Physics

V. F. Ivlev and V. M. Rudyak

1958

SovietRxiv

Abstract

Full Text

Physics

V. F. Ivlev and V. M. Rudyak

On the Existence of a Most Probable Size of a Magnetization-Reversal Jump

(Presented by Academician A. V. Shubnikov, 28 I 1958)

Despite the considerable progress recently achieved in the study of the Barkhausen effect ([1–8]), the question of the character of the distribution of magnetization-reversal jumps by size still remains unclear. Most investigators come to the conclusion that the number of magnetization-reversal jumps is the greater, the smaller their size, i.e., that the distribution curve

$$f(\Delta M) = \left|\frac{dN}{d(\Delta M)}\right|$$

(ΔM is the change in magnetic moment in a single jump; N is the number of jumps whose sizes are greater than ΔM) decreases monotonically with increasing ΔM.

It should be noted that in all these investigations the minimum value of ΔM that could be recorded by the apparatus was of the order of 10^{-6} CGSM.

Since magnetization-reversal jumps do not encompass an entire domain, but are irreversible displacements of domain walls, caused to a considerable degree by the statistical distribution of internal elastic stresses, it is to be expected that for each state of the specimen there should exist a most probable size of the region undergoing magnetization reversal.

For a detailed study of this question, the authors of the present article carried out investigations on an apparatus ([8]) whose sensitivity was successfully increased to 10^{-7} CGSM. This increase in sensitivity was achieved by sharply reducing interference from external stray magnetic fields through the use of compensating coils which, while having a high turn density, possessed low inductance. The investigations were carried out with unannealed and annealed specimens of electrolytic nickel, in the form of wires 0.5 mm in diameter and 35 mm long. The results of the investigation are shown in Fig. 1. It is evident from this figure that in both cases the distribution curve has a clearly expressed maximum, i.e., for each state of the specimen there exists a characteristic, most probable size of the magnetization-reversal jump. Comparison of the cur-

Fig. 1. Distribution curves of magnetization-reversal jumps for unannealed (1) and annealed (2) nickel

Figure 1: Fig. 1. Distribution curves of magnetization-reversal jumps for unannealed (1) and annealed (2) nickel

Fig. 1. Distribution curves of magnetization-reversal jumps for unannealed (1) and annealed (2) nickel.

1 and 2 shows that with annealing the total number of jumps decreases, while the maximum of the distribution shifts toward larger jumps. This shift is apparently caused by a decrease in elastic stresses as a result of annealing.

A similar maximum for the distribution curve of magnetization-reversal jumps by size was also obtained in measurements with an iron specimen.

In conclusion, we consider it our pleasant duty to express our gratitude to Prof. L. V. Kirenskii for a number of valuable suggestions in carrying out the present work.

Krasnoyarsk Pedagogical
Institute

Received
28 I 1958

REFERENCES

1. R. M. Bozorth, J. F. Dillinger, Phys. Rev., **41**, 375 (1932).
2. F. Förster, H. Wetzel, Zs. f. Metallkunde, **33**, 115 (1941).
3. H. D. Bush, R. S. Tebble, Proc. Phys. Soc., **60**, 370 (1948).
4. H. J. Williams, W. Shockly, Phys. Rev., **75**, 178 (1949).
5. F. Tzomakion, V. F. Ivlev, DAN, **66**, 2, 205 (1951).
6. V. F. Ivlev, Izv. AN SSSR, ser. fiz., **16**, 6, 664 (1952).
7. H. Sawada, J. Phys. Japan, **XI–XII**, 7, 6, 564 (1952).
8. V. F. Ivlev, V. I. Ilyushenko, L. I. Aseeva, Izv. AN SSSR, ser. fiz., **21**, No. 9 (1957).