CHAPTER – V

SUMMARY AND CONCLUSIONS

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Ferrites have been the subject of extensive study because of their wide range of appplications especially in electrical, electronic, microwave and computer field. The fascinating applications of ferrites are the outcome of variations in magnetic and electrical properties of the ferrites under various preparation conditions. With the advent of developments in optical and electron microscopy and XRD neutron diffraction and Mossbauer spectroscopy it is also possible now a days to understand the structure property correlationship. The control of properties through the microstructure is thus at more advanced stage in ferrite technology, which deals with the tailormaking of ferrites to suit for any particular application.

The electrical and magnetic properties of ferrites are mainly governed by the microstructure which develops during heat treatment [1]. Especially, porosity and grain size are dominent factors in governing electric and magnetic properties. The research in ferrite technology is thus concentrated in obtaining the required microstructure with reduced porosity. Magnesium ferrites appeared to be intersting as it shows electrical switching [3], lattice distortion [4], structural changes with temperature [5], sensitive to conditions of preparation. Magnesium based ferrites are also interesting from the point of view of negative temperature coefficient thermistors. In order to understand the role of composition and temperature in affecting the crystal structure, cation distribution and other properties, we have selected the following studies on Mg-Co ferrites :

(1) Preparation of $Mg_{1-x}Co_xFe_2O_4$ ferrites with $x = 0.0, 0.4, 1.0$, by the ceramic method.

(2) X-ray diffraction studies on ferrite samples for finding crystal structure, lattice parameters etc.

(3) Electrical resistivity and Curie temperature measurement studies for finding out conduction mechanism involved in the ferrites and behaviour of resistivity.

(4) Saturation magnetization measurement to study cation distribution in ferrite samples.

In chapter I historical developments, classification, of ferrites substitution in ferrites, general crystal structure and applications etc are discussed. The orientation of the problem is included at the end.

The chapter II includes the details of mechanism of solid state reaction, standard technology of ferrite preparation, procedure of sample preparation etc. For this work, we have prepared the samples by ceramic method [5],starting from oxides. The presintering was carried out at 800°C for 20 hours and the final sintering at 900°C for 20 hrs and 30 hrs respectively. The powder was pressed in the pellet form; which were then sintered for carrying out the measurement. Some light on other methods of preparation is also thrown. The hot pressing technique for obtaining dense ferrite and process of sintering also discussed in the same chapter.

The method of characterization of samples using X-ray diffraction technique is explained in details. All the ferrite samples are cubic spinel ferrites. XRD patterns of each sample is presented.

The chapter III deals with the studies on variation of electrical resistivity with respect to sintering time. It starts with conduction mechanism in solids, oxides and then in ferrites. The charge transport due to hopping of polarons is discussed. From the plot of log ρ versus 1/T 10^3 the activation energies in both ferri and para regions are calculated. The temperature at which the slope of straight line changes indicates the curie transition temperature. The activation energy of para region is higher than ferri-region. Explanation of this is given by considering the effect of magnetic disordering on conduction process [6]. It is observed that for a sample sintered for

30 hrs at 900°C the activation energy decreases than the sample sintered for 20 hrs at 900°C. Also reduction in porosity was specifically observed for the samples sintered for longer interval of time. The factor contributing the resistivity of ferrites, mainly porosity is explained in detail.

Chapter IV presents the hysteresis study of $Mg_{1-x}Co_xFe_2O_4$ ferrites. The saturation magnetization Ms was determined using High field loop Tracer. If the theories of magnetization are given in the beginning. The details of experimental set up and magnetization data calculations of specimens are presented. For all samples sintered at different interval of time at the same temperature it is observed that magnetization increases markedly, when sintering time is increased. This leads to conclusion that both porosity and increase in time of sintering has pronounced effect on magnetization. This may also be due to the formation of closed pore chains.

The energy of activation in ferrites decreases when porosity is less. Hense samples sintered for long interval of time are more conducting. It has the less activation energy both in para and ferri regions. Similarly for samples having low porosity magnetization is greater. This is observed for samples sintered for large time intervals. This effect is due to the cation distribution, contact area between grains, pores, structure of grain boundaries etc. All these factors relie on sintering time as well as temperature.

For having further detailed understanding of microstructural dependence the samples have to be studies by using a broad range of sintering time.

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