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Chemically Induced Dynamic Nuclear Polarization during Pyrrolysis of O,O'-Diacyl-4-hydroxyaminoquinoline 1-Oxide[1]

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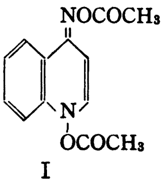
The chemically induced dynamic nuclear polarization (CIDNP) in nuclear magnetic resonance (NMR) spectroscopy has been extensively studied in the pyrrolysis of acylperoxides and azo compounds[3-9] and the halogen-metal exchanges[10-19] since this phenomenon was observed by Bargon, Fischer, and Johnson[3-5] and independently by Ward and Lawler.[10-12]

This short note describes CIDNP spectra obtained by pyrrolysis of O,O'-diacyl-4-hydroxyaminoquinoline 1-oxides[20] which involve a partial structure of =N-COR. O,O'-Diacetyl-4-hydroxyaminoquinoline 1-oxide (I)[21,22] dissolved in dioxane was sealed in an NMR sample tube and inserted into an NMR probe heated previously at 80°. The spectrum-recording of the signal in question was repeated as quickly as possible for recording a time-course change in the spectrum, as shown in Fig. 1. A few seconds after the sample insertion, a singlet signal due to methane protons appeared at 9.82 τ and rapidly increased until the signal height reached a maximum within less than 10 sec. Then, the signal became rapidly diminished up to a barely detectable extent in a lapse of a few minutes after the start of pyrrolysis. Enhancement factors



I

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[1] This study constitutes Part XIII of a series entitled "Studies on Chemical Carcinogens". Part XII: Y. Kawazoe, M. Tamura, and M. Araki, *Gann*, **61**, 593 (1970).

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[20] This compound is one of the derivatives which are supposed to be the proximate carcinogen in the carcinogenesis of 4-nitroquinoline 1-oxide.

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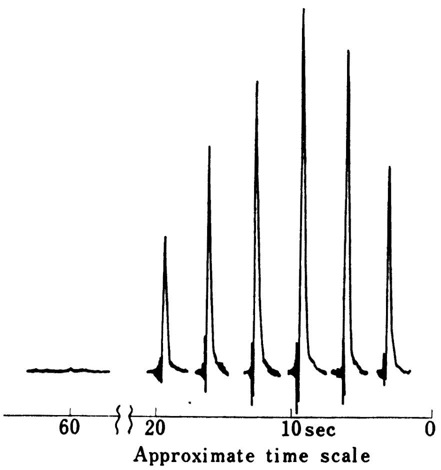

Fig. 1. Time-course Change in CH_4 CIDNP Signal at 9.82 τ Measured in Dioxane at 80°

Signal-height of the acetyl methyl protons before pyrrolysis was about 1/20 times lower than the highest peak seen in this figure.

Fig. 2. CIDNP Spectrum of CH_3D and CH_4 in Dioxane-d_6 at 80°

could not be measured accurately but the signal of methane protons was in apparent about 20 times more intense at maximum than that of the original acetyl methyl signal found in the starting spectrum. A less but definitely enhanced signal was observed at 50° over a lapse of more than 10 min. When the pyrrolysis was carried out in dioxane-d_6, an equally spaced triplet due to CH_3D protons was observed overlapped with a singlet signal of non-labeled methane protons, as reproduced in Fig. 2. The enhanced triplet spaced by $J_{HD}=2.1$ cps appeared at 0.01 ppm higher field than the non-labeled methane signal.[23] When carbon tetrachloride was used as the solvent, a CIDNP spectrum due to chloromethane was observed at 80° with an enhancement factor similar to that of methane.

These observations indicate that a homolytic fission of =N-O- bond was thermally induced and that an acetoxy radical thus produced was degradated to carbon dioxide and methyl radical. Then, the methyl radical, which had equal populations of unpaired electron at two spin states, abstracted a hydrogen from a solvent molecule. As a result, the methane molecule thus produced involved nuclear-polarized protons.[3–19] Signal-enhancement was reasonably understood in this way. The reaction scheme may be formulated as follows:[26]

$$\text{Diacetate (I)} \longrightarrow CH_3COO\cdot + \text{free radicals}$$

$$CH_3COO\cdot \longrightarrow CH_3\cdot + CO_2$$

$$CH_3\cdot \longrightarrow CH_4 \text{ (or } CH_3Cl)$$

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23) This sort of isotope effect on chemical shifts is widely known in some organic compounds.[24,25]

24) G.V.D. Tiers, *J. Chem. Phys.*, 29, 963 (1958).

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26) It was confirmed by chemical and gas chromatographic analysis that 0.4 equivalent moles of methane was evolved, accompanied with 0.4 equivalent moles of CO_2 and 0.8 equivalent moles of acetic acid.[22,27] Unidentified complex products were also produced thereby. The details of this pyrrolysis are to be published in near future.[27]

27) M. Araki, C. Nagata and Y. Kawazoe, *Chem. Pharm. Bull.* (Tokyo), to be published.

O,O′-Dibenzoyl derivative of 4-hydroxyaminoquinoline 1-oxide underwent a similar pyrrolysis to give an enhanced CIDNP spectrum of benzene protons.

Pyrrolysis of O-acylhydroxylamines, induced by homolytic fission of N-O bond, is being examined in detail with a help of CIDNP method in our laboratory.

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A New Method for the Colorimetric Determination of Acrinol Base by Solvent Extraction with Tetrabromophenolphthalein Ethyl Ester

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In general, acid dye[2,3] is known to react with amine or quarternary ammonium salt to form a colored compound. Bromothymol blue,[4] bromocresol green[5] or bromophenol blue[6] has been used for the conventional determination of thiamine, quartenary ammonium compound or quinine.

Tetrabromophenolphthalein ethyl ester (TBPE) is well known as a pH indicator. Various amines and organic cations were found to be extracted with TBPE into 1,2-dichloroethane. The colors of the extracted species can be classified into the following three categories. (1) Blue species which is extracted by the presence of acrinol base, sparteine or thiamine. (2) Red-violet species which is developed by the presence of N,N-dimethylpiperazine, eserine or triethanolamine. (3) Yellow species which is the same color as reagent blank even in the presence of aniline, 3-aminoquinoline, pyridine, N,N-dimethylformamide, EDTA, or NTA.

The discussion of this paper deals with a spectrophotometric determination of acrinol base by solvent extraction with TBPE. The proposed method has a better reproducibility and a higher sensitivity. The titrimetric method[7] has been used for the determination of acrinol which is widely used as disinfectant. 3-Methyl-2-benzothiazolinone hydrazone-ferric chloride[8] was described as a spectrophotometric reagent for acrinol.

Experimental

Apparatus and Reagents——1) Apparatus: Shimadzu Model QR-50 spectrophotometer with 10 mm cuvettes. Iwaki Model KM shaker with a time switch. Toa Denpa Model HM-5 pH meter.

2) Reagents: All the chemicals were of reagent grade. All aqueous solutions were prepared by the use of deionized water.

a) Tetrabromophenolphthalein Ethyl Ester (TBPE) Solution: Weighed amounts of tetrabromophenolphthalein ethyl ester potassium salt (mol.wt. 700.1) were dissolved in ethyl alcohol.

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