MAGNETIC SUSCEPTIBILITY OF FERRIC FLUORIDE NEAR THE NEEL TEMPERATURE

M.Lj.Napijalo, A.Srećković, L.Novaković

The Institute of Physics, Belgrade
The Faculty of Natural Sciences, Belgrade

Ferric-fluoride, FeF_3, crystallizes in a rhombohedral system, space group $D_{3d}^6(R\bar{3}c)$ with two stoichiometric units per unit cell|1|. Fe^{3+} ions are situated in octahedron centers which are formed by F^- -ions while the octahedrons themselves are linked together by mutual corners. Ferric-fluoride is a weak ferromagnet|2|. Magnetetic moments of atoms are in the antiferromagnetic colinear order and lie in planes (111); at the same time they are slightly canted out of this plane, so that FeF_3 has a weak ferromagnetic moment in the direction [111].

Néel temperature of FeF_3 was neutronographically determined|2| by the use of Mössbauer effect |3-6| and by measuring with the vibrating sample magnetometer|3|. The data from different papers are tabulated in Table 1.

Table 1

Ref.	|2|	|3|	|4|	|5|	|6|
T_N(K)	394	362,4	364,8	362	363,2

Determination of T_N was not performed by measuring magnetic susceptibility as in the case of other weak ferromagnets (for example|7|).

The authors performed the investigations of FeF_3 near the Néel temperature by measuring magnetic susceptibility with the Gouy method using the powder sample with the purity of 98% (Koch-Light) as in Ref.|5|. The investigations were carried out by means of electromagnet with

pole caps of 15 cm in diameter at maximum magnetic inductions of 2,3,4,5 and 7 kG. The sample temperature was defined with an error less than $0,1^{o}C$ and the temperature change along the sample (15 cm) was less than $0,1^{o}C$. Magnetic susceptibility χ was measured in the temperature range from 290 K to 400 K for each of the mentioned inductions, and as a result five experimental curves were obtained.

The Néel temperature was determined for all five curves according to the position the inflection point what corresponds to the diffuse phase transitions|8|. It is found that the magnetic field intensity does not affect the so defined temperature of phase transitions, as well as that all five curves give

$$T_N = (364,8 \pm 0.2)K$$

As in |5|, the critical exponent β was determined for the dependance.

$$\chi \propto (1-T/T_N)^{\beta} = \varepsilon^{\beta}$$

The experimental results presented in the plot $\log\chi$-$\log\varepsilon$ for the region $0.00285 \leq \varepsilon \leq 0.0285$ lie on the straight lines of different slope: the different values of critical exponent corresponding to different field intensities (Table 2)

Table 2

B(kG)	2	3	4	5	7
β	0.337	0.314	0.270	0.263	0.220

These values extrapolated for B=0 give

$$\beta_{extr.} = 0.384$$

what can be compared with the values of β obtained by means of other methods (Table 3)

Table 3

Ref.	|3|	|4|	|5|
8	0.358	0.360	0.38

References:

1. Hepworth, M.A., Jack, K.H., Peacock, R.D. and Westland, G.J., Acta Cryst., 10, 63 (1957).
2. Wollan, E.O., Child, H.R., Koehler, W.C. and Wilkinson, M.K., Phys.Rev., 112, 1132 (1958).
3. Bertelsen, H., Knudsen, J.M. and Krogh, H., Phys.Stat. Solid, 22, 59 (1967).
4. Wertheim, G.K., Guggenheim, H.J. and Buchanan, D.N.E., Solid St. Commun., 5, 537 (1967).
5. Levinson, L.M., J.Phys.Chem.Solids, 29, 1331 (1968).
6. Gamlickij, V.Y., Ykimov, S.S., Nikolaev, V.I. and Simonov, N.F., Pis'ma v. ZETF, 13, 129 (1971).
7. Borovik-Romanov, A.S., Antiferromagnetizm, in Antiferromagnetizm i ferriti, ed. Y.G.Dorfam, Izd-vo AN SSSR, Moskva, 1962.
8. Rolov, B.N., Razmitye fazovye perehody, "Zinatne", Riga, 1972.