oscillatory fields. The observed intensity of the resonance corresponded to about 15% of the intensity of the beam emerging from the box. Surfaces of unheated eicosane and polyethylene have also been tried. Both gave Ramsey curves of a size comparable to that of heated teflon. At present we are trying to determine whether the small size of the Ramsey pattern truly represents relaxation of the atoms on the walls or is due to some experimental difficulty. It is suspected that the power levels in the microwave cavities may not have been their optimal values.

The only reported experiment closely related to the present one is the recent successive oscillatory fields experiment of Robinson, Ensberg, and Dehmelt[5] which was based on another aspect of Ramsey's proposal.[1,2] However, Dehmelt's experiments were limited to low-frequency transitions between states which differed only in magnetic quantum number. The experiments in the present report are the first wall collision resonance experiments involving high-frequency transitions between states of different hyperfine F values as well as the first resonance experiments of any kind with the broken atomic beam resonance method. The present resonance experiments are more distantly related to the nonresonance wall bounce experiments of Hawkins[6] and the spin relaxation experiments of Robinson, Ensberg, and Dehmelt.[5]

At present, an extensive program for testing different collision surfaces is being initiated in the hopes of finding a suitable surface for a high precision atomic clock incorporating both the storage box[1,2] and maser principles.[7]

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PIEZOELECTRIC EFFECT IN INDIUM ANTIMONIDE*

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It is expected that crystals of the zinc blende structure will be piezoelectric, since the lattice lacks a center of symmetry. The ionic character of InSb has been indicated by several authors[1-3] to be in the range of 10-20% of the total available charge.

We have made qualitative observations of piezoelectric resonances at the first and third harmonics of thickness vibrations in two InSb plates. Because of the relatively high conductivity (~200/ohm cm) of InSb at room temperature which would effectively short out the piezoelectric voltage, measurements were taken at 78°K and 4.2°K where the resistances of the samples were large.[4] The plates, 0.71 and 1.02 mm thick and 5 mm square, were cut normal to the [111] direction, and their faces ground parallel within a few hundredths of a mm. The plates were then etched and their large flat surfaces plated with rhodium; thin copper leads were indium-soldered to the corners of the plated sides. The plates were then mounted in a vacuum to reduce acoustic losses. One sample had a p-n junction in the plane of the plate and, as suggested by Burstein,[5] such a sample should be suited for a qualitative observation of a piezoelectric effect, having a relatively high resistance, even at liquid nitrogen temperatures. The other sample (from an adjacent slice) was high-resistivity p-type ($\sim 1.4\times10^3$ ohm-cm at liquid helium temperature). In both samples the effect was detected as a slight drop in voltage across the plate when the frequency of the driving oscillator (loosely coupled to the sample) was tuned through one of the resonant modes of the plate. The voltage change was observed as a departure from a null condition in a voltage compensation circuit. The calculated and observed resonance frequencies for the two plates are given in Table I. The effect was detected in the p-n junction plate at both liquid nitrogen and liquid helium temperatures at the same frequencies. In the p-type plate it could be detected only at 4.2°K.

As is characteristic of vibrating plates, the thickness modes are coupled to numerous other modes of vibration, flexure, face shear, etc., resulting in a number of resonances grouped

Table I. Calculated and observed frequencies and some observed Q's of two InSb plates.

p-n junction plate	*p*-type plate	
calc. freq's., Mc/sec	calc. freq's., Mc/sec	
1.92 ± 0.06	2.74 ± 0.06	
5.76 ± 0.18	8.22 ± 0.18	
obs. freq's., Mc/sec	obs. freq's., Mc/sec	Q in units of 10^4
1.949	2.764	0.57
1.962	2.796	1.7 to 2.4
1.973	2.857	1.0
1.988	2.869	1.4
1.995		
	8.380	
5.857	8.403	
5.874	8.419	
	8.440	

around the thickness mode. This is what was observed – resonances being found in the p-type plate from 2.60 Mc/sec to 2.87 Mc/sec, and from 8.38 Mc/sec to 8.44 Mc/sec. A similar situation existed in the p-n junction plate. The strongest of these modes for the fundamental and third harmonic are tabulated in Table I. The frequencies of the fundamental and third harmonic were calculated using elastic constants and density extrapolated to liquid helium temperature. The elastic constants used were means between the values given by McSkimin et al.[6] and Potter.[7] The latter's work was used for the extrapolation to liquid helium temperature. For the p-type plate, the Q's of several of the more prominent modes were measured and these results are also shown in Table I.

A quantitative evaluation of d_{14} is difficult since the contact impedance is large (~14 times the ohmic resistance of the sample). This contact impedance appears to decrease at piezoelectric resonance. The reason for this is not known at present. Further experiments are planned in order to overcome this difficulty.

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EXCITATION OF VERY-HIGH-FREQUENCY SOUND IN QUARTZ

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Recently Baranskii[1] reported the generation of longitudinal ultrasonic waves along the x axis of a 1.5-cm-thick quartz plate in the frequency range from 10^8 to 2×10^9 cps, using standard optical diffraction methods for detection.[2]

We have performed a series of further experiments at 10^9 to 2.5×10^9 cps as part of a program to extend research with ultrasonic waves into