Chapter VII
Summary and conclusions

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SUMMARY AND CONCLUSIONS

7.1 SUMMARY

It is quite well known that composite binary, ternary or higher oxides crystallising in pervoskite, spinel, garnets, magnetoplumbites and other hexagonal ferrites have found greater and greater interest due to their industrial applications. A survey of literature shows that comparatively less work seems to have been done on particularly compounds involving nickel in a hexagonal structure.

From this preliminary survey of hexagonal ferrites, the compounds with a general chemical formula $NiAl_xFe_{12-x}O_{19}$ were prepared. These compounds have been synthesized for the first time and studied from structural, magnetic and electrical point of view.

These compounds were prepared by solid state reaction at 1200° C for 24 hr. continuously. The formation was taken to be complete when the diffraction pattern did not show any sign of existence of other phases. Our structural results show that the compounds in this series are crystalline with a hexagonal structure, where as the sample S_6 is a crystalline spinel structure. The unit cell dimensions determined by an xrd analysis are found with lattice constant 'a' between 5.88 to 6.01

A° and 'c' between 23.146 to 23.43 A°. The Infrared spectroscopic study supported the formation of a ferrite phase and the ionic distribution order.

The d.c. electrical character has been studied by two probe method in temperature range 200° C to 900° C which shows that these compounds are semiconductors, and conduction has been explained on the basis of hopping of charge carriers. The activation energy for the compounds is calculated from plots of log ρ vs 1/T. The activation energy ranges from 0.575 ev to 1.171 ev (ferri) and 0.02 ev to 0.545 ev (para). In first eight compounds a dip is observed at certain temperatures which is associated with Curie temperature.

To study magnetic property, hysteresis loop of each compound were traced using hysteresis loop tracer. Oscilloscope of tracer was calibrated using standard nickel sample. The saturation magnetisation(Ms) and nB calculated from hysteresis loop parameters and other physical quantities of the ferrite.

7.2 CONCLUSIONS

From the study of these compounds, following conclusions have been inferred ,

1. From valence states and site distribution, electrical and magnetic behaviour are predictable.

2. From the study of these compounds it can be concluded that preference is Al^{3+} in 2a, 12 K sites which are spinel blocks in M - structure.
3. As we substituted Fe^{3+} by Al^{3+}, Al^{3+} occupy first 2a sites and then 12 K sites.

In all the iron containing compounds Fe^{3+} ions occupy the trigonal bipyramidal (2b) site.

7.3 Suggestion for further work

Mixed calcium oxides with chemical formula $CaFe_{12-x}Al_xO_{19}$, $CaFe_{12-x}Cr_xO_{19}$, $CuFe_{12-x}Al_xO_{19}$, $CuFe_{12-x}Cr_xO_{19}$, will have interest by varying the Al^{3+}, Cr^{3+} percentage. The influences of these cations exists considerably on magnetic and electric behaviour of the ferrites. Some studies like thermo-electric behaviour, differential thermal analysis, are expected to provide greater insight into the subject matter, which in effect can prove to be useful in applications at the present stage of industrial development and a utility of ferrites.