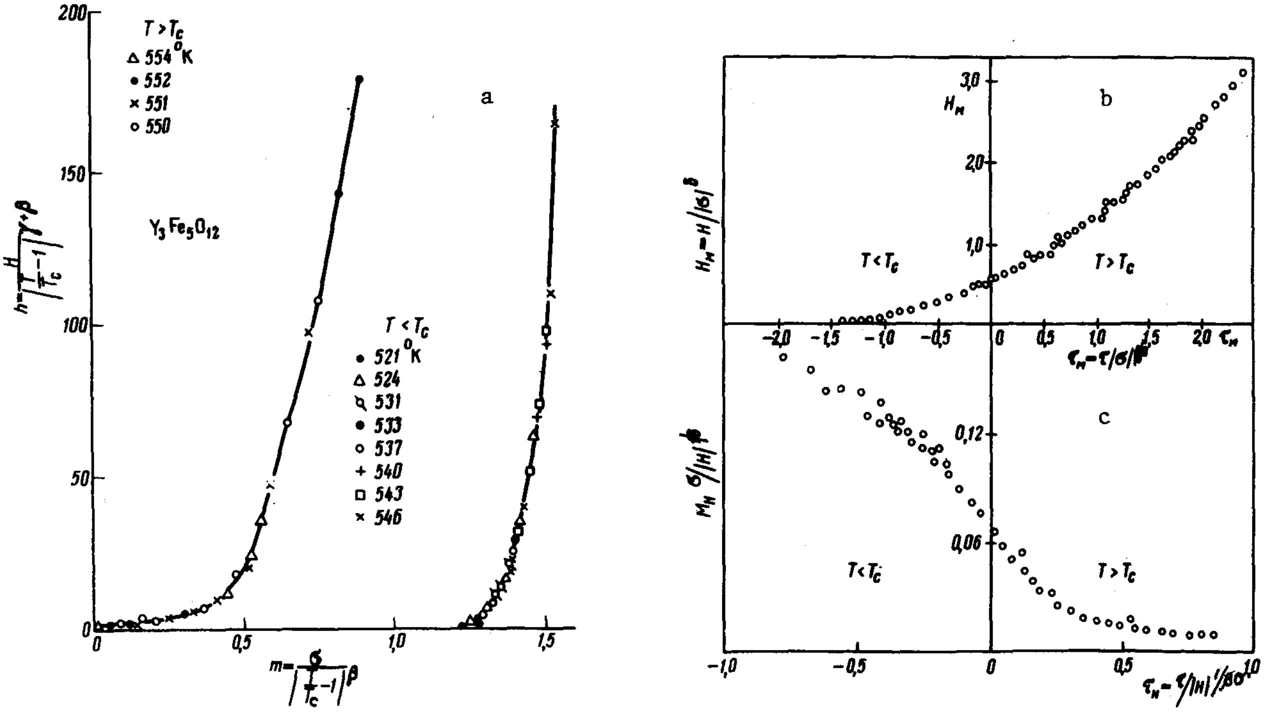

magnetic field (with the natural exception of the value H = 0). From the point of view of construction, $F^{(3)}$ is much more convenient than $F^{(1)}$ and $F^{(2)}$. We can conclude from the foregoing analysis of the scaling equations that the magnetic data for $Y_3Fe_5O_{12}$ are in agreement with them.

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ASYMMETRY OF MOTION OF DOMAIN WALL IN AN ORTHOFERRITE CRYSTAL

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We investigated the domain structures of single-crystal $YFeO_3$ and $DyFeO_3$ with deformed surface layers. We observed that the character of the domain-wall motion depends essentially on the direction of wall displacement and on the magnetization direction in the surface layer.

