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SYNTHESIS OF SPIROFLUORENES *via* KETENE ADDUCTS

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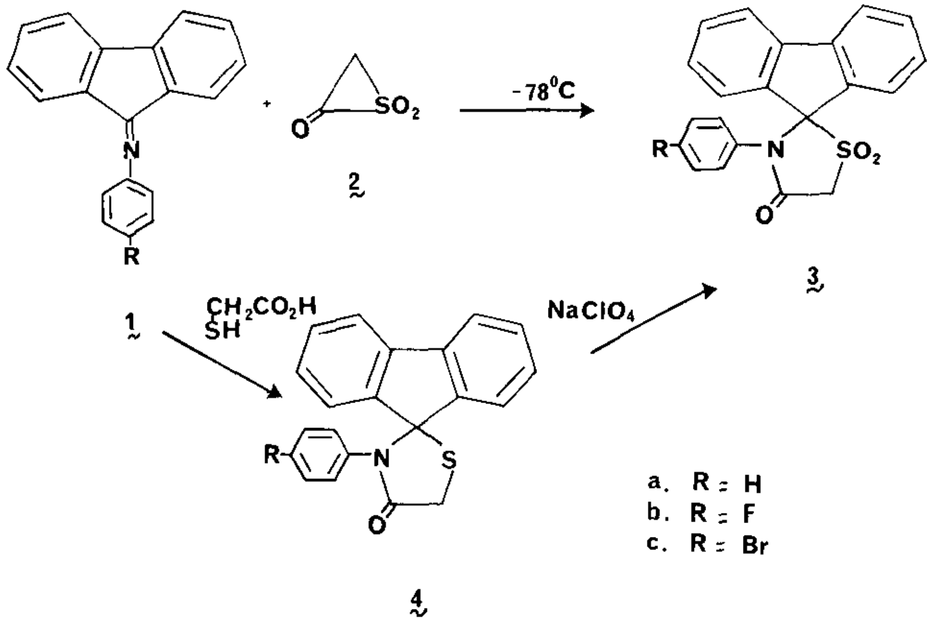
Abstract - New classes of spirofluorenes were prepared *via* simple transformations of ketene adducts.

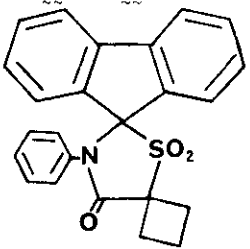
We have recently reported the synthesis of spirofluorenes of biological interest by conventional synthetic routes.[1,2] As a continuation of our investigations of the biological activity of spirofluorenes, we now wish to report the synthesis of novel spirofluorenes using ketene adducts as precursors.

The cycloadditions of N-fluorenylideneanilines **1** with 2-oxathiirane 1,1-dioxide **2** afforded spirothiazolidinones **3a-c** in 70-80% yields. The same compounds were also prepared by an alternate synthetic route involving the condensation of imines **1a-c** with mercaptoacetic acid and subsequent oxidation of the intermediate spirothiazolidinones (**4a-c**) with sodium perchlorate (Scheme 1).[3,4] The yields for both methods were comparable.

Scheme 1



Another class of spirofluorenes (5 and 6) were prepared _via_ the simple and mild transformation of ketene adducts 3a and 3c.



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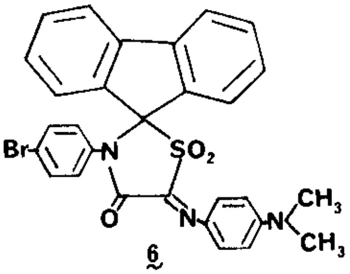

