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SUPPRESSION OF SUBSIDIARY ABSORPTION IN FERRITES BY MODULATION TECHNIQUES

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In the preceding paper,[1] Suhl has shown theoretically that the threshold power for subsidiary absorption in ferrites can be increased by superimposing on the dc magnetic field, H_{dc}, a small ac modulation, H_m. Experiments have been performed which confirm the above prediction and show that subsidiary absorption can indeed be suppressed at power levels as high as 10 db above the threshold power.

The experiments were performed on an yttrium iron garnet (YIG) sphere 0.059 inch in diameter with a uniform precession linewidth of 1.2 oe. The sphere was placed near the wall of a cavity resonant at 9250 Mc/sec. Eddy current losses were minimized by using a cavity wall 0.002 mm thick and thus an external modulating coil was suitable. In Fig. 1 a plot is shown of the relative amplitude of H_m required to suppress subsidiary resonance for various values of microwave field, h. For these data h was oriented perpendicular

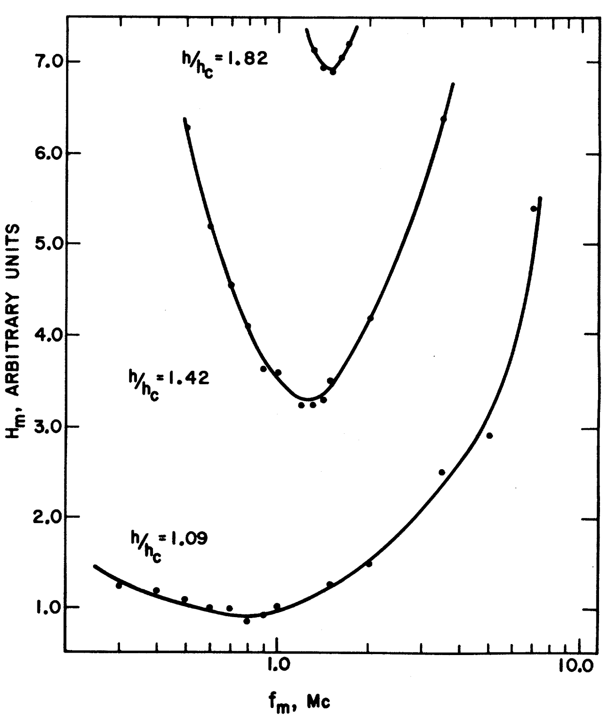

FIG. 1. The minimum modulating field, H_m, required to suppress perpendicular pumped subsidiary resonance as a function of the modulation frequency for various microwave fields.

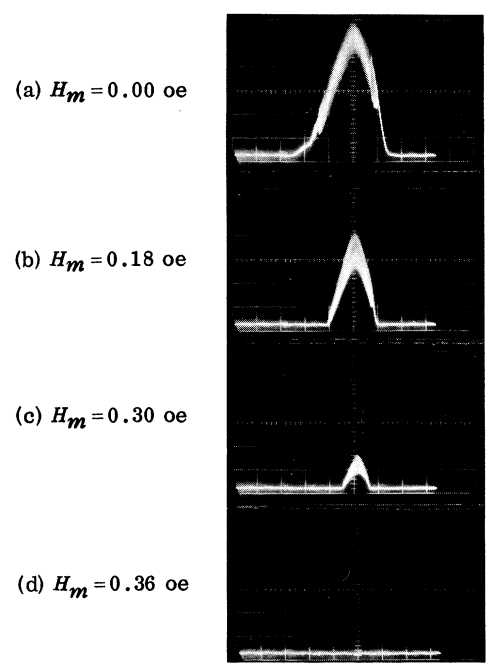

FIG. 2. Absorption is recorded on the vertical axis as H_{dc} is traversed through parallel pumped subsidiary resonance. Horizontal scale is 20 oe/cm. The modulating field is increased from trace (a) through trace (d).

to H_{dc} which was set to 2054 oe, the subsidiary resonance peak. The results show that the optimum modulation frequency is about 0.8 Mc/sec for a microwave field near the threshold field, h_c. Furthermore, it is evident that H_m is quite sensitive to changes in either modulation frequency or microwave field. These results are in general agreement with the Suhl theory although a detailed comparison cannot as yet be made.

