CHAPTER - IV

Summary and Conclusions

SUMMARY AND CONCLUSIONS

The substitution of diamagnetic ions in spinel ferrites is known to produce changes in their electrical, magnetic and microstructural properties. The observed changes in electrical and magnetic properties are used to obtain ferrites with known modified properties. The present work is based on magnetic studies of Cu - Zn ferrites substituted with Li^{1+} ions. Due to square loop hysteresis and temperature stability, we decided to carry out magnetic studies on Li substituted Cu - Zn ferrite system.

Earlier workers have synthesized Cu - Zn ferrites and various substituted Cu - Zn ferrites by standard ceramic method. This method has few disadvantages eg. large particle size, inhomogeneity, low surface area, and poor sinterability. Chemical routes enable synthesis of ferrites in state of high homogeneity and purity than the ceramic method. There are several chemical routes available like coprecipitation, solprecipitation, spray pyrolysis, decomposition of organometallic precursors, and sol-gel. We have employed coprecipitation technique using oxalate precursors for synthesis of these ferrites. This technique gives good homogeneity, greater reactivity, fine particle size, high purity.

The ferrite system $Zn_{0.5}Cu_{0.5-t}Li_{2t}Fe_2O_4$ where t = 0.00, 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.15, 0.20 and 0.3 were synthesized by coprecipitation technique using oxalate precursors. The solid solutions of oxalate complexes, thus obtained were decomposed. The decomposed products were then pressed to pellets and toroids in desired dimensions. The pressure of 10 $ton/inch^2$ for 5 minutes were applied to form the pellets and toroids.

The thesis comprises of four chapters.

The first chapter gives historical development of ferrites and brief theory on various parameters which characterize the ferrites. The data of various properties of zinc, copper and lithium ferrite is given. A brief survey of research work carried out on Cu - Zn and substituted Cu - Zn ferrites is also given. The orientation of work has been given at the end of the first chapter.

The second chapter consists/constitutes of four sections. The part A section deals synthesis of ferrites. A brief analysis of ceramic method and wet chemical method is presented in the section. The solid solution of oxalate complexes were obtained by coprecipitation of Cu^{2+}, Zn^{2+}, Li^{1+}, Fe^{3+} acetate solutions with oxalic acid.

The part B section deals with the XRD studies of the ferrites prepared. XRD studies were carried out using Philips X-ray diffractometer. The lattice parameter values decrease with increase in lithium concentration. This is attributed to smaller ionic size of lithium.

The part C section deals with the determination of densities of ferrite compositions under investigation. The densities were determined using xylene medium and compared with X-ray density.

The part D sections deals on the Scanning Electron Microscope (SEM) studies. The SEM studies revealed that with the increase in lithium concentration the average grain size increases.

The third chapter is divided into three sections

Section A deals with A.C. susceptibility studies using double coil set-up. The $X_{a.c.} - T$ curves for all the compositions of $Zn_{0.5}Cu_{0.5-t}Li_{2t}Fe_2O_4$ show temperature independent up to the Curie temperature. This suggests that all the compositions contain predominantly M.D. grains in them. But there is peaking behaviour at high temperature in most of the compositions, indicating presence of some S.D. grains. The Curie temperature is found to increase on addition of lithium concentration.

Section B deals with hysteresis studies. Variation of n_B as a function of Li^{1+} is governed by Y - K type of three sublattice model. Y - K angles have been calculated for various compositions.

Magnetocrystalline anisotropy field (H_K^A), magnetocrystalline anisotropy constant (K_1) and remanence ratio have been calculated. With addition of Li^{1+} (H_K^A), (K_1) and (R) are found to increase.

Section C deals with the initial permeability studies. Measurements of μ_i as a function of temperature and frequency were carried out on HP LCR-Q meter.

It is observed that permeability Obeys Globus model. The main contribution to μ_i arises due to the wall permeability (μ_{ω}), which is greater than rotational permeability (μ_{rK}). There is a decrease in μ_i with the substitution of Li^{1+}, which is explained by Globus model.

The μ_i - T curves, with its real part μ' and imaginory part (μ'') for various compositions show that it increases slightly with temperature up to Curie temperature. Near Curie temperature there is a sharp drop to zero. These curves resemble with $X_{a.c.}$ - T curves, indicating presence of M.D. grains but role of S.D. grains being significant at high temperature is also seem from μ, μ' - T curves. The frequency variation of μ' and μ'' clearly indicated low frequency dispersion. This is attributed to the domain wall movements, which supports the observations.

The dispersions of Loss factor (L.F.) studies indicate losses are minimum in the high frequency region as expected. The thermal variation of Loss factor indicates that L.F. decreases with increase in temperature up to 125 °C. To improve the Loss factor these ferrite must be operated at low temperatures.