Static Parameters of Domain Structures in Iron Garnet Films

A. A. Rusinov[1] and E. A. Rusinova[2]
[1]*Ural Federal University, Yekaterinburg, Russia*
[2]*Ural State University of Railway Transport USURT, Yekaterinburg, Russia*

Keywords: Dynamic domain structures, leading center, static parameters.

Abstract: This article is devoted to the study of the static parameters of domain structures found in garnet ferrite films (Balbashov, 1976; Kandaurova, 1990; Kandaurova, 1999). In the works (Rusinov, 2014; Rusinov, 2015), the effect of alternating and constant magnetic fields on structures of this kind has already been considered in detail. The mechanisms of formation and destruction of structures, as well as the processes of formation of DDS on artificial and natural defects, are considered. The experimentally obtained results allowed us to conclude that such formations are very sensitive to changes in magnetic fields, which allows them to be used in the creation of non-destructive testing devices, for example, to control the quality of a railway track.

1 INTRODUCTION

Dynamic domain structures called Leading centers are formed on point defects in thin epitaxial films of iron garnets. Experimental studies have shown that for the formation of this type of structures, a necessary condition is the presence of a defect. Both natural and artificial defects were present on the studied samples. The origin of the defect has practically no effect on the behavior of the ECs; with changes in the parameters of the magnetic fields, the ECs behave identically (Rusinov, 2018; Rusinov, 2020; Kandaurova, 2005; Kryuchkova, 2021; Rusinov, 2021). Examples of such structures are shown in Fig.1.

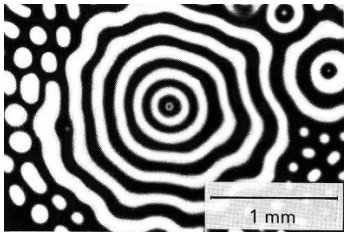

Figure 1: Dynamic Structures, Small and Large Leading Centers.

Figure 1 clearly shows that the EC is a system of concentric rings, the center of which is located on the defect. With a change in the amplitude and frequency of the magnetic field, the number of rings of the Small and Large ECs changes significantly. The experiment showed that such structures exist only in a certain range of frequencies and amplitudes of the magnetic field. A detailed study of the areas of existence of VCs made it possible to determine the boundaries of the destruction and formation of these structures. Figure 2 shows the regions of existence of Leading centers for different f and H. It can be noted that with an increase in the frequency of the alternating field, the regions shift towards lower amplitudes and decrease in size.

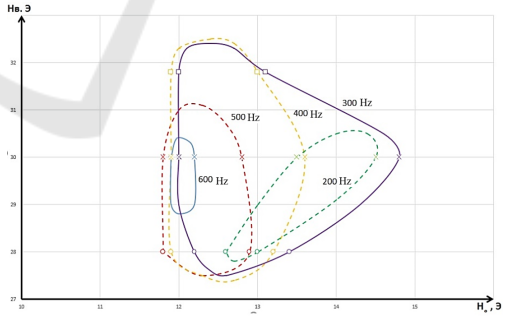

Figure 2: Areas of VC existence at different frequencies of an alternating magnetic field.

The process of formation is accompanied by a gradual increase in the number of rings of the Leading center, and the process of destruction by a decrease in the number of ring domains until the structure completely disappears. Figure 3 shows the dependences of the number of VC rings on various defects, depending on the amplitude and frequency of the alternating field.

Rusinova, E. and Rusinov, A.
Static Parameters of Domain Structures in Iron Garnet Films.
DOI: 10.5220/0011586900003527
In *Proceedings of the 1st International Scientific and Practical Conference on Transport: Logistics, Construction, Maintenance, Management (TLC2M 2022)*, pages 344-346
ISBN: 978-989-758-606-4

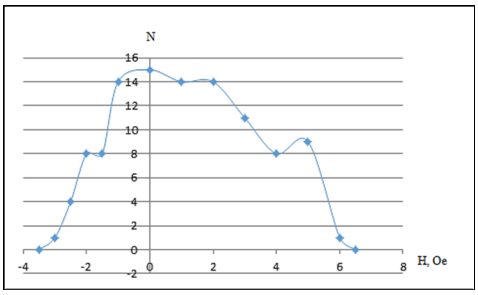

Figure 3a: Dependence of the number of VC rings on H, on an artificial defect.

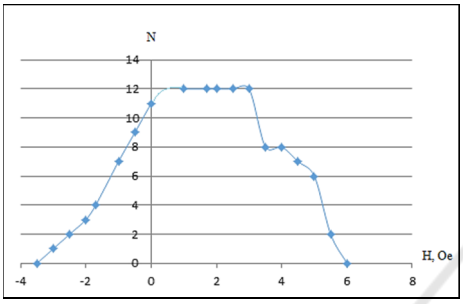

Figure 3b: Dependence of the number of VC rings on H, on an artificial defect.