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Compound 5 was prepared by heating 3a with a strong non-nucleophilic base such as sodium hydride in DMF at 100° (½ hr.), followed by alkylation with 1,2 dibromopropane. In the presence of an excess of sodium hydride, the generated tertiary anion displaces the remaining bromine of the substituted bromopropane to afford 5 (8 hr). Compound 6 was obtained by heating 3c with p-N,N-dimethylaminonitrosobenzene and a catalytic amount of ammonium acetate in dry benzene and removing the water formed in the reaction by azeotropic distillation. Previous investigators had described the reactions of ketenes with N-benzylidenealkylamine or - arylamine N-oxides.[5,6] We have extended these investigations to N-fluorenylidenealkylamine or - arylamine N-oxides.[7,8] Although the reaction of diphenylketene and N-fluorenylidenemethylamine N-oxide was reported by Taylor et al.[6] to afford, among other products, spirooxazolidinone 7, only the melting point (145°) of this compound was given. Since no spectral or analytical data was available at the time, we reinvestigated this reaction.[9] When this condensation was carried out in benzene,

Scheme 2

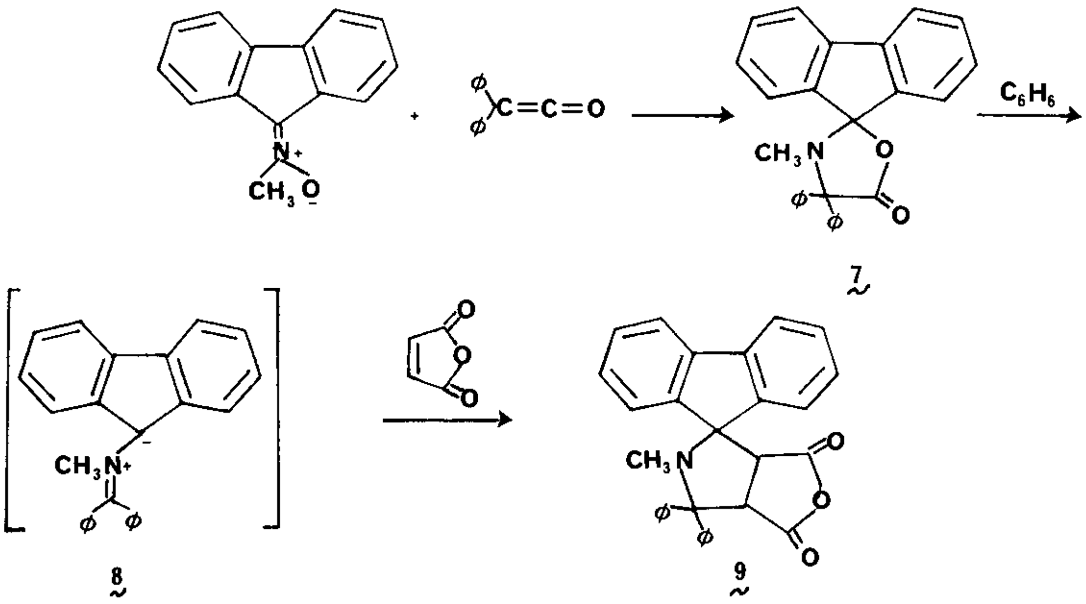

Table 1. Physical and Spectral Properties of Spirofluorenes.

