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**Chapter IV**  
**I. R. characterization of ferrites**

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## CHAPTER IV

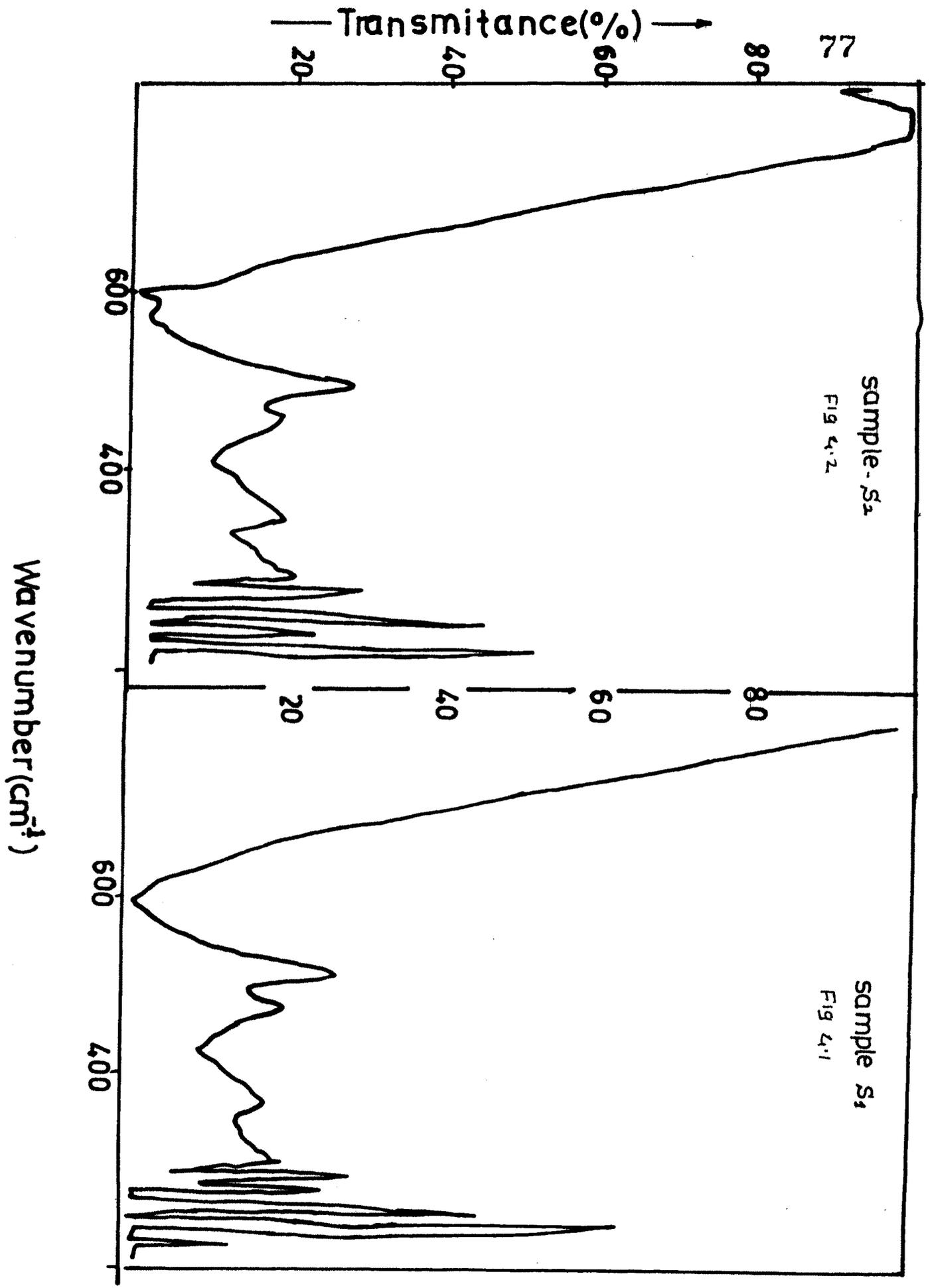
## INFRARED CHARACTERISATION OF FERRITES

