LETTERS TO THE EDITOR

THE CRYSTAL STRUCTURE OF BIS HYDROGEN MALEATO TETRAAQUO IRON (II) $Fe(C_4H_3O_4)_2.4H_2O$

THE title compound was studied to unravel the scheme of hydrogen bonds in the crystal as also to study the metal-oxygen ligands.

Crystal data: Triclinic with $a = 7{\cdot}31$, $b = 9{\cdot}69$, $c = 5{\cdot}24$ Å, $\alpha = 104{\cdot}7°$, $\beta = 90{\cdot}7°$, $\gamma = 114{\cdot}8°$, $Z = 1$, Space group $P\bar{1}$, $D_{obs} = 1{\cdot}83$, $D_{calc} = 1{\cdot}84$ gm/cc.

515 reflexions, zonal and three-dimensional, were collected using single cyrstal and Weissenberg photography with Cu K radiation. The intensities were estimated visually, data corrected for usual correction factors and brought to nearly absolute scale by statistical method.

Structure Determination, Refinement and Comments:

The structure has been solved in projections by the heavy-atom technique (heavy atom-occupying the special position 0, 0, 0 of centre of symmetry). Fourier syntheses gave the positions of the light atoms. The present R factors are: R (*hko*) = 0·12, R (*okl*) = 0·14. A view of the structure looking down [001] is given in Fig. 1. In the structure, the metal is six-fold

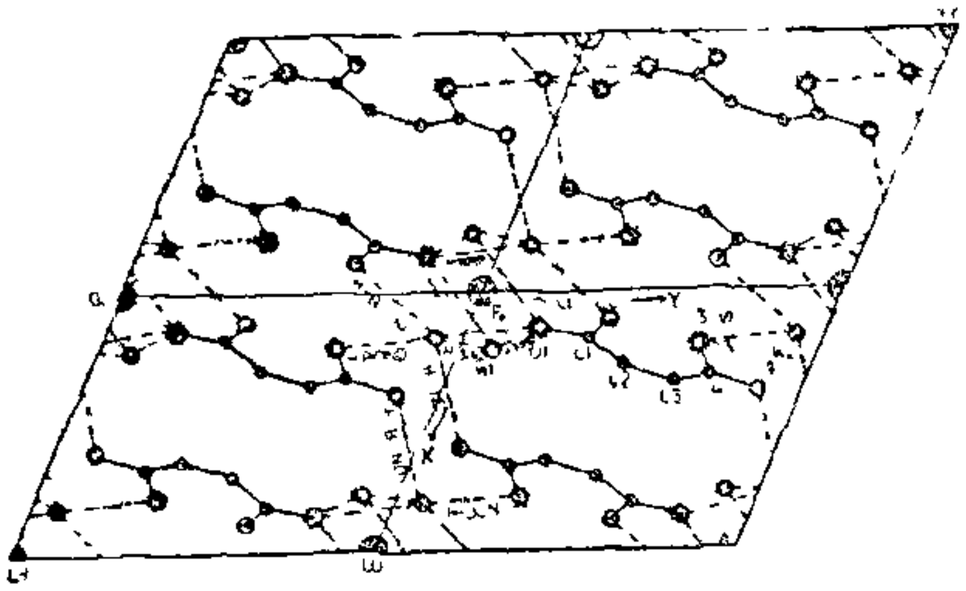

FIG. 1

coordinated by oxygen atoms, metal-oxygen distances ranging from 1·96 to 2·21 Å. The dimensions of the maleate anion are normal. In the structure there are ten short distances ranging from 2·73 to 3·20 Å. Some of these may be real hydrogen bonds inclusive of bifurcated hydrogen bonds. A tentative scheme of hydrogen bonds is shown in the above figure. However, great interest lies in the location of the hydrogen bonds and in establishing the true scheme of hydrogen bonds in the structure. This part of the work is currently in progress.

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FERRIMAGNETIC VOLUME CHANGE IN LITHIUM-NICKEL FERRITES

THERMAL expansion of pure lithium ferrite has been studied by Haudek[1] and Naiden and Red'kin[2]. However, it is observed that no data on the thermal expansion of lithium-nickel ferrites are available in the literature. Also magnetic materials show interesting behaviour in the vicinity of the Curie temperature if the studies are extended to sufficiently high temperatures. With this aim, a study of the dependence of the coefficient of thermal expansion (α) of lithium-nickel ferrites on temperature and composition has been undertaken. The results thus obtained are presented in this communication.

Lithium-nickel ferrites of four different compositions having the chemical formula:

$$[(Li_{0{\cdot}5}\ Fe_{0{\cdot}5})_{1-\delta}\ Ni_{\delta}]\ Fe_2O_4$$

where δ ranges from 0 to 0·6, have been prepared starting from lithium carbonate (BDH 99% pure), nickel nitrate (BDH, 99% pure) and ferric oxide (99% pure) by the double sintering method. Rectangular bars are sintered between 1100° C and 1200° C depending on the composition in an oxygen atmosphere and are used in the present investigation.

The coefficient of thermal expansion for these ferrites has been determined over a temperature range 168° C to 725° C using the dilatometer technique[3]. Thermal expansion measurements are recorded at intervals of 50° C in general and 25° C to 30° C in the vicinity of the Curie temperature using a mechanical displacement dial gauge that could read to a thousandth of a mm. The accuracy in the determination of the value of α has been found to be $\pm$ 1%.

A plot of the coefficient of thermal expansion α *versus* temperature for the four ferrites is shown in Fig. 1. From the present study, it has been observed that the value of α increases gradually with the increase of temperature. All the four curves, however, show a hump in the vicinity of the Curie temperature, the maximum of the hump occurring exactly at the Curie temperature. This anomaly in the variation of the coefficient of thermal expansion near the Curie temperature can be attributed to the additional volume change caused by the destruction of the spontaneous magnetization. In the case of nickel and cobalt ferrites, Haudek[1] observed a similar variation of α with temperature with a hump in the vicinity of the Curie point. On the other hand, in the case of lithium ferrite he did not observe a similar hump, although the value of α showed an increase with increase of temperature. Naiden and Red'kin[2], however,