EFFECT OF UNIFORM COMPRESSION ON THE MAGNETIZATION OF Ho *AND* Er *IN THE ANTIFERROMAGNETIC REGION*

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MEASUREMENTS of the relative change of the specific magnetization on compression (the pressure coefficient $\alpha = \sigma^{-1}(\Delta\sigma/\Delta p)$) were made on polycrystalline samples of holmium and erbium in magnetic fields up to 17 kOe. The measurement procedure and the method of producing the pressures were described earlier.[1] The values of the adiabatic compressibility at room temperature [2] were used to calculate α. According to the neutron-diffraction data [3] and magnetic measurements,[4] Ho is antiferromagnetic in the temperature region from 20° to 133°K, and ferromagnetic below 20°K. The antiferromagnetic structure of Ho is a complex spiral structure with the spiral axis directed along the c axis.

The dependence of α on the field at temperatures of 77° and 111.1°K is shown in Fig. 1. At 77°K, in fields up to ≈ 7 kOe, the pressure coefficient is constant within the experimental error and independent of the field. In this region, $\alpha = -(84.4 \pm 5.6) \times 10^{-7}$ atm^{-1} at p = 2600 atm, and $\alpha = -(83.8 \pm 5.6) \times 10^{-7}$ atm^{-1} at p = 1800 atm. The sharp enhancement of the effect in stronger fields is obviously due to the partial destruction of the spiral spin structure and the appearance of ferromagnetic ordering. At 111.1°K, the effect is smaller; the pressure coefficient is constant also in the antiferromagnetic region (up to H ≈ 12 KOe) and equal to $\alpha = -(44.3 \pm 2.9) \times 10^{-7}$ atm^{-1} at p = 1880 atm, and $\alpha = -(45.4 \pm 3.0) \times 10^{-7}$ atm^{-1} at p = 3700 atm.

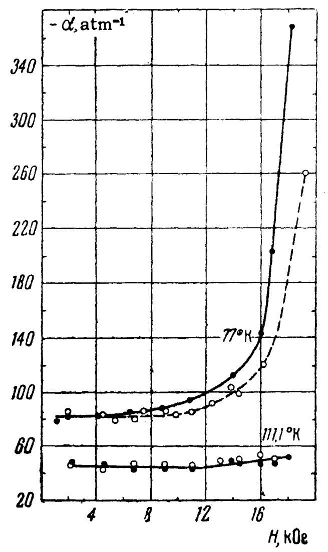

FIG. 1. Holmium. Dependence α(H) at 77°K: ○ – at p = 2600 atm, ● – at p = 1800 atm; at 111.1°K: ○ – at p = 3700 atm, ● – at p = 1880 atm.

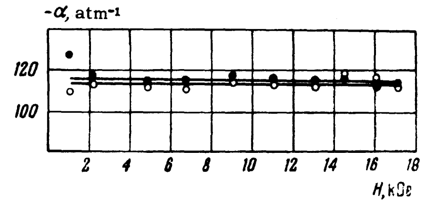

FIG. 2. Erbium. Dependence α(H) at 77°K: ○ – at p = 2800 atm, ● – at p = 1820 atm.

Erbium is antiferromagnetic in the temperature range from 20° to 80°K.[5] The structure of Er in the 52—80°K region is also a complex spiral structure:[6] the z component of the moment varies sinusoidally with distance along the c axis with a period equal to 3.5 c_0. Measurements of α were carried out at 77°K (near the Néel point) using annealed samples of Er. Figure 2 illustrates the dependence $\alpha(H)$. The pressure coefficient at both pressures is constant within the experimental error: $\alpha = -(114.8 \pm 7.7) \times 10^{-7}$ atm^{-1} at p = 2800 atm, and $\alpha = -(115.8 \pm 7.8) \times 10^{-7}$ atm^{-1} at p = 1820 atm.

From the results of these measurements it follows that at the cited temperatures the magnetization of both Ho and Er decreases under uniform compression, and the ratio $\Delta\sigma/\sigma$ is independent of H in the antiferromagnetic region but proportional to pressure within the investigated limits.

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