Effect of the Zn$^{2+}$ Distribution on the Magnetic Properties of Ba$_2$Zn$_2$Fe$_{14}$O$_{22}$(Zn$_2$-Y) Hexaferrite Investigated by Thermal-Scan Mössbauer Spectroscopy.

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Summary. — The role of the cation distribution on the magnetic characteristics of Ba$_2$Zn$_2$Fe$_{14}$O$_{22}$(Zn$_2$-Y) hexaferrite has been analysed by using Mössbauer techniques. For this purpose we developed a low-cost microcomputer-controlled thermal-scan Mössbauer apparatus that allows accurate measurements of the Curie temperature. The measuring times are much shorter than those attained with previously described similar apparatus. The variation of the Curie temperature with the sintering temperature of Zn$_2$-Y has been correlated with different cation distributions of Zn$^{2+}$ among the two tetrahedral sublattices present in the Y-structure.

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1. — Introduction.

In the past years, increasing attention has been devoted to the study of the intrinsic magnetic properties of hexagonal ferrites. For a detailed description of their crystalline structures and magnetic properties, we refer to the extensive literature on this subject (1-3). Hexagonal ferrites containing Zn have proven to be compounds suitable for applications in high-frequency

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devices (1); among them the planar Y-type ferrite $\text{Ba}_2\text{Zn}_2\text{Fe}_{12}\text{O}_{36}(\text{Zn}_2-\text{Y})$ is of particular interest due to its large initial permeability and low magnetic loss. It has been shown that even small variations in the distribution of $\text{Zn}^{2+}$ ions among the two different tetrahedral sites present in the Y structure ($c_{1v}$ and $c_1^2$ according to standard crystallographic notation) can affect the magnetic parameters of $\text{Zn}_2-\text{Y}$ ferrite (5-7).

The cation distribution in magnetic oxides is known to depend markedly on the thermal treatments undergone by the samples. For sintered polycrystals, the sintering temperature plays an important role in this respect. The dependence of the cation distribution on the thermal treatment performed on the samples has been studied in detail in spinel ferrites and garnets (8,9). Some evidence of the existence of analogous effects in hexagonal ferrites already exists (10,11). The aim of the present work is to analyse this problem by looking at the correlations between the sintering conditions of zinc-containing ferrites and the values of the magnetic parameters which are sensitive to the cation distribution. Among these, as shown in ref. (12), is the Curie temperature. The Curie temperature ($T_c$) can be measured by different thermal-scan methods. We choose to employ a Mössbauer thermal-scan technique since it has the advantage of being a zero-field technique. This characteristic is of great advantage in analysing complex magnetic materials as hexaferrites in which non-collinear spin configurations are often present. These can give rise to contributions to the susceptibility near $T_c$ that can affect the $T_c$ values determined with conventional magnetization measurements. Mössbauer measurements are usually time consuming. Therefore, in order to perform the $T_c$ measurements by eliminating any waste of time, we have developed an automated thermal-scan Mössbauer apparatus using a low-cost microcomputer with the Forth language. Its detailed description is given in the next section.