Single-crystal plates of rare-earth orthoferrites, the domain structure (DS) of which is presently used for practical purposes, are cut mostly from bulky crystals, after which they are mechanically polished. Such a treatment produces a thin deformed surface layer whose magnetic properties differ significantly from the internal section of the plate. As shown in [1 - 5], the presence of this magnetically-hard layer leads to a number of singularities in the behavior

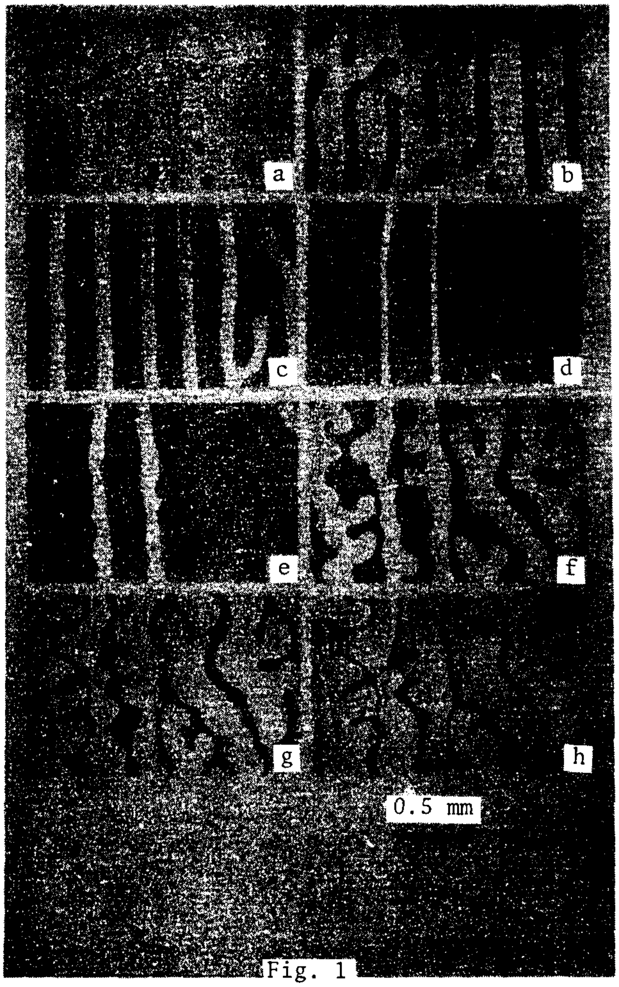

Fig. 1

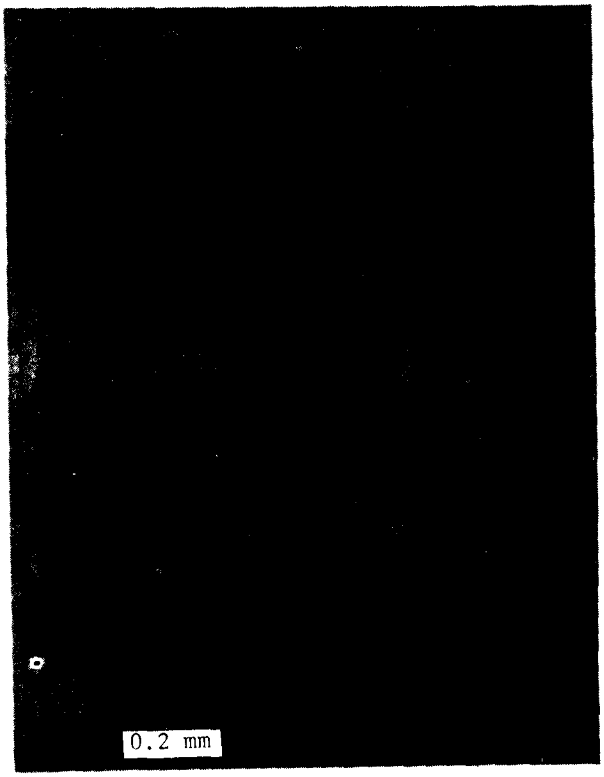

Fig. 2

Fig. 1. Domain structure of $YFeO_3$ crystal in a magnetic field (in Oe) equal to 0 (a), 22 (b), 44 (c), 73 (d), 44 (e), 22 (f), 10 (g) and 0 (h) (the field is perpendicular to the observed surface).

Fig. 2. Effect of the direction of motion V of the domain wall on its shape in a $YFeO_3$ crystal. The cross sections on the right pertain to parallel (a, b) and antiparallel (c, d) directions of the magnetization in the surface layer

of the DS; these singularities are of interest from both the practical and the theoretical points of view.