Compound No.	Yield, %	mp, °C	Spectral Data
3a	81	260-262	IR ν_{max}^{KBr} 1680 (C=O), 1140 and 1335 cm^{-1} (SO$_2$); ^{1}HNMR(CDCl$_3$) δ 5.0(s,2H), 6.65-7.0(m, 5H), and 7.3-8.0(m, 8H); m/e 361 (M$^+$).
3b	76	237-239	IR ν_{max}^{KBr} 1680 (C=O), 1130 and 1325 cm^{-1} (SO$_2$); ^{1}HNMR(CDCl$_3$) δ 5.0(s, 2H) and 6.85-7.95(m, 12H); m/e 315 (M$^+$-SO$_2$).
3c	79	240-241	IR ν_{max}^{KBr} 1700 (C=O), 1140 and 1325 cm^{-1} (SO$_2$), ^{1}HNMR(CDCl$_3$) δ 4.95(s,2H), 6.70-7.1(m, 4H) and 7.20-7.9(m, 8H).
4a	71	225-227	IR ν_{max}^{KBr} 1650 (C=O), ^{1}HNMR(CDCl$_3$) δ 4.25(s, 2H) and 6.55-7.8(m, 13H); ^{13}CNMR(CDCl$_3$) 78.27 ppm(C-9).
4b	82	130-132	IR ν_{max}^{KBr} 1650 (C=O), ^{1}HNMR(CDCl$_3$) δ 4.20(s, 2H), and 6.75-7.95(m, 13H).
5	63	223-225	IR ν_{max}^{KBr} 1675 (C=O), 1115 and 1320 cm^{-1} (SO$_2$); ^{1}HNMR(CDCl$_3$) δ 2.1-2.5 (m, 2H), 2.9-3.2(t, 4H), and 6.8-7.5(m, 13H); m/e 401 (M$^+$).
6	82	138-140	IR ν_{max}^{KBr} 1680 (C=O), 1600 (C=N), 1120 and 1320 cm^{-1}(SO$_2$); ^{1}HNMR(CDCl$_3$) δ 3.1(s, 6H), 6.6-6.8 (m, 4H), and 7.1-7.8(m, 12H).
7	72	148-150	IR ν_{max}^{KBr} 1775 cm^{-1} (C=O), ^{1}HNMR(CDCl$_3$) δ 2.15(s,3H) and 7.1-7.6(m, 18H); ^{13}CNMR(CDCl$_3$) 102.7 ppm (spiro C-9); m/e 403 (M$^+$).
9	59	237-239	IR ν_{max}^{KBr} 1775 and 1840 cm^{-1}(C=O); ^{1}HNMR(CDCl$_3$) δ 2.25 (s,3H), 3.41-4.0 (m, 2H), and 6.4-7.9 (m, 18H); m/e 457 (M$^+$).

spirofluorene **7** was obtained as the sole product. Attempts to condense diphenylketene with N-fluorenylideneaniline N-oxide resulted in the formation of an unstable adduct which decomposed with gas evolution.

When **7** was heated in benzene, loss of carbon dioxide occurred to afford the highly colored nitrogen ylid (**8**) which was trapped with maleic anhydride to afford spirofluorene **9** (Scheme 2). Attempts to form a similar ylid form the adduct obtained form *tert*-butylcyanoketene and N-fluorenylidenemethylamine N-oxide were unsuccessful.

REFERENCES AND NOTES

1. M. A. Abou-Gharbia and M.M. Joullié, *J. Pharm. Sci.*, **66**, 1977, 1653.
2. M. A. Abou-Gharbia, T. T. Su and M. M. Joullié, *J. Pharm. Sci.*, **67**, 1978, 953.
3. A. Gomes and M. M. Joullié, *J. Heterocycl. Chem.*, **6**, 1969, 729.
4. Sodium permanganate afforded a poor yield of the sulfone and m-chloroperbenzoic acid gave no yield.

. R. N. Pratt, D. P. Stokes, G. A. Taylor and P. C. Brookes, *J. Chem. Soc. (C)*, 1968, 2086; D. P. Stokes and G. A. Taylor, *ibid.*, 1971, 2334.

6. A. F. Gettins and G. A. Taylor, *J. Chem. Soc. Chem. Comm.*, 1972, 1146.
7. M. A. Abou-Gharbia and M. M. Joullié, *Synthesis*, **5**, 1977, 318.
8. M. A. Abou-Gharbia, I. Miura and M. M. Joullié, *Heterocycles*, **9**, 1978, 457.
9. A subsequent publication, A. F. Gettins, D. P. Stokes, and G. A. Taylor, *J. Chem. Soc. Perkin I*, 1977, 1849, reports additional data for **7**, however, the melting point given, 138° still disagrees with our value (148-150°) and their previous results. (145°).

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