INSTABILITY OF MAGNETOSTATIC WAVES IN FERROMAGNETS

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Submitted 19 January 1970
ZhETF Pis. Red. 11, No. 4, 215 - 230 (20 February 1970)

We present here, for the first time, results of an experimental investigation of the radiation of parametrically excited volume and surface magnetostatic waves (MSW) from tangentially magnetized single-crystal discs of yttrium iron garnet with parallel pumping (pumping frequency 9400 MHz). Radiation at half the frequency was received with the aid of a loop located near the sample, and was registered with a high-sensitivity receiver. We measured simultaneously the instability threshold by two methods: by the appearance of additional absorption [1] and by the appearance of low-frequency oscillations [2].

Figure 1 shows the threshold curves and the radiation bands of the surface (shaded area) and volume (vertical lines) MSW for a tangentially magnetized disc (diameter 3.54 mm, thickness 1.35 mm) oriented along the [111] crystallographic direction. We see that the surface MSW are unstable in a rather wide range of magnetizing fields. The presence of additional peaks in the radiation band is apparently connected with excitation of various modes of surface waves [3]. The emission of volume MSW takes place in strictly fixed magnetizing fields (very narrow radiation band). The constant fields at which the radiation is observed correspond to minima on the threshold curve of the additional absorption [4]. Emission of volume MSW is observed

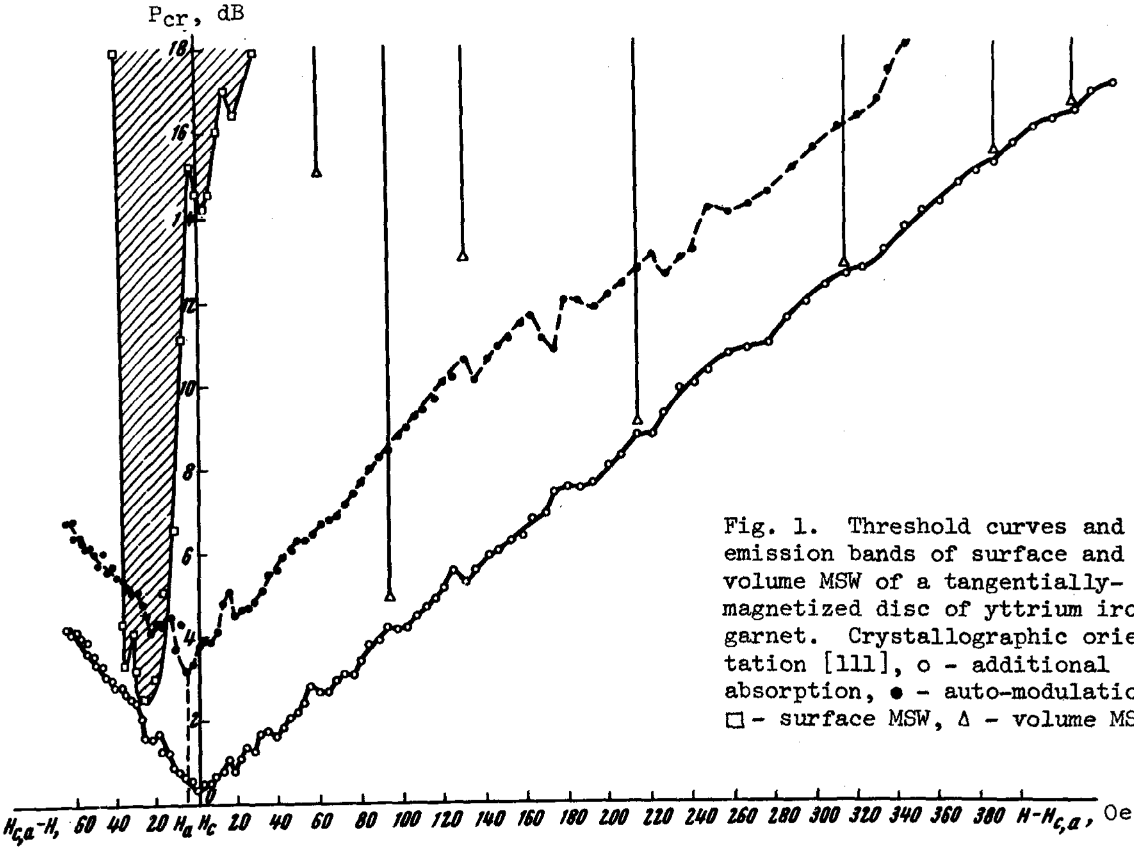

Fig. 1. Threshold curves and emission bands of surface and volume MSW of a tangentially-magnetized disc of yttrium iron garnet. Crystallographic orientation [111], o - additional absorption, ● - auto-modulation, □ - surface MSW, Δ - volume MSW.

