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A Novel Catalytic Cycle For The Synthesis Of Epoxides Using Sulfur Ylides: Application To Base Sensitive Aldehydes.

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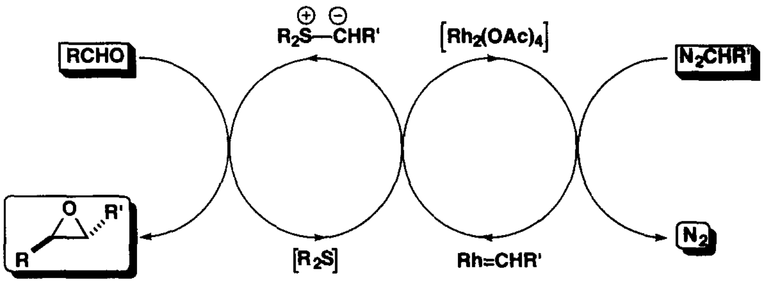
Abstract: *Epoxidation of base sensitive aldehydes can be achieved by a new catalytic cycle which requires the slow addition of a diazocompound to a solution of an aldehyde containing catalytic quantities of a sulfide and catalytic quantities of rhodium acetate.*

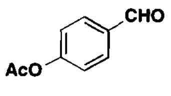
The reaction between sulfonium salts and carbonyl compounds to give epoxides are usually mediated by base, typically KOH/NaOH in wet acetonitrile[1,2] or dimsyl sodium in DMSO.[3] However, carbonyl compounds containing sensitive functional groups may not be compatible with the basic conditions required and alternative strategies for epoxidation (e.g. oxidation of an alkene) are usually required. We have recently discovered a novel catalytic cycle for epoxidation of carbonyl compounds which is carried out under *neutral* conditions (scheme 1)[4] and so base sensitive functional groups should survive the very mild reaction conditions.



Scheme 1

In this paper, the neutral conditions of our catalytic cycle for effecting epoxidation of carbonyl compounds is highlighted by carrying out epoxidation on base sensitive aldehydes.

A number of base sensitive aldehydes (**1**-**5**) were subjected to epoxidation using the two traditional methods (KOH/NaOH in wet acetonitrile and dimsyl sodium in DMSO) and our newly developed catalytic cycle and the results are summarised in table 1. Our selection of aldehydes was made primarily on their sensitivity: p-acetoxy benzaldehyde **1** has an extremely labile ester group, chiral aldehyde **2**[5] has a potentially epimerisable proton, glyoxylate **3** readily forms hydrates in the presence of trace amounts of water, phenyl acetaldehyde **4**, is particularly prone to enolisation and self condensation, and acrolein **5** polymerises easily.[6]



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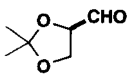

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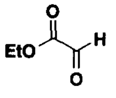

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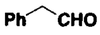

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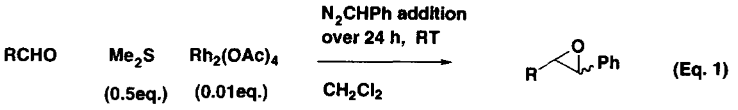

Table 1: Yields and Ratios of Epoxides Formed From Aldehydes 1-5 Under Different Conditions

aldehyde	yield of epoxide			ratio[d]
	Me_2S[a]	DMSO[b]	KOH[c]	(trans:cis)
1	75%	33%	-	50:50
2	73%	34%	-	33:33:33[e]
3	53%	53%	-	100:0
4	80%	43%	-	90:10
5	54%	23%	16%[f]	92:8

a Neutral reaction as shown in equation 1.
b Dimsyl sodium in DMSO and dimethyl benzyl sulfonium perchlorate (ref 3).
c KOH in wet acetonitrile and dimethyl benzyl sulfonium perchlorate (ref 1).
d Ratio of epoxide diastereomers for equation 1, determined by NMR integration .
e Product is a trans:trans:cis ratio of epoxy diastereoisomers.
f Obtained from ref 6.

For all the aldehydes tested, no epoxide was obtained using the KOH method (except a low GC yield for acrolein[6]) but reduced yields of epoxides were obtained using the dimsyl sodium method compared to the use of our new catalytic cycle. Particularly noteworthy, are the successes with glyoxylate **3** and acrolein **5** as these provide important epoxides with useful functionality for further manipulation.

In summary, our new catalytic cycle for epoxidation gives much improved yields of epoxides than those obtained using traditional sulfur ylide chemistry and in addition requires the use of just catalytic amounts of sulfides. Our new catalytic cycle is tolerant of a wide variety of sensitve functional groups.

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References

(1) Borredon, E.; Delmas, M.; Gaset, A. *Tetrahedron. Lett.* **1982**, *23*, 5283-5286.
(2) Borredon, M. E.; Delmas, M.; Gaset, A. *Tetrahedron* **1987**, *43*, 3945-3954.
(3) Corey, E. J.; Chaykovsky, M. *J. Am. Chem. Soc.* **1965**, *87*, 1353-1364.
(4) Aggarwal, V. K.; Abdel-Rahman, H.; Jones, R. V. H.; Lee, H. Y.; Reid, B. D. *J. Am. Chem. Soc.* **1994**, *116*, 5973-5974.
(5) This aldehyde has been reacted with dimethyloxosulfonium methylide and dimethylsulfonium methylide and gave a 65:35 ratio of diastereoisomers: Hagen, S.; Anthosen, T.; Kilas, L. *Tetrahedron* **1979**, *35*, 2583-2589.
(6) This adehyde has been reacted with dimethyl benzyl sulfonium ylide and obtained a 16% yield of the corresponding epoxide: Hagen, S.; Anthosen, T.; Kilas, L. *Tetrahedron* **1979**, *35*, 2583-2589. The 16% yield quoted represents a GC yield, not an isolated one..

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