Gyromagnetic Ratios of Manganese Alloys

G. G. SCOTT
Research Laboratories, General Motors Corporation, Warren, Michigan
(Received August 8, 1960)

The gyromagnetic ratios of two different ferromagnetic alloys of manganese were measured by Einstein-deHaas experiments. The Heusler alloy Cu_2MnAl gave a g' value of 1.993 ± 0.002. The alloy MnSb gave a g' value of 1.978 ± 0.002.

INTRODUCTION

INVESTIGATORS who have measured the gyromagnetic ratio of Heusler[1] alloys have given a g' value of 2.00 indicating complete orbital quenching. Since highly specialized facilities have been made available[2] for making measurements of the Einstein-deHaas effect, it has become possible to determine whether or not orbital quenching is complete to one lower order of magnitude. It was also considered to be of interest to compare the magnetomechanical factors for different ferromagnetic alloys of manganese. Accordingly, rods were cast and ground to the proper size of Cu_2MnAl (the usual Heusler alloy) and MnSb. The experimental equipment and techniques used by us for making measurements of the Einstein-deHaas effect have been previously described.[3]

RESULTS

The series of experiments on the Heusler alloy is summarized in Table I. In these experiments two different rods of Cu_2MnAl were used. This is indicated by the break in the table. The value obtained for g' is 1.993 ± 0.002. Although this value departs only 0.35% from the spin-only value for g', the precision of these experiments is such that it is unlikely that orbital quenching is complete. Ferromagnetic resonance experiments by Yager and Merritt[4] show a similar ($g=2.01$) departure from the spin-only value.

The experiments on manganese antimonide are summarized in Table II. Here the orbital contribution to the net magnetic moment is considerably higher, the g' value being 1.978 ± 0.002.

It is concluded from these experiments that the ferromagnetic alloys of manganese have small but definite orbital contributions to the net magnetic moments and that the amount of these orbital contributions is dependent on the particular alloying atoms used.

TABLE I. Values of g' for Cu_2MnAl obtained for various daily runs.

Magnetizing current milliamperes		g'
10.00		1.998
10.00		1.980
10.00		2.002
5.00		1.990
5.00		1.992
10.00		1.991
5.00		1.995
	Average	1.993

TABLE II. Values of g' for MnSb obtained for various daily runs.

Magnetizing current milliamperes		g'
10.00		1.977
10.00		1.981
14.00		1.976
14.00		1.979
14.00		1.965
14.00		1.982[a]
10.00		1.988
	Average	1.978

[a] This value obtained by Dr. J. V. Laukonis of General Motors; other values by author.

[1] S. J. Barnett, Proc. Am. Acad. Arts Sci. **75**, 109 (1944).
[2] By the Charles F. Kettering Foundation.
[3] G. G. Scott, Phys. Rev. **119**, 84 (1960).
[4] W. A. Yager and F. R. Merritt, Phys. Rev. **75**, 318 (1949).