SHIFT OF THE CURIE TEMPERATURE OF GADOLINIUM BY HYDROSTATIC PRESSURE UP TO 35 KILOBARS

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Experiments are described for determining the influence of hydrostatic pressure up to 35 kbar on the Curie temperature of gadolinium. It was established that the Curie temperature of gadolinium decreases linearly over the whole range studied. The experimentally determined coefficient of proportionality between the amount of shift of the Curie temperature and the pressure is -1.34 deg kbar^{-1}.

THE influence of hydrostatic pressure on the Curie temperature of gadolinium was studied earlier in the range 1 to 8000 atm [1] and 1 to 6000 atm [2]. According to the results of these studies, the Curie temperature of gadolinium decreases in proportion to the pressure,

$$-\Delta\Theta = \Theta_p - \Theta = ap, \qquad (1)$$

where Θ and Θ_p are the values of the Curie temperature under atmospheric pressure and under pressure p, respectively, and a is a proportionality coefficient, equal to 1.2 ± 0.005 deg katm^{-1} (1.225 deg kbar^{-1}) according to the data of [1] and to 1.55 deg katm^{-1} (1.58 deg kbar^{-1}) according to the data of [2]. A value of $d\Theta/dp$ near these was also obtained in experiments conducted under quasi-hydrostatic pressure up to 26 kbar, and reported in preliminary form in an earlier paper [3], and also to 21.5 kbar in [4]. The agreement of these results with those cited above shows that in determination of the influence of pressure on the magnetic transformation temperature, the liquid or gas used for transmission of the pressure to the specimen can be successfully replaced by a solid plastic material.

Reported below are some additional data on the shift of the Curie point of gadolinium with pressure in the range up to 35 kbar. As was described earlier [3,5], the pressure was produced in a piezometer by the method of "piston displacement"; silver chloride served as the medium being compressed. The specimens were minature toroids, cut from cast polycrystalline metal, which was reported to contain the following controlled impurities: Yb and Tb (in all) 0.1%, Ca 0.02%, Fe 0.01%, Cu 0.005%.

In the course of the experiment, curves showing the dependence of magnetic permeability (μ) on pressure were taken, at constant temperature (the temperature fluctuations during the time of an experiment did not exceed 0.5 to 1°). The

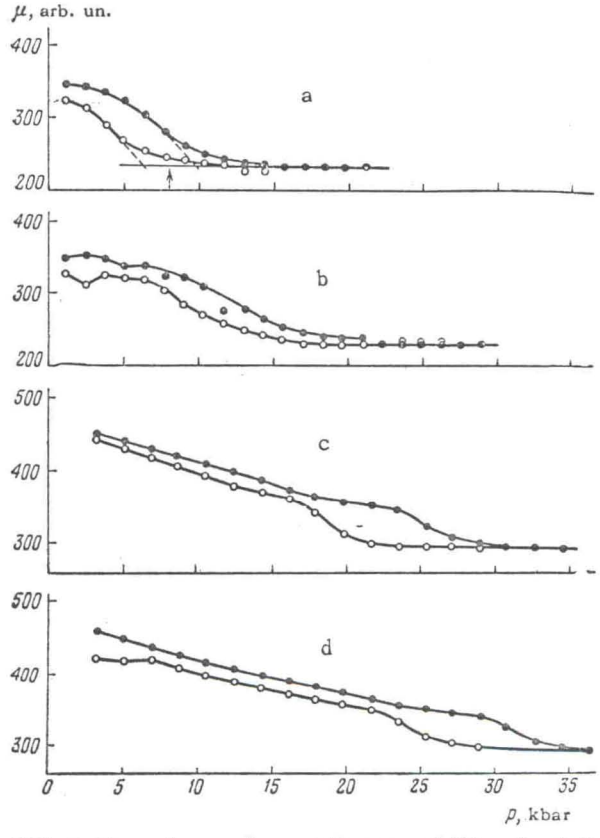

FIG. 1. Dependence of magnetic permeability of gadolinium on pressure at various temperatures: a, −1.5°C; b, −15°C; c, −23°C; d, −30°C. Dark circles, experimental values obtained on increase of pressure; open circles, on decrease. The arrow in Fig. 1a gives the value of the magnetic transition pressure at the indicated temperature.