

Memorandum M-2462

Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: JOINT GROUP 37 - GROUP 63 MEETING ON FERRITE RESEARCH

To: Jay W. Forrester

From: David R. Brown

Date: October 16, 1953

Abstract: A review of the interests of Group 63 has shown which basic quantities require experimental determination. These include anisotropy, exchange coefficient, and relaxation frequency. Measurements can be made most directly with single-crystal ferrites. These measurements are necessary to verify the analysis of the switching mechanism in square-loop ferrites. They are also measurements of primary importance to Group 37.

Those present at the meeting held October 14, 1953, included S. Foner and B. Lax from Group 37 and P. K. Baltzer, D. R. Brown, D. A. Buck, J. B. Goodenough, A. L. Loeb, N. Menyuk, and F. E. Vinal from Group 63.

P. E. Tannenwald and J. O. Artmann have received samples from the $MgO \cdot MnO \cdot Fe_2O_3$ system prepared by Vinal. These will be used to determine line-broadening in microwave-resonance experiments. The samples include ferrites with squareness ratios ranging from 0 to 0.9, and ferrites having the composition most suitable for gyrator application.

A chemical analysis of MF-1331 will be undertaken.

The chemical laboratory in Group 63 will undertake the synthesis of several perovskites. A lanthanum-strontium perovskite and lanthanum-cobalt perovskite will be prepared. The techniques will be the same as those used for preparing ferrites.

Vinal will undertake a preliminary investigation of organizations best qualified to receive support from the Lincoln Laboratory for the synthesis of ferrite single crystals. He suggests that two methods in addition to the three listed in M-2454 should be included. These are (1) growing the crystal from a flux and (2) producing a crystal by the strain-anneal method.

Goodenough reviewed the interests of Group 63. An investigation of the switching mechanism in square-loop materials has led to a detailed analytical study of the equations of motion of domain walls, the creation of domain walls, and the coercive force. Some experimental work has already been undertaken. The nucleation field strength and switching coefficient have been determined for a number of materials including 1/4-mil and 1/8-mil molybdenum Permalloy. Experimental data fit the analytical formulation, but values assigned to some basic parameters can only be roughly estimated in an indirect way from experiments of others reported in the literature. Some basic parameters requiring determination are: (1) anisotropy (2) the exchange coefficient and (3) the relaxation frequency.

Group 63 is developing techniques to cut a "picture frame" from a ferrite crystal to permit study of domain-wall motion in a simple structure. Techniques for cutting the crystals are being developed with the assistance of Raytheon and techniques for orienting the sides of the "picture frame" with respect to the crystal axes are being developed with the cooperation of Group 35. In addition, metallographic techniques are being used to study the grain structure of polycrystalline ferrites. Experiments are being planned to study the effect of strain on domain boundaries in 68 Permalloy and silicon iron.

Measurements on single-crystal ferrites will permit a direct determination of some of the basic parameters which appear in the analytic formulation and are necessary to verify this formulation.

The next meeting will be held on October 28 at 9:30 AM. Group 37 will discuss ferromagnetic resonance.


David R. Brown

DRB:hpm

cc: R. R. Everett
Group 63 Staff
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W. H. Radford
L. Gold