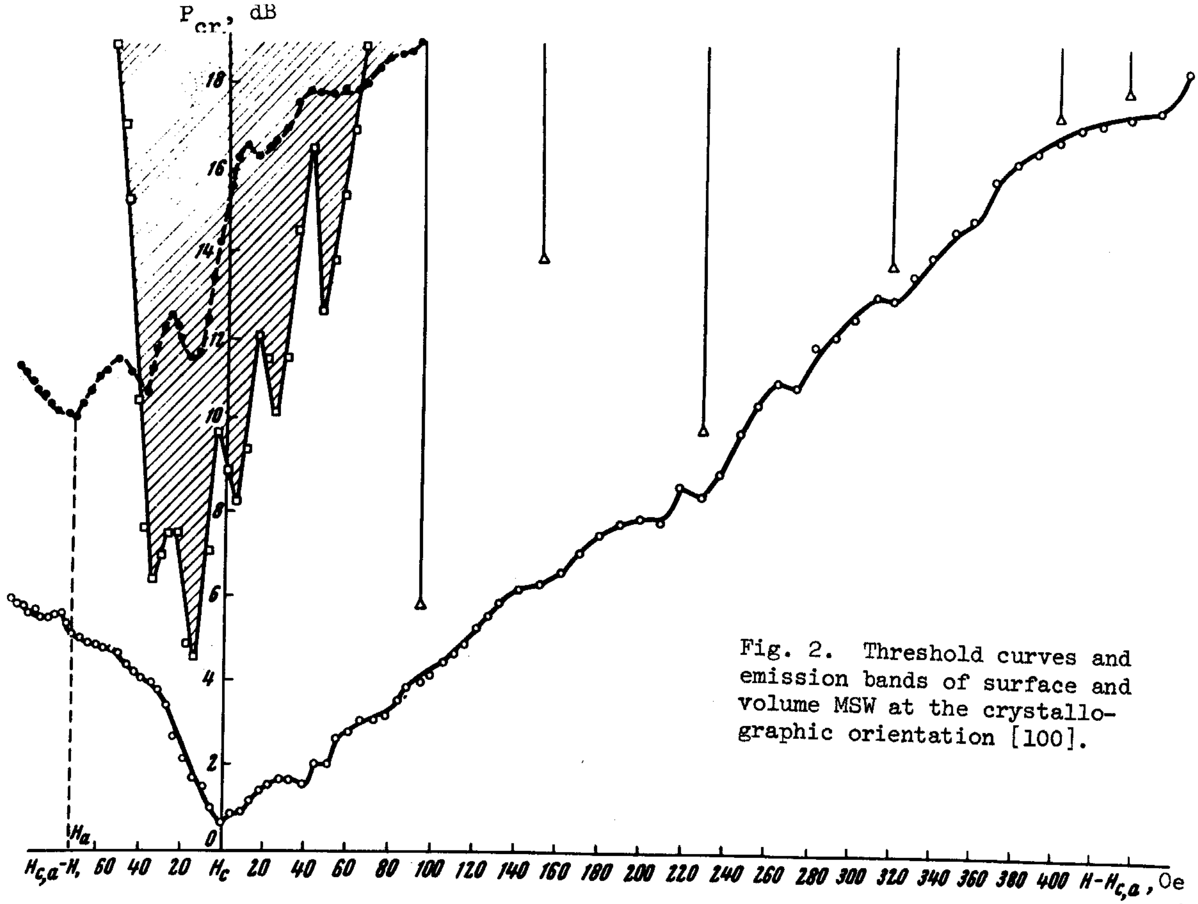

Fig. 2. Threshold curves and emission bands of surface and volume MSW at the crystallographic orientation [100].

