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AZIRINE ALKYLATION

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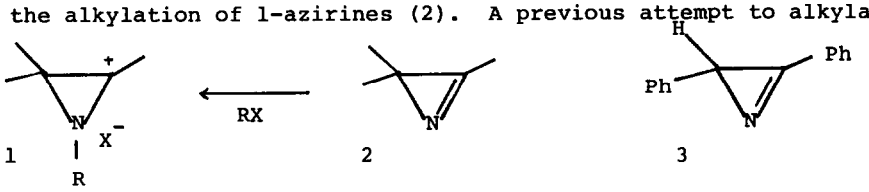
Aziridinyl cations (1) have been postulated as reaction intermediates.[1,2] In spite of their theoretical and synthetic interest, inaccessibility has prevented any systematic study. One potentially useful route to these cations involves the alkylation of 1-azirines (2). A previous attempt to alkylate

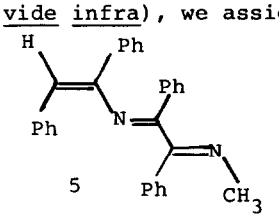


1 2 3

1-azirines has been made and it was reported that 1-azirines are inert towards alkylation.[2] Subsequent to these attempts more reactive alkylating agents have become available and in this communication we would like to report the successful alkylation of 2,3-diphenyl-1-azirine (3).[3]

A 0.5 M solution of 3 and carbon tetrachloride was frozen at -78°. An equimolar solution of methyl triflate and dichloromethane was then added at -78°. The resultant mixture was allowed to warm slowly to ambient temperature and stirred for several hours. After this time bright yellow crystals of 4 (46% yield) precipitated from the solution. This product's elemental analysis indicated a substance derived from two molecules of 3 and one of methyl triflate.[4] A nmr spectrum in liquid SO_2 showed a methyl singlet at δ3.31, a one-proton singlet at δ6.34 and twenty aromatic protons. Treatment of 4 with aqueous sodium bicarbonate yielded the free base (5) in quantitative yield (melting point 157.5 to 159.5°). The nmr spectrum of 5 in liquid SO_2 showed aromatic protons, a three-proton singlet at δ2.98 and a one-proton singlet at δ5.78. Treatment of 5 with trifluoromethane sulfonic acid regenerated 4.

On the basis of the above information and mechanistic consideration (vide infra), we assigned structures 4 and 5.[5] Confirmation of these structures



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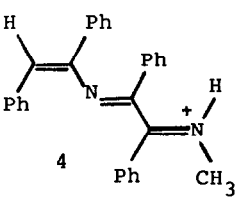
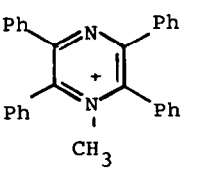


4

$CF_3SO_3^-$



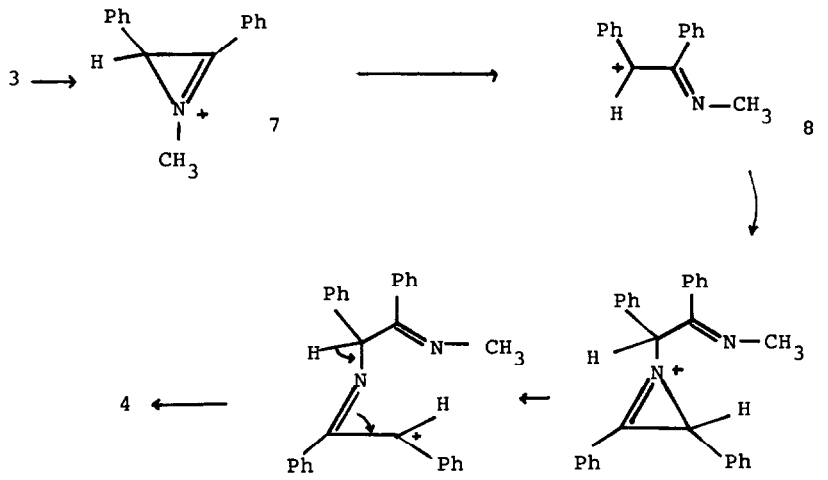
6

$CFSO_3^-$

was obtained by refluxing 4, aqueous hydrochloric acid and ethanol for 12 hours. From this reaction N-methyltetraphenylpyrazine triflate (6) was isolated in 40% yield (melting point 262.5 - 264°). This material was identical to an authentic sample of this material prepared by alkylation of the known tetraphenylpyrazine.[6]

The formation of 4 can be explained by the pathway indicated in Scheme I. We propose that the initial step is alkylation of the azirine[7] to generate intermediate 7. Even under mild alkylating conditions, 7 undergoes ring opening to the unstable but less strained cation 8.[1a] This unstable cation then, in turn, alkylates the second molecule of 3 and proceeds, in turn, to generate product 4.

Scheme I



We have demonstrated, therefore, that aziridinyl cations may be generated from azirines via alkylation. It is evident from Scheme I and previous work[1a] that the stability of the aziridinyl cation towards ring opening is dependent upon the C_2 and C_3 substituents. Our work thus suggests that it should be possible to choose azirine substituents (releasing at C_2 and attracting at C_3) which would allow alkylation and discourage ring opening. This and related approaches are in progress.

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REFERENCES AND NOTES

1. cf. (a) J.A. Deyrup and R.B. Greenwald, J. Amer. Chem. Soc., 87, 4538 (1965); (b) A. Hassner, S.S. Burke and J. Cheng-fan I, Ibid., 97, 4692 (1975); (c) R.E. Brooks, J.O. Edwards, G. Levy and F. Smyth, Tetrahedron, 22, 1279 (1960); (d) N.J. Leonard and B. Zwanenburg, J. Amer. Chem. Soc., 89, 4456 (1967).
2. F.W. Fowler and A. Hassner, J. Amer. Chem. Soc., 90, 2875 (1967).
3. F.W. Fowler, A. Hassner and L.A. Levy, J. Amer. Chem. Soc., 89, 2077 (1969)
4. Satisfactory elemental analyses, mass spectra and pmr spectra were obtained for all new compounds.
5. The stereochemistry and site of protonation in 4 are unknown and written as shown for convenience.
6. F.R. Japp and W.H. Wilson, J. Chem. Soc., 49, 875 (1886).
7. cf. J.A. Deyrup and W.A. Szabo, J. Org. Chem., 40, 2048 (1975).