The above Suhl theory can, of course, be extended to the parallel pumped case where the microwave magnetic field is parallel to the dc field. Figure 2 shows the results obtained for this parallel pumped condition. In Fig. 2(a) an oscilloscope trace shows the subsidiary absorption as a function of H_{dc} with no modulation applied. The noisy absorption is due to the relaxation oscillations which usually accompany subsidiary resonance.[2] As the modulation field amplitude is slowly increased, the subsidiary absorption gradually becomes suppressed as shown in the succeeding traces 2(b), 2(c), and 2(d). For this microwave field ($h/h_c = 1.26$) a modulating field of 0.36 oe is required for complete suppression. The optimum modulating frequency is 0.25 Mc/sec as compared to the 0.8-Mc/sec frequency for the perpendicular pumped case of Fig. 1. At power levels of 5 db or more above threshold the disappearance of the absorption with increasing modulation amplitude takes place in a discontinuous manner and will be described in detail in a forthcoming paper. The application of these results as a tool to explore the spin-wave spectrum and to various microwave devices will also be discussed.

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OSCILLATORY MAGNETORESISTANCE IN n-TYPE PbTe

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Distinct oscillations of the transverse magnetoresistance of three oriented single crystals of n-type PbTe in dc magnetic fields have been observed. These results confirm the existence of a multivalley band structure having prolate energy ellipsoids oriented along the $\langle 111 \rangle$ crystalline axes.[1,2] It is further established that there are four ellipsoids, thus locating the energy minima at the zone edge. The temperature dependence of the oscillatory amplitudes yields a value for the cyclotron mass m_e^* and, in addition, the transverse and longitudinal effective masses are calculated. A recent note,[3] describing the behavior of the transverse magnetoresistance in pulsed fields in an n-type PbTe crystal, has given indications of oscillatory effects. However, the measurements, showing a single minimum, were not interpreted in terms of a possible model for the band structure.

The bulk of our measurements were made on a [110]-oriented sample having a carrier concentration n of $3.45\times10^{17}/\text{cm}^3$ and a Hall mobility of 1.2×10^6 cm^2/volt-sec at 1.7°K. With the current along the [110] direction, measurements as shown in Fig. 1 were obtained with magnetic fields up to 26.5 kgauss in the [001] and [1$\bar{1}$0] directions at 1.7 and 4.2°K. Measurements made on additional [110] and [100] samples having dif-

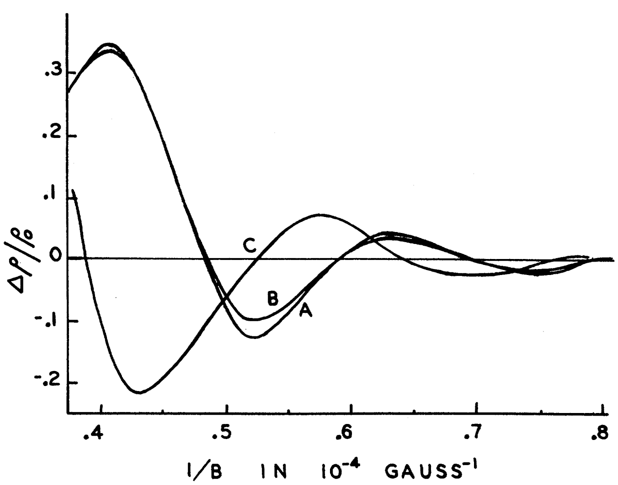

FIG. 1. Oscillatory component of the transverse magnetoresistance for current along [110]; curve A: B_{001} at 1.7°K; curve B: B_{001} at 4.2°K; curve C: $B_{1\bar{1}0}$ at 1.7°K. ρ_0 is the zero-field resistivity.

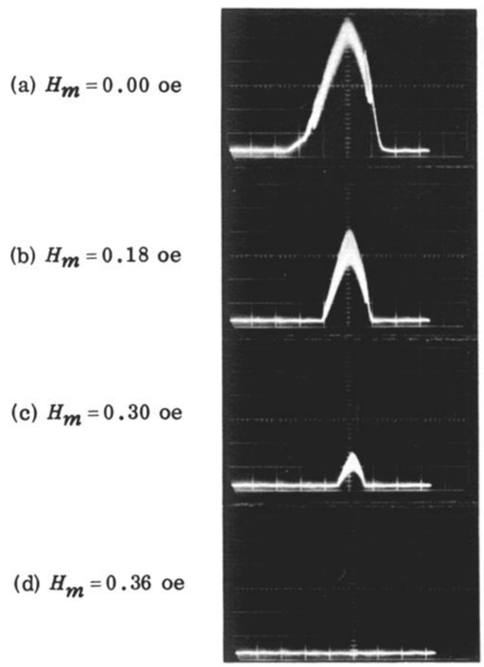

FIG. 2. Absorption is recorded on the vertical axis as H_{dc} is traversed through parallel pumped subsidiary resonance. Horizontal scale is 20 oe/cm. The modulating field is increased from trace (a) through trace (d).