CHAPTER-VI

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SUMMARY AND CONCLUSION

Ferrites have been the centre of attraction of many scientists and technologists in the last two decades, mainly because of their interesting physical properties and many technological uses. Several kinds of ferrites have been synthesised and characterized during that period. The spinel ferrites which form a class of technologically important ferrites are being extensively evaluated even today. More essantial improvements are obtained by advance in technology, such as the use of very pure raw materials or of method of preparation(1,2). Further the role of microstructure in governing the properties of these ferrites is imphatically established e.g. porosity depends upon sintering temperature and time and also on purity of sample and pressure applied during the preparation. The coercive force is found to be higher for lower firing temperature and time for longer grinding time(3). The grain boundary region is important for the control of magnetic properties of ferrites(4) Venkataramani and others(5) have discussed the dependence of microstructure on sintering temperature.

Thus with the view point of structure properties co-relation the orientation of work involved following studies of

$Cu_xMn_{1-x}Fe_2O_4$ ferrites sintered for three different sintering times viz. 20,30 and 40 hours for the same sintering temperature (950°C) we have selected $Cu_xMn_{1-x}Fe_2O_4$ ferrites, since these are useful in very high frequency devices demanded by modern technology. These are useful in preparation of high frequency cores, transformers, antennas, and microintegrated Circuits(6) The optimum properties needed for applications can be met through the control of composition, manpulation of thermal history and pressure applied during shaping offinal product. The resulting porosity inteffers with wall motion and decreases both losses and permeability. This arosed on conduction, magnetization and microstructure of the seris of samples sintered at same sintering temperature but at three different sintering times.

In chapter I a short history of ferrite materials is given. Here the points such as classification, substitution, crystal structure, normal and inverse structure,applications etc. are discussed along with the orientation of the problem.

The chapter II is devoted for explaining the preparation techniques of ferrites with a somewhat more emphasis on the ceramic technique. The ceramic technique is used to prepare sample in the present case. The presintering at 800°C for 10 hours is followed by final sintering at 950°C for 20,30 and 40 hours. In the same chapter the detail calculations

on the determination of lattice parameters and the results obtained in the present case are presented. Zerox copies of the XRD patterns are also presented.

The chapter III deals with the studies on variation of electrical conductivity with respect to temperature. The charge transport through the ferrite by hopping mechanism of electron and polaron is explained in more details with recent development in the subject. The plot of log ρ versus 1/T provides a method to calculate the activation energies in both ferri and para regions. The higher activation energy of para region over ferri region is explained by considering the effect of magnetic disordering on conduction process(7) changes and reduction in activation energies are conspicuously observed for samples sintered at temperature, 950°C for 20,30 and 40 hours. The conductivity is greater for the samples sintered for 40 hours, than the samples sintered for 30 and 20 hours i.e. the resistivity decreases for the samples higher sintering time. Similarly, reduction in porosity was specifically observed for the samples sintered for different timings.

Chapter IV presents the hysteresis study of $Cu_xMn_{1-x}Fe_2O_4$ ferrites. The saturation magnetization (M_s) values have been obtained with the help of high field loop tracer which

was used in the present case was supplied by M/S Arun Electronics, Bombay. The method of calibration and specimen calculation are presented. The observed Ms and μ_B values agree reasonably well with the reported values. Measurement of Curie temperature and I-V characteristics are also given here The details of experimental set up used is presented in this chapter. The I - V characteristics at different temperature are measured. It is observed that the switching current increases as switching temperature increases and also it is found that at given temperature as the copper content increases both the switching current and breakdown voltage increases However, the I-V characteristics of $Cu_{0.6}Mn_{0.4}Fe_2O_4$ shows a constant breakdown voltage at different temperatures. This may be attributed to eutectic phase transition.

In the chapter V microstructure and properties with sintering process and grain growth, exaggerated grain growth, porosity and hot pressing is explained in detail. The magnetic properties are also discussed in view point of microstructure. At the end of this chapter the scanning electron micrographs of the ferrites sintered at 950°C for 20,30 and 40 hours are presented. The close look at the micrographs reveals that the porosity is relatively high and the pores are large in case of ferrites sintered for 20 hours than the ferrites sintered for 40 hours at the same 950°C temperature.

From above work it is certainly true that the energy of activation of ferrites decreases when the porosity is less at the higher sintering time. In other words, the dense samples, sintered for greater time possess more conductivity and less activation energy in both ferri and pararegions. Similarly, the magnetization is definitely superior for the samples which posses low porosity and are sintered for maximum time. This effect is due to grain to grain contact area, cation distribution structure/of grain boundaries and the pores. All these factors essentially depends upon the sintering temperature or sintering time.

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