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Abstracts

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THE DIPOLAR ECHOES IN SOLIDS

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The "solid-echo" technique $90^0_Y - \tau - 90^0_X - Acq(t)$, proposed by Powles, Mansfield and Strange [1,2] provides means of circumventing the receiver dead-time problem, which would otherwise cause the omission of a major part of the free induction decay (FID) signal. At present this technique is a powerful NMR method for studying molecular structure and dynamics in solid state [3-12]. In this report the general "solid-echo" technique $(2n+1)\cdot 90^0_Y - \tau - 90^0_X - Acq(t)$ has been investigated.

It has been shown that at $M_2\tau_c^2 >> 1$ (the case of rigid lattice) and at $M_2\tau_c^2 << 1$ (the case of motional narrowed NMR line) the maximum of echo signal is observed at $t_e = 2\tau + t_2 - t_1/2$. (Here t_i ($i = 1,2$) are the widths of the RF pulses. The times t and τ are measured from the beginning of the first pulse).

From our consideration it follows that time position and amplitude of the echo maximum signal depend on the correlation time τ_c of molecular motion and on the RF pulses widths. Dramatically changes in the echo signal behavior are observed in the slow-motion region ($M_2\tau_c^2 \approx 1$), where the amplitude of the echo signal is reduced and the maximum of the echo signal is shifted to the end of the second pulse. We have shown that in the slow-motion region the time position and amplitude of the echo are sensitive to the details and thermal parameters of molecular dynamic process. It has been also shown that the study of the temperature dependence of the time position and amplitude of the echo maximum can yield valuable information about a shape of a potential well in solids.

The obtained theoretical results have been applied to the analysis of temperature dependencies of echo signals in polycrystalline ammonium chloride (NH_4Cl). The length of $\pi/2$ pulse was 3.6 μs. It has been investigated for $\tau - t_1 = 4\mu s$ and the following pulse sequences: $270^0_Y - \tau - 90^0_X - Acq(t)$, $450^0_Y - \tau - 90^0_X - Acq(t)$ and $630^0_Y - \tau - 90^0_X - Acq(t)$. The solid-echo signal of $90^0_Y - \tau - 90^0_X - Acq(t)$ has been also considered. A comparison of the developed theory with experimental results demonstrates a good agreement between them.

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