spectrometer capable of resolving 1 A., no change in the cut-off wave-length was observed nor was there any alteration in the position of characteristic absorption bands at 2359 A. and 2363 A. As present theory indicates a change of only 10^{-8} eV. atm.$^{-1}$ in the width of the energy gap, these negative experimental results are consistent with theory.

F. C. Champion
J. R. Prior

King's College,
University of London,
Strand,
London, W.C.2.
Sept. 16.

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Measurements of the Permeability Tensor for 'Ferroxcube' at 24,000 Mc./s.

It is well known that ferrimagnetic materials become anisotropic upon application of a magnetic field and that consequently the permeability of a magnetically saturated ferrite medium is described by a tensor[1]:

$$\|\mu\| = \begin{Vmatrix} \mu & -jk & 0 \\ jk & \mu & 0 \\ 0 & 0 & 1 \end{Vmatrix}$$

For a positive and negative circularly polarized wave, the tensor is diagonalized, and the effective permeability is a scalar, $\mu \pm k$. The real and the imaginary parts of the elements of the tensor have been measured by several workers[2,3], using resonance cavities excited with circularly polarized modes. In order to study ferrite itself, it was pointed out by Spencer *et al.*[3] that it is necessary to determine the intrinsic magnetic quantities μ and k. Because of the radiofrequency demagnetizing fields the values $\tilde{\mu}$ and $\tilde{k}$ derived from the measurements depend on the sample shape. Those intrinsic values are computed from the experimental values using a magnetostatic approximation for the internal field.

Practically all measurements published hitherto have been carried out at 3,000 Mc./s. or 10,000 Mc./s.; most of them on American commercial products. We have measured the tensor components for the European commercial product 'Ferroxcube IV *B*' at 24,000 Mc./s. It is interesting to consider the position of μ at our working frequency on the dispersion and the absorption curves for the initial permeability. These dispersion and absorption curves can be interpreted[4] as a natural ferromagnetic resonance in the internal anisotropy field. 24,000 Mc./s. is situated beyond the anomaly of the dispersion curve. As a consequence, the residual magnetic losses are much smaller.

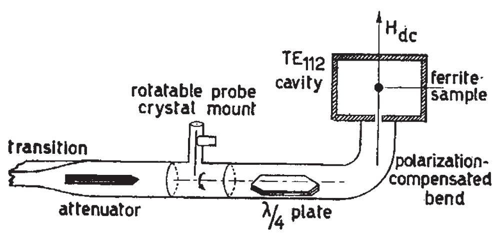

Fig. 1. Diagram of the circular polarizing device

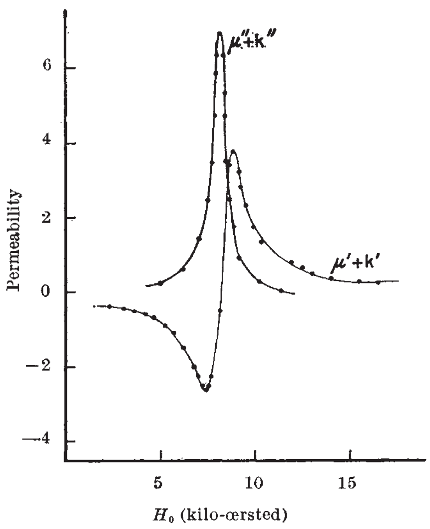

Fig. 2

In our measurements we have used a TE_{112}-reflexion cavity with ferrite spheres or disks placed in a position of maximum radio-frequency magnetic field and zero radio-frequency electric field. In order to excite the cavity, microwave radiation is fed through a circular polarizing apparatus constructed at our laboratory and shown schematically in Fig. 1. The sense of the circular polarization is reversed either by changing the orientation of the λ/4-plate or by reversing the d.-c. magnetic field. Care has been taken to avoid ellipticity in the circular guide and also on the adjustment of the quarter-wave plate.

The empty cavity resonates at 23,995 Mc./s. with a loaded Q-value of 3,985. Using the Bethe–Schwinger cavity perturbation theory, it is easily shown that the frequency shift, and the change in loaded Q, are directly proportional respectively to the real $(\tilde{\mu}' \pm \tilde{k}')$ and the imaginary part $(\tilde{\mu}'' \pm \tilde{k}'')$ of the effective permeability. For a sphere the intrinsic values are related to the experimental values by the equation:

$$\mu \pm k = -[2(\tilde{\mu} \pm \tilde{k}) + 1][\tilde{\mu} \pm \tilde{k} - 4]$$

The results of a typical run on a polycrystalline sphere with diameter 0·95 mm., using the apparatus described, are shown in Fig. 2. The values $\mu' + k'$ and $\mu'' + k''$ are plotted against the steady magnetic field. From other measurements on spheres and disks and with the aid of Kittel's relations for ferromagnetic resonance[5], we were able to calculate an effective value of g. We found a mean value of 2·11.

Further details will be published later.

G. G. Robbrecht
J. L. Verhaeghe

Natuurkundig Laboratorium,
Rijksuniversiteit,
Ghent, Belgium.
July 31.

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