

THE EFFECT OF UNIAXIAL COMPRESSION ON THE CRITICAL FIELD OF THE "SPIN FLIP" TRANSITION IN Cr₂O₃

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A sharp dependence of the anisotropy energy of antiferromagnetic Cr₂O₃ on pressure has been found. The effect cannot get a trivial explanation by features of magneto-dipole interaction. It may be connected with the properties of the spin-orbit interaction in the crystal.

Of transition metal ion sesquioxides isomorphous in crystal structure with corundum the uniaxial antiferromagnetic Cr₂O₃ is the subject of close attention caused by the specific properties of its magnetic symmetry which allows the existence of a magneto-electric effect. Its anisotropy energy *K* has been measured [1], but its nature is not understood yet finally. It has been found [2] that about half *K* arises from a magneto-dipole interaction. The present letter reports the anisotropy energy to be so sensitive to lattice geometry, that the crystal prostration along the rhombohedral axis C₃ with the external stress ~7kbar would produce a zero anisotropy energy and spontaneous "spin-over" of the spins into the basal plane. This result has been obtained while studying the effect of uniaxial compression along the C₃ axis on the critical field of "spin flip" transition in Cr₂O₃. The measurements have been carried out at 20.4°K in a pulsed magnetic field oriented along the C₃ axis to within 5' using a pair of balanced pickup coils [3]. The dependence of the critical field on the applied stress is shown in fig. 1. Within the experimental errors it may be described by a straight line whose slope gives

$$\frac{1}{H_c(0)} \frac{dH_c}{dp} = 7.5 \times 10^{-2} \text{ kbar}^{-1}$$

The value of critical field *H_c* and its dependence on the stress is given by *K* and the susceptibility difference $\Delta\chi = \chi_{\perp} - \chi_{\parallel} \approx \chi_{\perp}$:

$$H_c = (2K/\Delta\chi)^{\frac{1}{2}}, \quad \frac{1}{H_c} \frac{dH_c}{dp} = \frac{1}{2} \left(\frac{1}{K} \frac{dK}{dp} - \frac{1}{\Delta\chi} \frac{d(\Delta\chi)}{dp} \right)$$

The order of magnitude of the second summand may be got from the pressure dependence of the

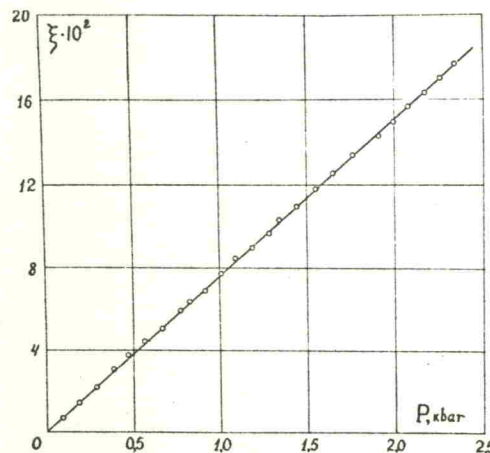


Fig. 1. Changes in the critical field of the "spin-flip" transition in Cr₂O₃ ($\xi = \{H_c(p) - H_c(0)\} / H_c(0)$) under uniaxial pressure along the rhombohedral axis. *T* = 20.4°K.

Néel temperature since both *T_N* and χ_{\perp} describe the superexchange interaction value in the crystal. However, the pressure effect on *T_N* [4] appears to be too small ($dT_N/T_N dp = -5 \times 10^{-3} \text{ kbar}^{-1}$) and consequently the value of the effect observed is accounted for by the anisotropy constant. Taking *K* = 2 × 10⁵ erg/cm³ [1] we find $dK/dp = 3.0 \times 10^{-5}$. It is interesting to note that the shift of *H_c* with pressure appeared to be by an order of magnitude larger than the corresponding one for Fe₂O₃, which was calculated from the magnetostriction jumps at the critical point [5]. Having the same crystalline structure and similar anisotropy energy and critical field values, Fe₂O₃ differs from Cr₂O₃ in the metal

MEMORANDUM FOR THE RECORD

On the 14th day of January 1912, the Board of Directors of the [Company Name] met at the [Location] and discussed the [Topic]. The following is a summary of the proceedings:

The Board considered the report of the [Department] and found it satisfactory. It is recommended that the [Action] be taken.

The Board also discussed the [Topic] and decided to [Action]. It is recommended that the [Action] be taken.

The Board further discussed the [Topic] and decided to [Action]. It is recommended that the [Action] be taken.

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