uclear acoustic echo in cobalt

V. F. Taborov

Institute of Metal Physics, Ukrainian Academy of Sciences
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Observation is reported of acoustic nuclear spin echo in single-crystal cobalt at a temperature 4.2 K in a magnetizing field 1.8 T.

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Nuclear echo in cobalt is easily observed when the nuclear spins are excited by an electromag-ic field. We know, however, of only one report of observation of nuclear acoustic echo in

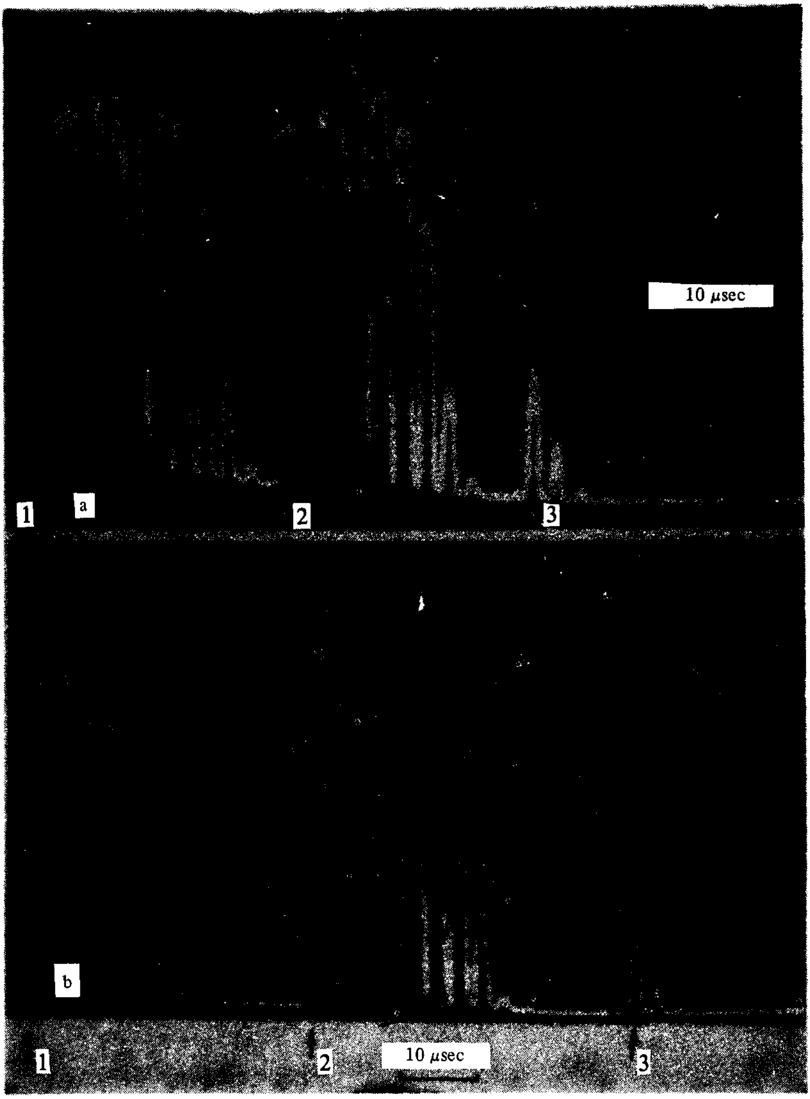

FIG. 1. Acoustic-echo signal (3); 1,2—first and second sounding pulses: a) $\tau = 30$ μsec and b) τ
μsec between 1 and 2.

magnetically-ordered crystals ($KMnF_3$ and $RbMnF_3$).[1] Experiments of this type on semicor tors are of particular interest. We report here the results of an experiment aimed at obse: nuclear acoustic echo in cobalt single crystals at a temperature 4.2 K.

It is known that magnetization, as a rule, affects adversely the condition for the observati nuclear resonance in cobalt. However, the magneto-acoustic interaction in single crystals of c in the demagnetized state is very small, but when the crystal becomes magnetized in the dif direction the interaction increases and has a maximum as a function as the field. Although a perature this maximum is not as large as at room temperature, it is precisely in the magnetized e that it becomes easy to observe the nuclear acoustic echo in cobalt. The experiment was 'ormed on a single-crystal cobalt sample of almost spherical shape with 12 mm diameter and ı small plane-parallel areas to which the piezoelectric sensor could be used. The longitudinal ıd was excited by a lithium-niobate plate at an approximate frequency 215 MHz. The direc- s of the sound propagation and of the magnetizing field were perpendicular to the easy axis. By ting the sample around the easy axis we could vary the angle between the sound propagation ction and the field direction.

Figure 1 shows oscillograms of the signals observed at delays 30 μsec (a) and 40 μsec (b) ⁄een the sounding pulses. After the sounding pulses 1 and 2, a series of reflected pulses is ːrved, followed by the echo signal 3, the first pulse of which is observed at the instant $\tau+t$, re τ is the delay time between the sounding pulses and t is the delay time of the acoustic pulse ıe sample. The relaxation time T_2, determined from the decrease of the echo-signal amplitude n the time of delay between the sounding pulses is increased at 4.2 K, turned out to be 35 μsec. echo signal is maximal at a frequency 215 MHz in a field of approximately 1.8 T. It can be med that the frequency 2.5 MHz, at the indicated value of the field, corresponds to the nuclear rption line of the magnetic absorption observed at 219.9 MHz in the demagnetized states.[2]

The oscillograms of Fig. 1 were obtained at a sounding-pulse repetition frequency 50 Hz. n the repetition frequency is increased above 200 Hz, the echo signal decreases. This means the relaxation time T_1 is of the order of 10^{-3} sec. Under the given experimental conditions, the signal is observed at all angles, in the basal plane, between the field direction and the sound ːtion. The signal was maximal at 45°, somewhat less at 90°, and several times smaller at 0°.

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