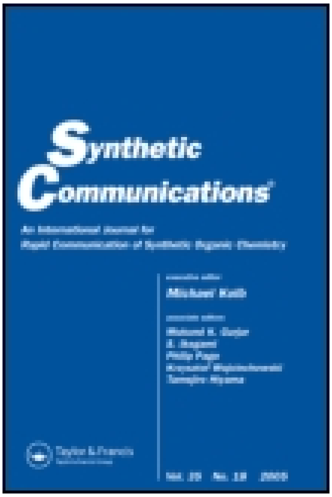

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Microwave Assisted Rupture of Furoxans to Nitrile Oxides and Intermolecular Capture by Dipolarophiles

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MICROWAVE ASSISTED RUPTURE OF FUROXANS TO NITRILE OXIDES AND INTERMOLECULAR CAPTURE BY DIPOLAROPHILES

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Abstract: 3,4-Diaroylfuroxans **1** react with various dipolarophiles **3** under microwave activation to afford the cycloadduct **4** instead of the expected isoxazole **5** in good yields in the absence of solvent.

Extensive studies have been carried out on the thermal regeneration of alkyl and aryl substituted nitrile oxides from the corresponding furoxans[1]. Only strained furoxans and furoxans bearing bulky substituents revert to nitrile oxides at moderate temperature[2]. More generally, 3,4-disubstituted furoxans revert to nitrile oxides only at temperature at which the nitrile oxides rapidly rearrange to isocyanates[3], although thermolysis of unstrained aliphatic and aromatic furoxans at 245°C to afford the corresponding nitrile oxides has been described by Chapman et.al[4]. In contrast, with the exception of acetyl and benzoyl nitrile oxide, which have been generated in situ from hydroximic acid halides or nitrolic acids[3,5] the

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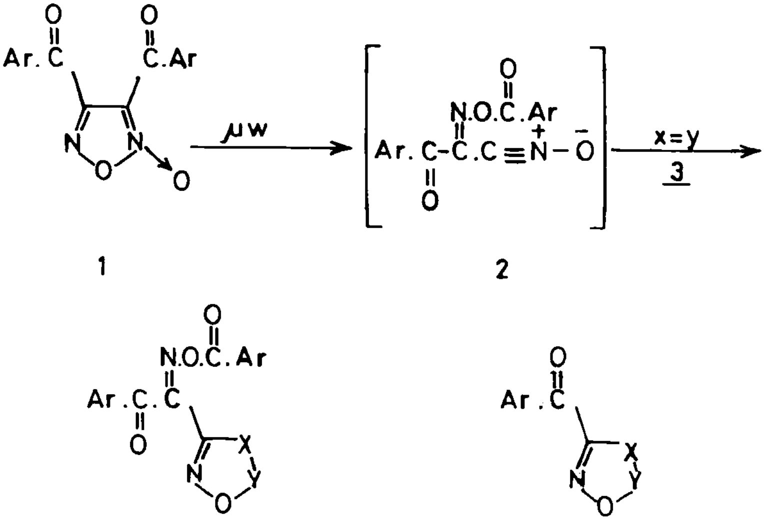
*To whom the correspondance should be addressed chemistry of acyl nitrile oxides is less investigated[6]. Boulton et.al. reported regeneration of acyl nitrile oxide from the corresponding diacylfuroxan dimers[6,7]. Herein we wish to report the first example of in situ generation of aroyl nitrile oxide from the corresponding diaroyl furoxan and their cycloaddition reactions with various dipolarophiles under microwave irradiation[8]. The reaction proceeds efficiently in good yields at ambient pressure within minute time and in the absence of solvent.



