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SUMMARY AND CONCLUSIONS

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CHAPTER - V

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Since last two-three decades, the soft ferrites have aroused considerable interest because of their electrical, magnetic, electronic, microwave and computer applications. Extensive work has been done on these materials with a view to determining their electrical and magnetic properties to decide the suitability for certain applications. The high resistivity in particular and therefore, low eddy current losses at high frequencies, is considered to be a very important behaviour of soft ferrites leading to a large number of applications. It is observed that, when a non-magnetic ion like zinc is partially substituted for a divalent ion in the ferrite formula $M^{2+}Fe_2^{3+}O_4^{2-}$, the magnetization properties are found to improve. Cadmium is also a non-magnetic divalent atom which can be substituted in place of zinc. As we know $CdFe_2O_4$ has higher resistivity while $ZnFe_2O_4$ is a well known semiconductor and therefore, looking from the point of view of developing ferrite materials, the prime importance should be given to the resistivity of the final product. Large amount of work is done on zinc substituted mixed ferrites, however, very little work is found in literature on cadmium substituted mixed ferrites. Therefore, we found it worthwhile to undertake investigations on cadmium substituted magnesium ferrite system namely $Cd_xMg_{1-x}Fe_2O_4$.

The mixed ferrite system $Cd_xMg_{1-x}Fe_2O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0) has been prepared by standard ceramic technique. The investigations are carried out on this system as follows :

i) Crystal structure characterization by X-ray diffraction studies.

ii) D.C. electrical resistivity ( ); estimation of Curie temperature T_c and study of electrical switching.

iii) Hysteresis and saturation magnetization (M_s) studies with composition at room temperature.

The dissertation comprises of five chapters. The first chapter is of introductory nature in which along with the historical background of ferrites, the crystal structure, the spinel structure has been discussed in detail. The theories pertaining to these ferrimagnetic materials namely Neel's two sublattice theory[1] and Yafet-Kittel theory[2] are discussed. The important electrical and magnetic properties are also discussed together with various important applications. At the end of this chapter the orientation of the present work is given.

The title of the second chapter is, "Preparation of ferrites and crystal structure characterisation". In the beginning of this chapter, different methods of ferrite preparation have been discussed in brief and the details of the ceramic technique and the actual method used for ferrite preparation in the present investigations are given. The mechanism of solid state reaction and sintering process are also discussed. The flow chart pertaining to the preparation of ferrites is presented. In the same chapter, the work done on the computerized X-ray diffractometer for the

crystal structure characterization of the system is presented. The analysis of the X-ray diffractograms is given. The results are presented along with the diffractograms and discussed. The absence of any irregular peaks in the X-ray diffractograms has confirmed the preparation of single phase, homogenous compounds.

Chapter three is devoted to d.c. electrical resistivity and electrical switching study. In the beginning of this chapter, the conduction mechanism and hopping process is discussed in brief, giving the problems to be encountered in such measurements. The graphs of $Log_{10}(\rho)$ versus (1/T) are presented and the transition temperatures obtained from these curves are compared with the actually measured Curie temperature (T_c), on an experimental set up developed in the laboratory. They are found to be in good agreement. The theoretical aspects of electrical switching phenomena are discussed in brief. The results on electrical switching at room-temperature in the slow cooled $CdFe_2O_4$ ferrite are presented with the help of I-V characteristic graph. The other five ferrite samples under investigation do not show electrical switching.

Chapter four is devoted to hysteresis and saturation magnetization (M_s) studies in the present system. In the beginning of the chapter, certain magnetic properties have been discussed in short together with losses in magnetic materials. The experimental set up is also discussed. The compositional dependence of magnetic moment (n_B) has been studied and

it is found that in all the compositions, the n_B values initially increase with increasing Cd content, reach a maximum and then decrease beyond a composition of about 50% cadmium. This result is interpreted as to exhibit a simultaneous prevalence of Neel's two sublattice model and Y-K model in the range of compositions 20% to 50% of cadmium while beyond this composition, where n_B values decrease with increasing Cd content, the Y-K model predominates[3,4].

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