obtained T_{S-F} = 115 ± 2°K, and for samples whose longitudinal axis was parallel to [100] we got T_{S-F} = 134 ± 2°K.

All samples were subjected to magnetic annealing by cooling from T_1 = 360°K to T_2 = 77°K in a transverse magnetic field H = 34 kOe either parallel to [100] or to [110]. The change of the temperature dependence of the electric resistance R = f(T) depends on the direction of the annealing field H relative to the crystallographic direction. For H parallel to [100], the anomaly at T_{S-F} becomes stronger and occurs at T = 120 ± 2°K, both for the sample with the longitudinal axis parallel to [100], and for the sample with longitudinal axis parallel to [110] (Fig. b). Heating above T_N restores the initial character of the R = f(T) completely. In the case of magnetic annealing in a field H_c parallel to [110], the anomalies of the temperature dependence of the electric resistance in the vicinity of 115 - 135°K disappears (Fig. c). It was impossible to restore the initial character of the R = f(T) variation by heating the samples to T = 390°K. Magnetic annealing in a field H making an angle of 45° to the [100] and [010] axes produces apparently the same effect as compression along the [001] axis [6, 7], and this process is not completely reversible. It should also be noted that the sample ruptured along the long axis [001] after a number of magnetic annealings in a field H = 34 kOe.

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TEMPERATURE COEFFICIENT OF LINEAR EXPANSION AND MAGNETOSTRICTION OF POLYCRYSTALLINE CHROMIUM

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The transition of the chromium lattice from cubic to orthorhombic at the Neel temperature T_N, and from rhombic to tetragonal at the spin-flip temperature T_{S-F} [1], should naturally be accompanied by anomalies of the elastic properties [2].

We have investigated the temperature expansion and the magnetostriction of polycrystalline samples of chromium in the temperature interval 77 - 350°K. The measurements were made by the ordinary tensometric method using a compensation pickup [3]. This pickup was introduced to eliminate the galvanomagnetic and temperature effects of the pickups themselves.

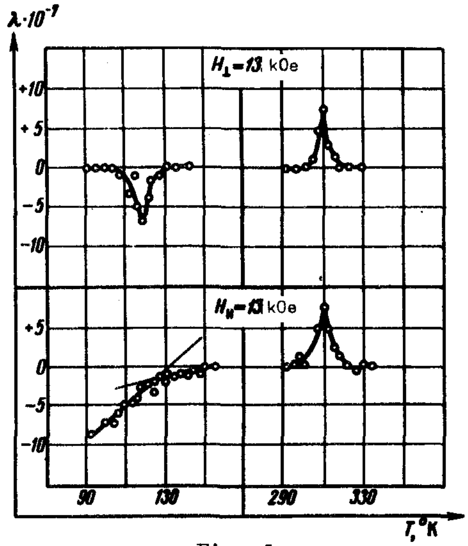

Fig. 1

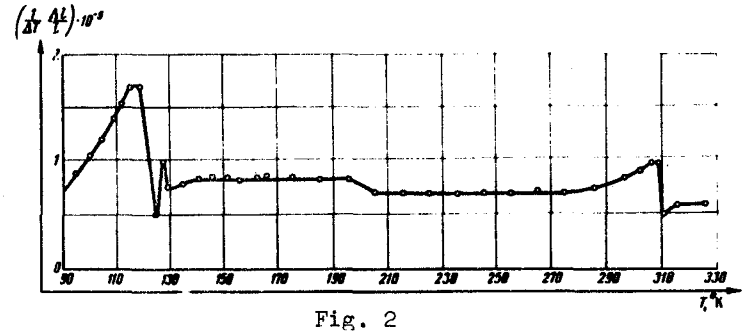

Fig. 2

Fig. 1. Temperature dependence of the longitudinal and transverse magnetostriction in the region of T_N and T_{S-F}, H = 13 kOe.

Fig. 2. Temperature dependence of the coefficient of thermal expansion.

Figure 1 shows the temperature dependence of the longitudinal and transverse magnetostriction in the regions of T_N and T_{S-F}. At T_N, the longitudinal and transverse magnetostrictions are positive and equal in magnitude. At 120°K the longitudinal and transverse magnetostrictions are negative, and at temperatures below 120°K the transverse magnetostriction is vanishingly small, whereas the longitudinal one increases in absolute magnitude.

