
3. G. Balavoine, S. Juge, and H. B. Kagan, Tetrahedron Letters, 4159 (1973).
4. C. Eskenazi, J. F. Nicoud, and H. B. Kagan, J. Org. Chem., 44, 995 (1979).
5. W. H. Pirkle and P. L. Rinaldi, J. Amer. Chem. Soc., 99, 3510 (1977).
6. K.-T. Liu and Y.-C. Tong, J. Chem. Res. (S), 276 (1979).

(Received in Japan 5 April 1980)