Magnetostatic Waves in a Single Crystal Barium Hexaferrite Platelet with in-Plane C-Axis

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Abstract – **In the paper for the first time it is shown that a single crystal barium hexaferrite with an easy axis (c-axis) lying in the sample plane can be used as a self-biased mm-wave ferrite resonator with two intensive resonances. It is experimentally established that the domain structure (DS) of this sample in a completely demagnetized state is the closest to the structure of parallel strip domains structure (PSDS).**

Keywords – **barium hexaferrite, millimeter wave, in-plane c-axis, self-biased.**

I. INTRODUCTION

There are many works devoted to the experimental and theoretical investigation of M-type hexaferrite samples. In particular, in the work [1], for the BaM samples made with c-axis perpendicular to plane of a sample the excitation of magnetostatic waves (MSW) was experimentally observed without need of external biasing field H_0. In such the samples, depending on the type of created inside structure (cylindrical magnetic domains (CMD) or stripe magnetic domains (SDS)) MSW can be perturbed up to 3 modes in an absolutely demagnetized state. The paper [2] is devoted to experimental investigation of spectral characteristics in a wide frequency range of self-biased planar mm-wave notch filter, where barium hexaferrite film with an in-plane c-axis grown on a sapphire substrate is used as a resonant element. Note that for this film only one FMR resonance was found in the state of remanent magnetization at frequency 52.5 GHz with lower quality factor Q than typical, as in Ref. [1].

II. EXPERIMENTAL RESULTS AND DISSCUSION

This paper presents the results of experimental investigation of FMR absorption spectra of barium hexaferrite platelet, with size 2.3*0.7*0.075 mm^3 and made of bulk single crystal material. The sample was glued to the quartz platelet with 145 μm thickness and was made in a way that c-axis is parallel to the plane of the sample.

In Fig. experimentally obtained FMR absorption spectrum of current sample at H_0=0 is shown. In this case, two MSWs modes at frequencies 47.28 GHz and 53.13 GHz with typical values of Q, as in Ref. [1], have been excited. Note that intensive high-frequency resonance at 53.13 GHz for a single crystal platelet is observed the first time and it has not been observed in the spectra of FMR absorption for a typical DS [1]. Also value of calculated frequencies of MSWs for PSDS with domain wall, which is a flat plane parallel to c-axis, are indicated by dashed lines in the Fig. [3]. The calculation was carried out for the parameters of current specimen BaM. As it is seen, the experimental value of high-frequency resonance is slightly different from the theoretical one but the Q value is significantly higher than that for the out-plane c-axis samples with SDS, reported in Ref. [3].

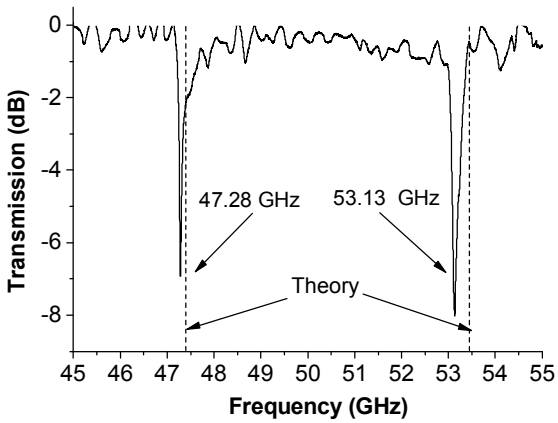

Figure. FMR absorption profile for single crystal platelet of BaM with in-plane c-axis at the biasing field H_0 = 0.

Thus, according to spatial model of DS in [3], we can make a logical conclusion that domain walls in this BaM sample is practically flat plane parallel to c-axis. That means that spatial distribution of DS in this case is very close to the structure of PSDS. We also carried out the experimental investigation of MSWs when sample c-axis is parallel to $H_0 > H_{sat}$, where H_{sat} is saturation field. In this case, experimentally obtained value H_{sat}=0.57 kOe coincides with the theoretical $H_{sat}=4\pi M \cdot N_z$=0.56 kOe, calculated as in Ref. [4].

III. CONCLUSION

For the first time two intensive modes in the absence of H_0 are observed in the excitation spectrum of MSWs in a single crystal platelet of BaM with in-plane c-axis. We suppose that the DS in such platelet is very close to the structure of PSDS.

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