It follows from Fig. 1 that at T_N and T_{S-F} an isotropic change occurs in the volume of the chromium sample. Small lattice distortions due to the change of symmetry from cubic to orthorhombic are not revealed by measurements on the polycrystalline samples. In the temperature interval 120 - 310°K, we observe also a maximum (of the absolute value) in the longitudinal and transverse magnetostrictions $\lambda_{\parallel}$ and $\lambda_{\perp}$ at those temperatures at which the longest axis of the rhombohedron becomes the shortest axis at 300°K [4]. The growth of the linear magnetostriction below 120°K is apparently connected with the increase of the anisotropy energy of chromium in the AF_2 phase.

Cooling the sample through the Neel point in a transverse magnetic field H = 22 kOe does not change significantly the character of the temperature dependence of the longitudinal magnetostriction, whereas the absolute magnitude of the transverse magnetostriction increases by $\sim 1 \times 10^{-6}$ in the temperature range 90 - 130°K.

Figure 2 shows the temperature dependence of the coefficient of thermal expansion $d = (1/\Delta T)(\Delta \ell/\ell)$ of a polycrystalline chromium sample. Minima are observed on this curve at $T = T_N$ and $T = T_{S-F}$. Magnetic annealing in a transverse field H = 22 kOe changes noticeably the character of the observed anomalies, the minimum giving way to a jumplike break. On going from the paramagnetic to the antiferromagnetic state, the jump is positive and amounts to $\sim 5 \times 10^{-7}$. On going from the AF_1 to the AF_2 phase, the jump is approximately half as large and equals $\sim 2 \times 10^{-7}$. A kink on the d = f(T) curve is observed also at the temperature at which the orthorhombic axis changes. It is of interest to note one more fact observed by us in the investigation of the temperature dependence of the linear expansion of chromium. When the sample is heated rapidly from 77 to 85°K, a compression of the sample to $(\Delta \ell/\ell) \sim 1.2 \times 10^{-5}$ is observed, after which the sample begins to expand again. The depth of the minimum is the larger, the faster the heating rate. In the case of extremely slow heating (20° in 3 hours), there are no anomalies.

The inverse phenomenon is observed when the sample is cooled, namely the sample expands upon cooling. The first report of such an anomalous behavior of chromium is contained in [4]. This behavior of chromium may be connected with the unique "superheating" of the sample. Then the increase of the internal energy, resulting from the delay of the transition, is offset by a decrease of the exchange energy via spontaneous compression. This conclusion agrees with a pressure study [5] that has shown that pressure decreases the energy gap, and hence the antiferromagnetic interaction.

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THRESHOLD PHENOMENA IN A PARAMETRICALLY EXCITED SPIN SYSTEM OF FERRITES

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It was shown in [1, 2] that it is possible to observe in a parametrically excited spin system secondary threshold phenomena due to the excitation of new groups of spin waves. The most important processes are those for which the energy and momentum conservation laws are written in the form

$$\omega_{k_0} = \omega_k + \omega_{k_0 - k}, \quad (1)$$

$$2\omega_{k_0} = \omega_{k_0 + \kappa} + \omega_{k_0 - \kappa}, \quad (2)$$

where $\vec{k}_0$ is the wave vector of the primary excited spin wave in the parametric excitation of spin waves (PESW). The first of these processes, predicted theoretically by one of the authors [1], was confirmed experimentally by Lemaire et al. [3]. In accord with [1], this effect was observed in a relatively narrow region of magnetizing fields H_0, defined by the inequality

$$0 \leq H_0 - \frac{1}{3}4\pi M \leq -2\pi M - \frac{1}{3}\left[(2\pi M)^2 + \left(\frac{\omega_{k_0}}{\gamma}\right)^2\right]^{1/2} + \frac{2}{3}\left[(4\pi M)^2 + \left(\frac{\omega_{k_0}}{\gamma}\right)^2\right]^{1/2}. \quad (3)$$

It turned out that the critical instability field (1) for yttrium ferrite exceeds the usual PESW threshold by 20 dB.

It was of interest to observe experimentally an instability of type (2), the excitation threshold of which may turn out to be low because of the compensation of the losses of the corresponding group of waves by an external alternating magnetic field. To this end, we investigated the behavior of a number of ferrite crystals beyond the PESW threshold. The measurements were made on spherical samples of 1.2 mm diameter at a frequency 9200 MHz and a temperature 300°K. The exciting pulse length was 3 μsec. The samples were magnetized usually along <111>. The investigation resulted in observation of a group of