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ANOMALIES OF THE TEMPERATURE DEPENDENCE OF THE FARADAY EFFECT AT THE COMPENSATION POINT OF GADOLINIUM IRON GARNET

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Most rare-earth iron garnets have a magnetic compensation point T_c, at which the magnetic sublattices exchange roles in the sense of determining the resultant magnetization of the iron garnet [1, 2]. In the region of the compensation point T_c, some of the properties of ferrimagnets exhibit anomalies. The anomalous temperature dependences of the coercive force $H_c(T)$ [3] and of the ferromagnetic resonance absorption linewidth $\Delta H(T)$ [4] indicate that a change of the magnetic structure of iron garnets takes place in the region of the compensation temperature [5].

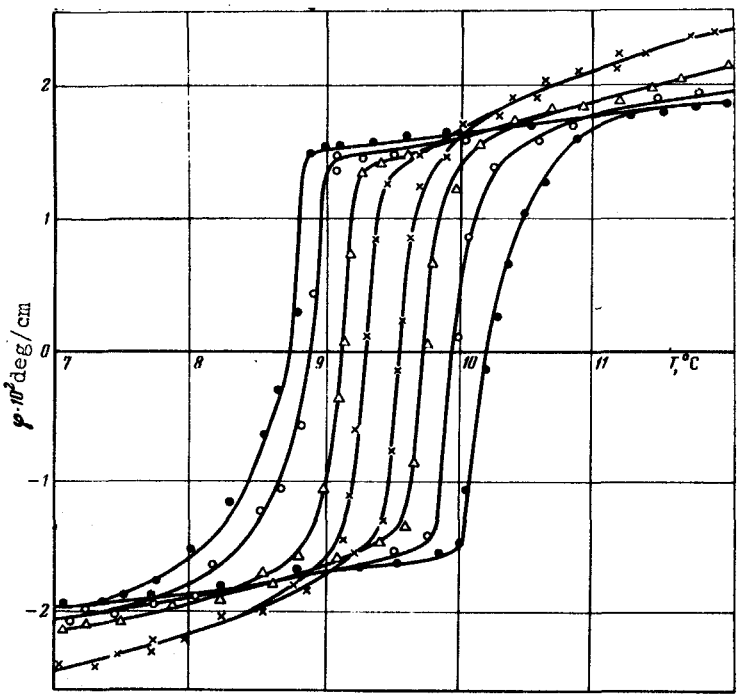

Fig. 1. Temperature hysteresis loops of the Faraday effect in $Gd_3Fe_5O_{12}$ [111] in a field up to 850 Oe: ● - 0.26 kOe, o - 0.33 kOe, ▲ - 0.50 kOe, × - 0.85 kOe.

We investigated the temperature dependence of the Faraday rotation in single-crystal gadolinium iron garnet on going through the compensation point at the wavelength 0.77 μ. A crystal 275 μ thick was oriented in the [111] plane. A temperature hysteresis of the Faraday effect (THFE) was observed. Figure 1 shows plots of the temperature dependence of the Faraday rotation obtained by heating and cooling the sample through the compensation point in magnetic fields up to 850 Oe. The THFE decreases with increasing field and practically vanishes in fields of 3 - 4 kOe. With further increase of the magnetic field, the THFE gives way to a smooth hysteresis-free transition through the compensation point, and the region of the transition expands with increasing field. Figure 2 shows plots of the angle of the Faraday rotation against the temperature, obtained by cooling and heating the sample through the compensation point in magnetic fields stronger than 4.5 kOe.

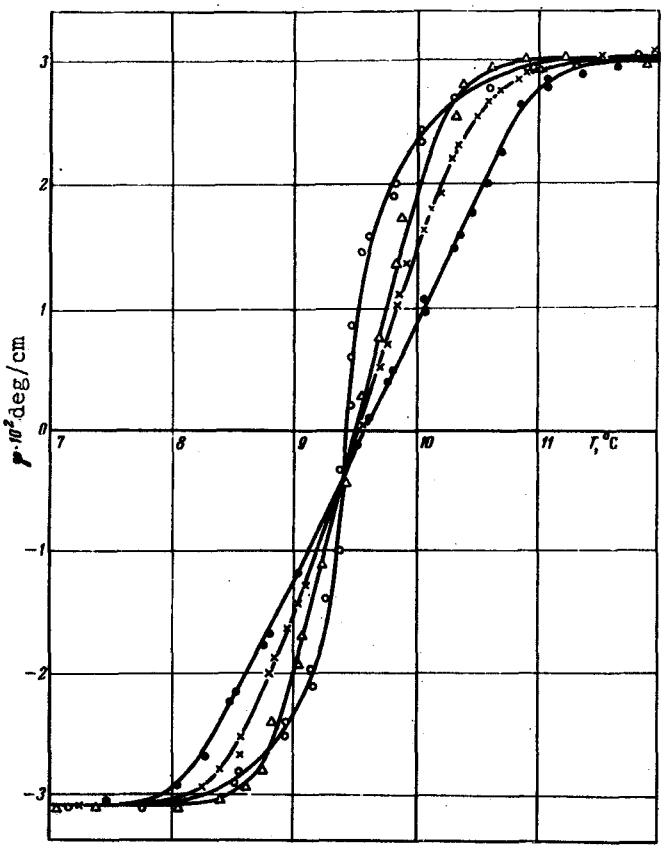

Fig. 2. Temperature dependence of the Faraday effect in $Gd_3Fe_5O_{12}$ [111] in fields stronger than 4.5 kOe.

The results of our investigations are apparently in agreement with the results reported in [6], where the question of the rotation of the sublattices of a ferrimagnet in a magnetic field was considered theoretically.

Thus, a temperature hysteresis of the Faraday effect has been observed in gadolinium iron garnet at the point of magnetic compensation T_c in fields not exceeding 4 kOe. The character of the behavior of the temperature dependence of the Faraday effect in fields exceeding 3 - 4 kOe near the compensation point is apparently due to the rotation of the magnetic sublattices.

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