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A STUDY OF MAGNETIC SUSCEPTIBILITY OF SINGLE-CRYSTAL GADOLINIUM UNDER ALL-ROUND COMPRESSION

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We measured the dependences of the initial magnetic susceptibility on the temperature $\chi(T)$ of a Gd single crystal along the *c* and *b* crystallographic axes in external magnetic fields and up to 1 GPa. The $\chi(T)$ curves were found to have maxima at the Curie temperature Θ_C, the spin-reorientation transition temperature Θ_{SR}, and the temperature $\Theta_A = 140$ K. The derivatives $\partial\Theta_C/\partial P$ and $\partial\Theta_{SR}/\partial P$ are determined, which are -13 and -67 K GPa^{-1} along the *c* axis and -12 and -29 K GPa^{-1} along the *b* axis, respectively.

The study of the effect of all-round compression on the magnetic susceptibility $\chi(T)$ gives useful information on the transformation of a magnetic structure exposed to a uniform stress. Although temperature shifts of magnetic phase transitions under pressure in heavy rare-earth metals have been well studied (see, e. g., [1]), the effect of compression on the shape of the $\chi(T)$ curves has not so far been investigated in detail for all rare-earth metals. This paper reports a study of the effect of pressure and magnetic field on the temperature dependences of the initial magnetic susceptibility measured along different crystallographic directions.

The description of the experimental procedure is given in [2]. The measurements were carried out at the ambient pressure and at pressures up to 1 GPa. The constant magnetic field in this case could vary to 2 kOe. The specimen used was grown by the Czochralski method. The specimens were oriented by the Laue method to an accuracy of $\pm 3°$ and were cut by the electric spark method.

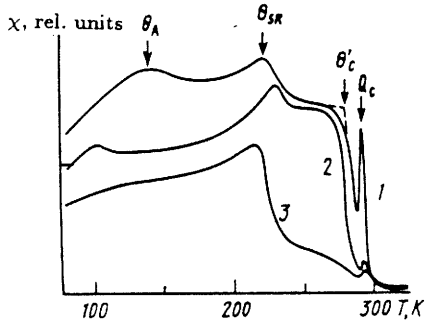

Fig. 1

Temperature dependences of the initial magnetic susceptibility χ of a Gd single crystal at the ambient pressure in a field applied along the *c* crystallographic axis: $H = 0$ (1), 0.33 kOe (2), and 0.57 kOe (3).

Figure 1 shows the $\chi(T)$ temperature dependences in magnetic fields up to 500 Oe applied along the *c* crystallographic axis. It is evident that exposure to the magnetic field transforms appreciably the $\chi(T)$ curves. According to neutron diffraction data [3], the *c* axis is an easy magnetization axis within the interval from the Curie temperature $\Theta_C = 294$ K to the temperature of spin-reorientation transition $\Theta_{SR} = 232$ K. At $T < \Theta_{SR}$ the easy magnetization direction deviates from the *c* axis through the angle θ, whose value varies with temperature. At $H = 0$ the $\chi(T)$ curves exhibit four characteristic properties. The maximum at the temperature $\Theta_C = 292$ K corresponds to the specimen transition from paramagnetic to ferromagnetic state. The maximum drastically diminishes with increasing field (by a factor of about 2 in the 0.1 kOe field),