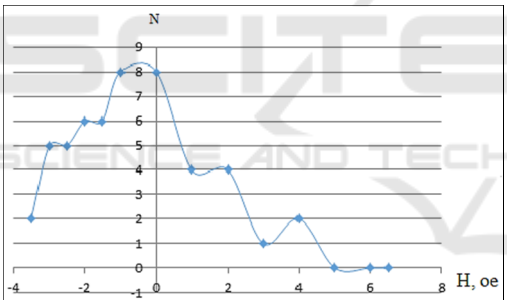

Figure 4a: Dependence of the number of VC rings on H, on a natural defect.

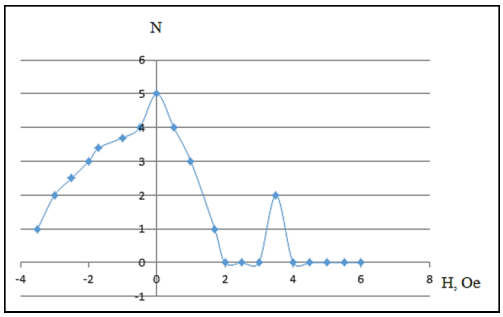

Figure 4b. Dependence of the number of VC rings on H, on a natural defect.

It is clearly seen that the maximum number of rings in Fig. 3a and 3b are larger than in Figs. 4a and 4b, it can also be noted that VCs with a large number of rings are more stable and exist in an equilibrium state for a longer time. It should be noted that as the pump field amplitude increases, the structures on different defects behave almost identically. A constant field has a destructive effect on the CC, but the greater the number of ring domains, the more stable the CC.

The period of nucleation of EC rings was determined for various amplitudes of an alternating magnetic field and a fixed frequency. The average period and frequency of the birth of ring domains has been calculated. The resulting dependence can be seen in Fig.3. With an increase in the amplitude H, the average period monotonically decreases, and the frequency of formation of new rings increases with an increase in the amplitude H.

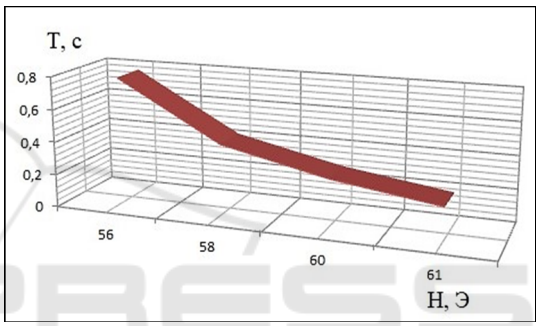

Figure 5: Dependence of the period of birth of ring domains on the amplitude of the alternating magnetic field.

2 FINDINGS

Studies of domain structures "Leading Center" have shown that alternating and constant magnetic fields affect the origin, destruction and existence of DDS data. Domain structures in the form of ring domains are formed on defects. Graphs of the dependence of the number of rings on the amplitude of the alternating magnetic field are plotted, it can be seen from the graphs that the region of stable existence of the VC depends on the number of rings, the larger the number of rings, the longer the DS exists in a stable state. The average period of the nucleation of the CC and its dependence on the amplitude of the alternating magnetic field are calculated.

REFERENCES

Balbashov, A. M., Chervonenkis, A. Ya., 1979. *Magnetic materials for microelectronics.* Energiya.

Kandaurova, G. S., Svidersky, A. E., 1990. *Letters to ZhETF*. 97(4). pp. 1218-1229.

Kandaurova, G. S., Osadchenko, V. Kh., Rusinov, A. A., Rusinova, E. A., 1999. *Letters to ZhETF*. 63(6). pp. 453-456.

Rusinov, A. A., Rusinova, E. A., 2014. *Bulletin of the Ural State University of Railways*. 2 (22). pp. 19-27.

Rusinov, A. A., Rusinova, E. A., 2015. *Bulletin of the Ural State Transport University*. 1 (25). pp. 18-23.

Rusinov, A. A., Rusinova, E. A., Avksentyeva, E. I., 2018. *Bulletin of modern research*. 12. 1 (27). pp. 401-402.

Rusinov, A. A., Rusinova, E. A., 2020. *International independent scientific journal*. 21(2). pp. 61-63.

Kandaurova, G. S., Osadchenko, V. Kh., Pashko, A. G., 2005. *Physics of the Solid State*.

Kryuchkova, D. S., Rusinova, E. A., 2021. «Influence of Magnetic Field on Dynamic Parameters of Domain Structures of the "Leading Center" Type,» in Theory, School and Concepts of Sustainable Development of Science in Modern Conditions. *Collection of articles on the results of the International Scientific and Practical Conference*. Sterlitamak. pp. 5-12.

Rusinov, A. A., Rusinova, E. A., 2021. Evolution and parameters of dynamic domain structures of the "Leading Center" type. *AIP Conference Proceedings. "Proceedings of the Scientific Conference on Railway Transport and Engineering, RTE 2021"*. 090008.