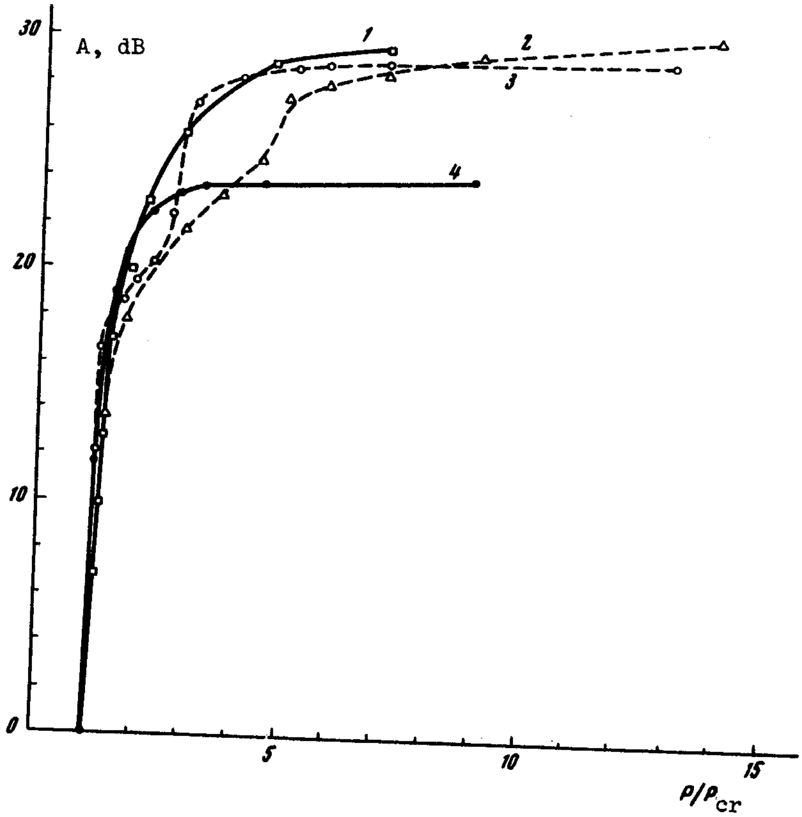

Fig. 3. Radiation power of volume and surface MSW vs. pump power. □ - [111], $H - H_c$ = 210 Oe; ● - [100], $H - H_c$ = 90 Oe; o - [111], $H_c - H$ = 30 Oe; Δ - [100], $H_c - H$ = 40 Oe.

at a pump power somewhat higher than the instability threshold. This is due to the difficulty of constructing a loop ensuring optimal coupling with the radiation field of a definite mode of oscillations of the ferrite sample [4].

An investigation of the influence of the crystallographic anisotropy (Fig. 2) on the instability of the MSW has shown that a change of the crystallographic orientation does not affect significantly the location of the generation bands of the volume MSW relative to the magnetization field. The radiation band of the surface MSW broadens greatly and is chopped up to a greater degree. This is obviously connected with the broadening of the region in which surface MSW exist [3] $(\gamma\sqrt{H_iB_i} \leq \omega \leq \gamma(H_i + B_i)/2)$; since H_i increases as a result at the expense of the anisotropy field, the different oscillation modes are better separated.

An anomalous change is observed in the gap between the threshold of the additional absorption and the threshold of occurrence of auto-modulation oscillations when the anisotropy field is increased. This change cannot be explained by the existing theory [2].

An analysis of the dependence of the radiation power on the pump power (see Fig. 3) leads to certain conclusions concerning the character of the steady state of the MSW. It must be noted first that the amplitude dependences of the volume MSW (curves 1 and 4) have no sharp anomalies when the instability of nonlinear ferromagnetic resonance sets in (when auto-modulation oscillations appear, Figs. 1 and 2). This indicates that the establishment of the MSW amplitude is not connected with excitation of auto-modulation oscillations, as is the case for short spin waves [2]. The smooth curves of the radiation power of volume MSW in Fig. 3 confirm that the MSW radiation is produced "directly," and not as a result of scattering by inhomogeneities (natural defects or elastic oscillations excited by the auto-modulation ones). The step seen on the power curves of the surface MSW (curves 2 and 3) is likewise not connected with excitation of auto-modulation oscillations (see Fig. 1), although the physical mechanism producing it is not quite clear. It is possible that this involves two-magnon processes (scattering of spin waves by defects) or processes of higher order (for example, 4-magnon processes (5)).

The authors are grateful to Ya. A. Monosov for a useful discussion.

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DISSOCIATION OF BORON TRICHLORIDE MOLECULES BY CO_2 LASER RADIATION

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Submitted 21 January 1970
ZhETF Pis. Red. 11, No. 4, 220 - 222 (20 February 1970)

It is known that gaseous BCl_3 is used in quantum electronics [1-4]. We have observed exposure of this gas to CO_2-laser radiation leads to dissociation of the BCl_3 molecules, accompanied by recombination radiation. This radiation was observed following both pulsed and