

APPLICATIONS OF ADIABATIC RAPID PASSAGE TO CORRELATION NMR SPECTROSCOPY.  
II. MEASUREMENT OF SPIN-LATTICE RELAXATION TIMES

Hiroshi OZAWA and Yoji ARATA\*

Computer Center, The University of Tokyo, Bunkyo-ku, Tokyo 113

\* Department of Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113

An adiabatic rapid passage method in correlation NMR spectroscopy has been proposed for measurements of spin-lattice relaxation times, and an illustrative example is given.

In this note, we report an application of adiabatic rapid passage in correlation NMR spectroscopy<sup>1</sup> to the measurement of spin-lattice relaxation times  $T_1$ . Another application of the adiabatic rapid passage method to suppress unwanted solvent lines, a technique analogous to the WEFT method<sup>2</sup> in the pulse FT NMR, has already been reported in a previous paper.<sup>3</sup>

A JEOL 100 MHz PS-100 spectrometer with a few modifications is employed at a modulation frequency of about 8 kHz. A sequence of two frequency sweeps with a delay time  $\tau$  is used; the first sweep at a high RF power is for adiabatic inversion of the magnetizations, and the second one at a lower RF level is for sampling the transient response. This sequence of two sweeps is equivalent to the  $180^\circ$ - $\tau$ - $90^\circ$  pulse sequence in the pulse FT NMR. Any residual transverse magnetization after adiabatic inversion is eliminated, if necessary, by the technique of homogeneity spoiling.<sup>4</sup> The acquired transient is processed on a HITAC 8800/8700 computer system to obtain the corresponding correlation NMR spectrum.

Figure 1 shows a series of partially relaxed fast passage transients and their correlation NMR spectra of a mixture of dichloromethane, dioxane, acetone, and cyclohexane (molar ratio 70:5:15:10, bubbled with nitrogen) taken with different  $\tau$ 's after the adiabatic inversion. The fast passage transients were sampled at 25 °C for 1.024 sec using 4096 data points at the sweep rate 1633.8 Hz/sec, and no window function was used in reproducing the correlation spectra. A semilog plot of the magnetization vs. time (Fig. 2) yielded  $T_1$ 's of 9.7, 6.4, 8.7, and 8.6 ( $\pm 0.3$ ) sec for dichloromethane, dioxane, acetone, and cyclohexane, respectively. The  $T_1$  values are in good agreement with those obtained by the pulse FT method using the  $180^\circ$ - $\tau$ - $90^\circ$  pulse sequence.

The present method has an advantage over the pulse FT method in that one can determine  $T_1$ 's for a part of the spectrum without perturbing the remaining part of it. Details of the experiments will be reported in the near future.

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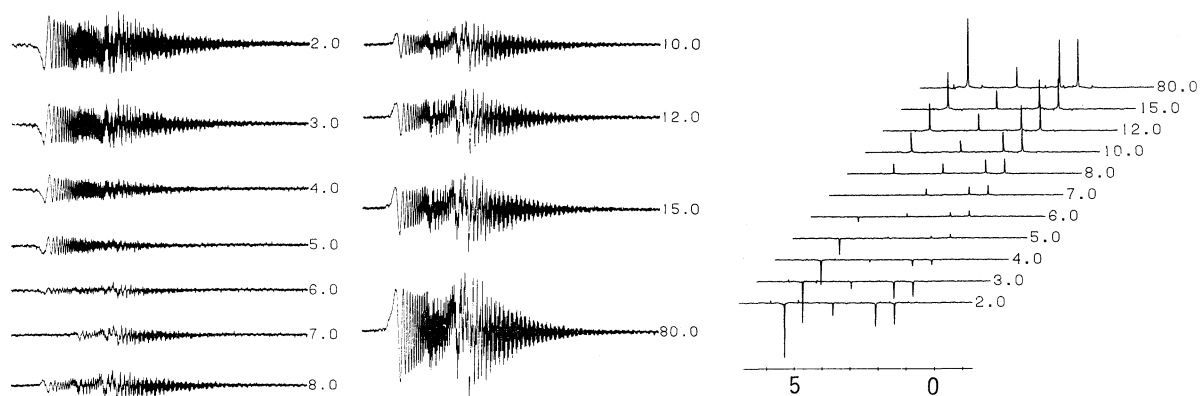


Fig. 1. Partially relaxed fast passage transient responses (left) and their correlation NMR spectra (right) of a mixture of dichloromethane, dioxane, acetone, and cyclohexane (from low to high field). Transients were sampled after the adiabatic inversion with delay times  $\tau$ 's (in sec) shown in the Figure. Chemical shifts in ppm are from external TMS.

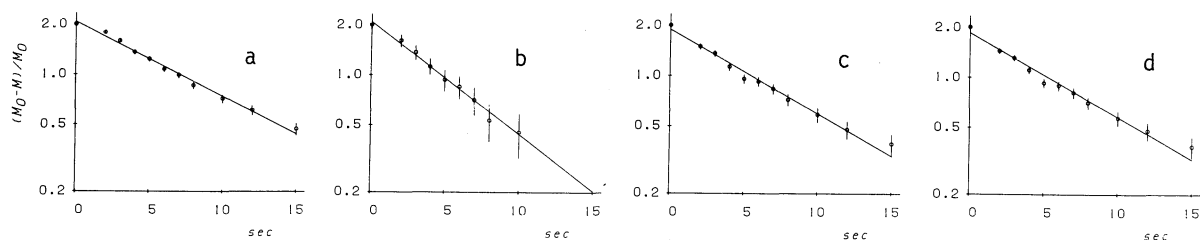


Fig. 2. Semilog plots of the magnetization vs. delay time  $\tau$  for dichloromethane (a), dioxane (b), acetone (c), and cyclohexane (d).

#### References

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