Ar = Ph, p-MeC_6H_4

x = y = MeOOCC ≡ CCOOMe

Ph C ≡ CH

PHCH = CH_2

PhCH = CHPh

Ph C ≡ CCOMe

The 3,4-dibenzoyl furoxan used was prepared by the reaction of acetophenone with dilute nitric acid in acetic acid solution followed by the addition of a little sodium nitrite as an initiator. this was than mixed thoroughly with dimethyl acetylenedicarboxylate in an Erlenmeyer flask and placed inside the microwave oven and irradiated for 12 mins. After usual work-up, affords a 2:1 adduct of benzoylnitrile oxide to dimethyl acetylenedicarboxylate (DMAD) exclusively, i.e. dimethyl 3-(O-benzoylbenzoylformaldoximino)isoxazole-4,5-dicarboxylate mp 97-98°C (Lit[6] mp 96.5-98); IR ν_{max} ($CHCl_3$) 1750, 1675, 1610 cm^{-1}. ^1H NMR ($CDCl_3$) δ 3.60 (s, 3H, $COOCH_3$), 4.10 (s, 3H, $COOCH_3$), 6.42-7.30 (m, 10H, aromatics), instead of the anticipated isoxazole **5** in 60% yields. Further increasing the reaction time gave no significant improvement in yields but rather decomposition of product occurred. The structue of the cycloadduct **4** thus obtained was finally confimed by comparing with an authentic sample. The reaction proceeds by the rearrangement of dibenzoylfuroxan and intramolecular transfer of the benzoyl group to afford the nitrile oxide **2** (perhaps the presence of polar N-O-functionalities in the furoxans and nitrile oxides render them efficient as micowave absorbers), which cycloadds to various dipolarophiles **3** to produce the cycloadduct **4** and there was no evidence for the formation of any other cycloadduct of the type **5**.

As shown in Table 1, several structurally varied dipolarophiles including phenyl acetylene, styrene, phenyl styrene, N-methyl maleimide and 4-phenyl 3-butyn 2-one underwent clean and remarkably fast cycloaddition with diaroylfuroxans under this procedure. Interestingly it was also observed that the presence of solvent slowered the reacion (the above reaction entry 1 takes about 6-8 hours for completion when carried out in toluene) the reasons for the efficiency of the process on the solid phase are not yet clear.

In conclusion it is noteworthy to mention that this simple and easily reproducible technique affords various cycloadducts in just one pot in shorter

Table 1: **Reaction time and yield of the product 4 in the cycloaddition of diaroyl furoxans with dipolarophiles.**

Entry	Ar	X=Y	Reaction time (min)	Lit reaction time	Yield[a] %	Lit[b] yield %
1	Ph	$MeOOCC\equiv CCOOMe$	12	-	60	43[6]
2	Ph	$Ph\ C\equiv CH$	15	4 hr[6]	65	70[7]
3	Ph	$PhCH=CH_2$	18	6 hr[6]	60	35[7]
4	Ph	$PhCH=CHPh$	14	-	55	25[7]
5	$4\text{-}MeC_6H_4$	$Ph\ C\equiv CCOMe$	15	-	65	50[6]
6	$4\text{-}MeC_6H_4$	$MeOOCC\equiv CCOOMe$	15	-	60	-
7	$4\text{-}MeC_6H_4$	$Ph\ C\equiv CH$	14	-	65	-
8	$4\text{-}MeC_6H_4$	$PhCH=CH_2$	18	-	60	-

[a] All the yields refer to isolated chromatographically pure compounds. [b] All the assigned structures have been confirmed by spectroscopic data (IR, NMR, MS) and melting points with those of authentic samples.

reaction time and with better yields than the classical homogeneous reactions in solvents under microwave irradiations.

Experimental

Mps were determined by using a buchi melting point apparatus and are uncorrected. The IR spectra were obtained on a Perkin-Elmer 237B IR spectrophotometer. All reagents were of commercial quality from freshly opened containers and were of commercial quality from freshly opened containers and were purchased from Aldrich Chemical Company and used without further purification. All the diaroyl furoxans used were freshly recrystallised before use and their properties checked by elemental analyses and spectroscopic data. The commercial microwave oven used is operated at 2450 MHz frequency.

Cycloaddition reaction of 3,4-diaroylfuroxans 1 with various dipolarophiles 3: General Procedure

In a typical case, 3,4-dibenzoylfuroxan (1.18g, 4 mmol) and dimethyl acetylene dicarrboxylate (1.42g, 10 mmol) were mixed together without solvent in an Erlenmeye Flask and placed in a commercial microwave oven (operating at 2450 MHz frequency) and iradiated for 12 mins. The reaction mixture was allowed to reach room temperature and extracted with dichloromethane (3 x 30ml). Removal of solvent and the residue on purification by column chromatography using chloroform-petroleum ether (3:1) as the eluent affords the cycloadduct dimethyl 3-(O-benzoyl formaldoximino) isoxazole-4, 5-dicarboxylate in 60% yield mp. 96-97°C (Lit[6] m.p. 96-98°C). Similarly other substrates were reacted under microwave irradiations and the corresponding cycloadducts 4 were isolated in 55-65% yields. The characteristics of these compounds are recorded in the table 1.

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