We used the Faraday effect to investigate the DS of $YFeO_3$ and $DyFeO_3$ crystal plates. The plates were polished after cutting with abrasives of gradually diminishing grain size. The final polishing was with diamond paste with 1-micron grain. The sample thickness was 80 - 100 microns. The easy magnetization axis (EMA) was perpendicular to the plane of the plate.

After cooling from the Curie temperature, moving domains were observed in the volume of the crystal, as well as the so-called shadow DS in the deformed surface layer. The latter disappeared after the samples were magnetized in a field 1 - 10 kOe parallel to the EMA (the size of this layer depends strongly on the prior history of the sample), or after cooling from 400°C in a field not exceeding 10 Oe. According to [3], this means that the entire surface layer was magnetized in one direction. Under this condition, the variation of the DS during the magnetization reversal of the internal part of the crystal is shown in Fig. 1.

It turned out that the shapes of the domain walls and the character of their motion depend strongly on whether the volume of the magnetic phase magnetized opposite to the orientation of the magnetization in the surface layer increases or decreases. If this volume increases (Fig.

1, a - d), then the walls move relatively smoothly and have more or less smooth shapes; conversely, if the volume of this phase decreases (Fig. 1, e - h), then the walls move very unevenly jumpwise) and have a clearly pronounced shoppy shape. The asymmetry effect is observed also if only one flat boundary is produced in the sample (Fig. 2). Upon passage through one and the same section of the sample in one direction, the local coercivity of the domain wall, H^{+}_{cw}, is high and reaches 20 - 30 Oe, whereas in the opposite direction, H^{-}_{cw} is much smaller (about 2 Oe). Accordingly, the shape of this wall is also different, depending on whether it had moved before from right to left (Fig. 2a) or from left to right (Fig. 2b). The picture of the magnetization reversal of the layer is reversed (Fig. 2, c, d).

The effect of the asymmetrical motion of the wall appears also when a shadow DS is present in the surface layer. The effect vanishes after ion polishing of the surface or after suitable heat treatment of the sample. However, even in this case one can observe an appreciable asymmetry of the local coercivity at individual defects.

It is possible that the singularities observed by us in the behavior of the domain walls are due to the manifestation of unidirectional anisotropy caused by exchange interaction between individual sections in the surface layer and the internal part of the crystal adjacent to this layer. It is likewise not excluded that the described effect is connected with the asymmetry of the distribution of the magnetization in the domain wall near the surface, and hence with differences in the magnetoelastic interaction with the defects.

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THERMOELASTIC EFFECT OF A FAST PARTICLE IN A SOLID

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We estimate the acoustic impulse produced in a solid by a gamma quantum of ultrahigh energy or by a relativistic multiply-charged ion. We discuss the possibility of acoustic registration of single gamma quanta and relativistic multiply-charged ions.

Considerable interest has recently been evinced in the registration of gamma quanta [1] and in the search for superheavy elements [2] among primary cosmic rays.

A procedure for acoustic registration of particles of ultrahigh energy was proposed in [3] and is applicable in principle also to the open outer cosmic space.

We present here theoretical and experimental estimates of the acoustic effects produced in two cases: a) by a cascading particle of ultrahigh energy, and b) by a relativistic multiply-charged ion. We shall discuss the possibility of their experimental observation.

Let the region of significant energy release in a track or in an electron-photon cascade be characterized by a radius R. During the time of the electron-ion relaxation, τ_0 N 10^{-10} - 10^{-9} sec, there is established in this region a temperature field that leads to thermal expansion of the medium and to excitation of cylindrical acoustic waves. The ensuring thermoelastic stresses are characterized by a bulk thermoelastic force

$$\mathbf{F}(\mathbf{r}, t) = -\Gamma \nabla P(\mathbf{r}, t), \tag{1}$$

where Γ is the Gruneisen parameter of the target material and $P(\vec{r}, t)$ is the density of the released energy.

Using the wave equation for the longitudinal oscillations of the medium