S Y N O P S I S

During the last few years magnetic oxides and especially the ferrites have aroused the interest of many research workers because of their interesting electrical and magnetic properties and their potential applications in the electronic industries. Magnetically soft ferrites find wide applications in high frequency devices like pulse transformers, inductors, deflection coils, antenas, modulators and numerous other applications depending on the requirements of high permeability and low loss at high frequencies square loop ferrites find extensive use in computors, memory devices and thin slops. Ferrites with lower permeability and larger mognetostriction are useful in accelerometers, mechanical filters and ultrasonic generators. Microwave applications of ferrites depend upon the nature of gyromagnetic resonance of ferrites which are exemplified in faraday rotation, phase shifters, cirailators and modulators.

A new class of ferrites viz. the hexagonal ferrites are characterised by high uniaxial anisotropy and are mostly used as permanent magnet materials. Barium ferrite,strontium ferrite and other ferrites having similar structure have been extensively used for this purpose. The ceramic magnets are relatively cheap,have high coercive force, high thermal and electrical resistivity and are chemicallyinert. At the same time, their maximum energy product (BH) max, is still sufficiently high to be useful.

It has been well established that the properties of ferrites mainly depend upon their chemical composition, the nature of heat treatment given to them and the microstructure under arrest. The precise control over properties,therefore, needs attention to be given towards these physico chemical factors.

The earlier work on hexagonal ferrites was mainly concentrated towards the development of new good quality permanent magnet materials and the related technology development comparatively less attention was given towards their understanding in the beginning. The major portion of research work on hexagonal ferrites is carried out either on the single crystals or the magnetically oriented polycrystalline specimens. Polycrystalline hexagonal ferrites with randomly distributed grains have been sporrsly studied. In the present effort these ferrites have been studied with the following broad orientation.

1) Preparation of different hexagonal ferrites by the ceramic methods.
2) Detection of the structure by X-ray diffraction.
3) Measurement of D.C. electrical resistivity as a function of temperature

4) Determination of curie points from the resistivity studied and

5) Proposing a suitably conduction mechanism for these ferrites.

The chapter I of the thesis gives a brief review of ferrites in general. The crystal structures of ferrites and their electrical and magnetic properties are discussed here along with some historical developments

The chapter II is devoted for the discussion of hexagonal ferrites. The elementary discussion on the requirements of permanent magnet materials is presented with the help of a hysteresis curve for a virgin ferromagnetic material. The relation between these requirements and the microstructure is also included. The hexagonal ferrites, their discovery, crystal structure, and properties are explained with suitable illustrations. The types of hexagonal ferrites viz. M,Z,W,Y etc. are explained with the help of a ternary phase diagram between BaO - MeO - Fe_2O_3. At the end of this chapter a brief review of the recent research work on hexagonal ferrites is included for the sake of completoness. The studies on their crystal structure, demain observation, mechanical properties and their characterization using Mossbauer and FMR techniques are reviewed.

The III chapter is divided into two parts. Part A deals with the methods of preparing ferrites and Part B with the details of the experimental techniques used in the present work. In part A the general methods of preparation of ferrites is reviewed and the role of heat treatment and inert atmosphare during preparation is discussed. The other factors like grain size which play a decisive role in the preparation of ferrites, the possibility of obtaining high density ferrites by hot pressing technique and the vacancy creep mechanism leading to the formation of ferrites in ceramic method are also discussed to the limited extent. The details of the procedure actually employed in the preparation of ferrites is also included in this part.

In the present work some hexagonal ferrites having the general formulae $Ba\ Fe_{12}O_{19}$, $Sr\ Fe_{12}O_{15}$, $M_2Ba\ Fe_{16}O_{27}$, $M_2\ Ba_2\ Fe_{16}O_{27}$, $M_2Ba_3\ Fe_{24}O_{41}$, where M is a divalent metal ion, have been prepared by the usual ceramic method. The appropriate mixtures of constituent oxides were ball milled and presintered in clean platinum crucibles at $800^{\circ}C$ for eight to ten hours. The mixture was crushed in an agate morter and reheated at $1200^{\circ}C$ for twelve hours. The pellets, pressed by applying pressure of the order of 10 to 12 tonnes were again sintered at $1200^{o}C$ for 24 hours in order to get a good compact. The X-ray diffraction patterns agree well with the crystal structures of hexagonal ferrites.

The resistivity measurement were carried out by two probe method using a suitable resistivity cell in the temperature range $25^{o}C$ to $650^{o}C$.

The IV chapter of the thesis explains the results on the d.c. resistivity measurements. The relevant theory on the transport properties of magnetic oxides in general and ferrites in particular by the 'hopping' mechanism of electrons is discussed in the beginning. The last section of this chapter deals with the results and discussion of the resistivity measurement.

The salient features include –

The resistivity of the ferrites falls with the rise of temperature indicating their semiconducting behaviour log ρ Vs 1/T plots are linear. The slope of the log ρ Vs 1/T changes its value at the curie temperature. The observed curie temperatures agree well with the previously reported values. The activation energies calculated by again the exponential dependence of resistivity on temperature are tabulated and discussed in relation to magnetic ordering and phase transion. The conduction is recognised to be due to the hopping of electrons.