where μ is the magnetic moment of the ion creating the field and $\mathbf{r}$ is its radius vector relative to the point considered. The total field is obtained by summing over all the magnetic ions of the crystal. In calculating how the anisotropy energy varies with the deformation, we will use an approximate method. We represent K in the form

$$K \sim \frac{\gamma}{v}. \tag{3}$$

This relationship between K and the volume of the unit cell ($v = a^2c$) is tied up with the fact that the field due to magnetic dipoles decreases as the cube of the interatomic distances [see (2)]. The quantity $\gamma = (a - c)/(a + c)$ is a dimensionless parameter characterizing the extent to which the magnetic lattice deviates from a body-centered cubic lattice. The anisotropy field of the latter equals zero, and (3) can be considered as the first term in the series of an expansion of K in terms of γ. Direct differentiation of (3) with respect to the relative changes in the unit cell constants along the different crystallographic directions gives

$$\frac{1}{K}\frac{\partial K}{\partial U_a}\Big|_c = 0.53, \quad \frac{1}{K}\frac{\partial K}{\partial U_c}\Big|_a = -3.6 \text{ and } \frac{1}{K}\frac{dK}{dp} = \frac{1}{K}\frac{\partial K}{\partial U_c}S_{33} + \frac{1}{K}\frac{\partial K}{\partial U_a}S_{13} = -3.4 \cdot 10^{-12} \text{ cm}^2/\text{dyn}. \tag{4}$$

Here $S_{33} = 0.90 \cdot 10^{-12}$ cm^2/dyn and $S_{13} = 0.36 \cdot 10^{-12}$ cm^2/dyn are the elastic compliance constants of the crystal, calculated from ultrasonic wave velocities at low temperatures [8] and data in [9]. The error in this calculation is because γ is not small. However, direct calculation of the quantity in (4) by summing the contributions of the sixteen nearest neighbors gives the same value.

The quantity $\chi_\perp(p)$ in the measured quantity can be determined from the expression

$$\frac{1}{H_c}\frac{dH_c}{dp} = \frac{1}{2}\left(\frac{1}{K}\frac{dK}{dp} - \frac{1}{\chi_\perp}\frac{d\chi_\perp}{dp}\right), \tag{5}$$

derived from (1) by differentiation, where the term on the left represents the experimental result after subtraction of the classical effect. Using the relationship $\chi_\perp \sim 1/J_{12}$ [1] we find

$$-\frac{1}{\chi_\perp}\frac{d\chi_\perp}{dp} = \frac{1}{J_{12}}\frac{dJ_{12}}{dp} = 1.9 \cdot 10^{-12} \text{ cm}^2/\text{dyn}.$$

This relationship, which indicates that the bulk interaction between the sublattices grows when the crystal is uniaxially compressed, gives only part of the information on the relationship between J_{12} and the interatomic distances.

In fact the expression

$$\frac{1}{J_{12}}\frac{dJ_{12}}{dp} = \frac{1}{J_{12}}\frac{\partial J_{12}}{\partial U_c}\Big|_a S_{33} + \frac{1}{J_{12}}\frac{\partial J_{12}}{\partial U_a}\Big|_c S_{13} \tag{6}$$

is an equation with two unknowns. A similar equation relating to H_c measurements under hydrostatic pressure conditions, also retaining the initial symmetry of the crystal, can be used in conjunction with (6) to determine both quantities of interest; the relevant experiments are being carried out at the present time. However, even now it is possible to compare our results with those from other experiments. There is qualitative agreement between our results and those of Gibbons [10], who observed marked contraction of a MnF_2 crystal along the symmetry axis during antiferromagnetic ordering, and also with the results obtained by Astrov, Novikova, and Orlova [11] and by Benedek and Kushida [12], who observed an increase in the temperature of ordering (T_N) with homogeneous compression. Quantitative agreement with the cited results should not be expected, since the latter include the relationship between the interatomic distances and the sublattice exchange integral J_{11}, the contribution of which cannot be neglected.

Finally, if we examine the inversion of magnetic sublattices as a phase change of the first kind, we can write the equation linking the change in magnetic field with the uniaxial pressure as a phase equilibrium curve [5]:

$$\frac{dH_c}{dp} = -\frac{\Delta U_c}{\Delta m}, \tag{7}$$

where ΔU_c and Δm are respectively the jumps in the relative crystal deformation along the C_4 axis and in the magnetic moment. This expression, which is analogous to a Clapeyron-Clausius equation, allows data on critical field displacements with pressure to be used to calculate the corresponding jumps in crystal dimensions at the critical point. The result $\Delta U_c = 0.26 \cdot 10^{-4}$ is in agreement with direct magnetostriction measurements on MnF_2 in a strong field [13].

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