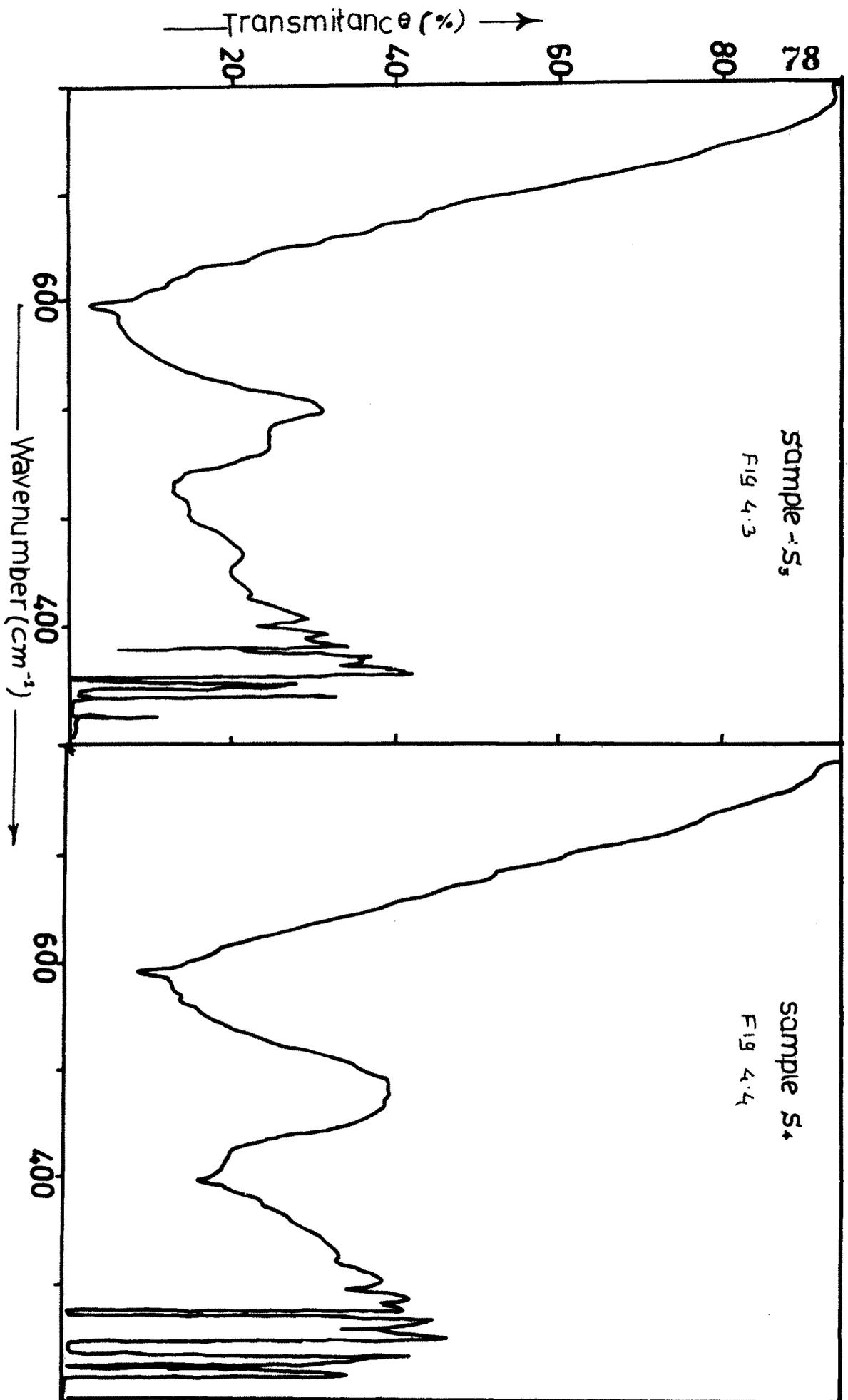
## 4.1 INTRODUCTION

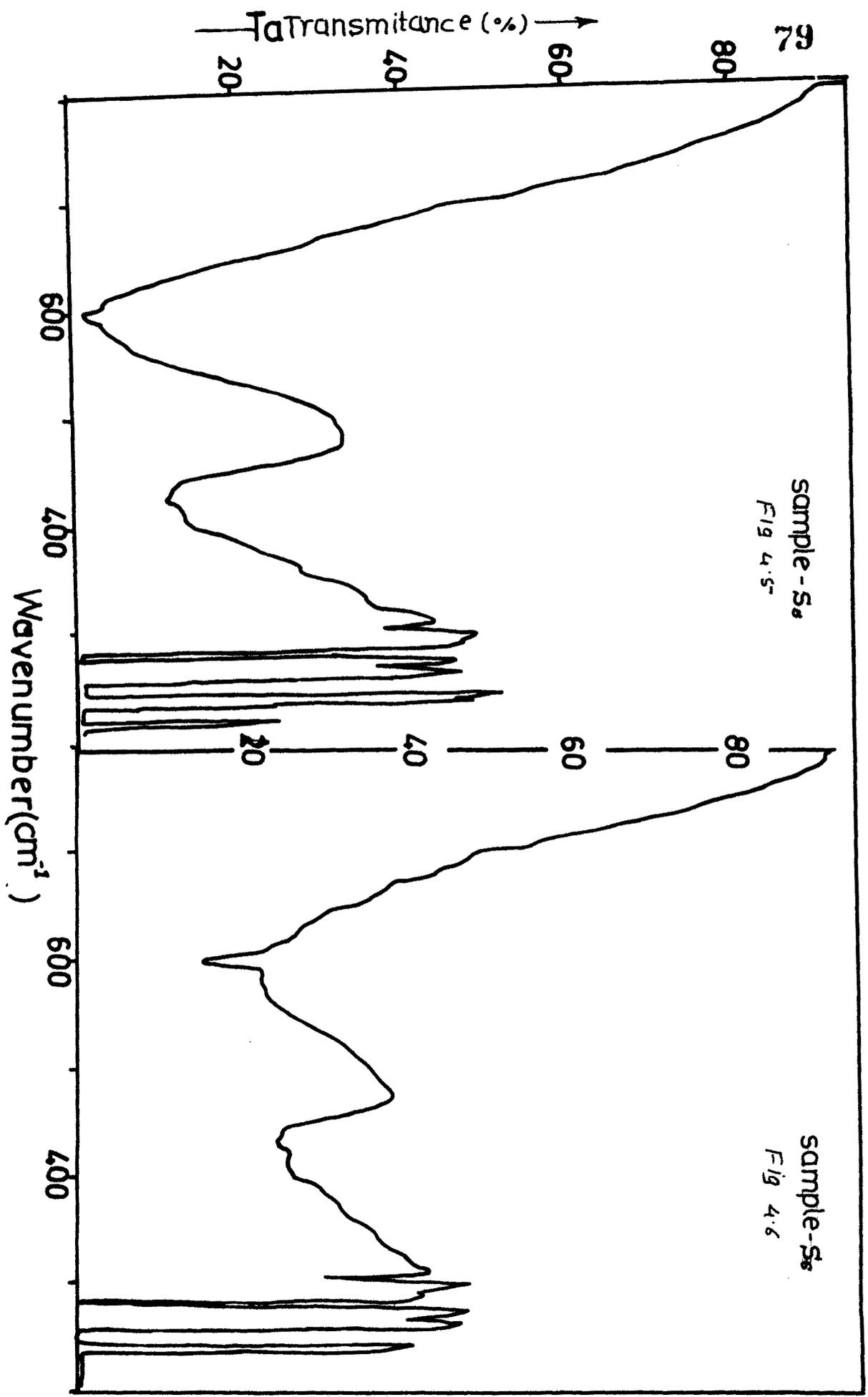
Studies of the spectral relation between structure and electromagnetic response of ferromagnetic material are useful in understanding their properties. Since the electric and magnetic properties of these materials depend on the precise configuration of atoms or ions in their structures. Methods of non-destructive analysis such as IR are especially suitable to determine such a configuration of a silver ferrite material. In particular the vibrational, electronic and magnetic dipole spectra can give information of about the position and valency of the ions in the crystal lattice. The IR spectroscopy can be used to

1. Study of cation ordering
2. Study of deformation
3. Determine co-ordination of cations in the structure

The spectra which shows two absorption bands below  $1000\text{ cm}^{-1}$  is a common feature of all ferrites. Absorption in this region is not restricted to this class of compound but occurs in most metallic oxides (1,2). The bands arise from lattice vibrations of the oxides ion against the cations. At higher frequencies, gradually increasing absorption caused by electronic transition is

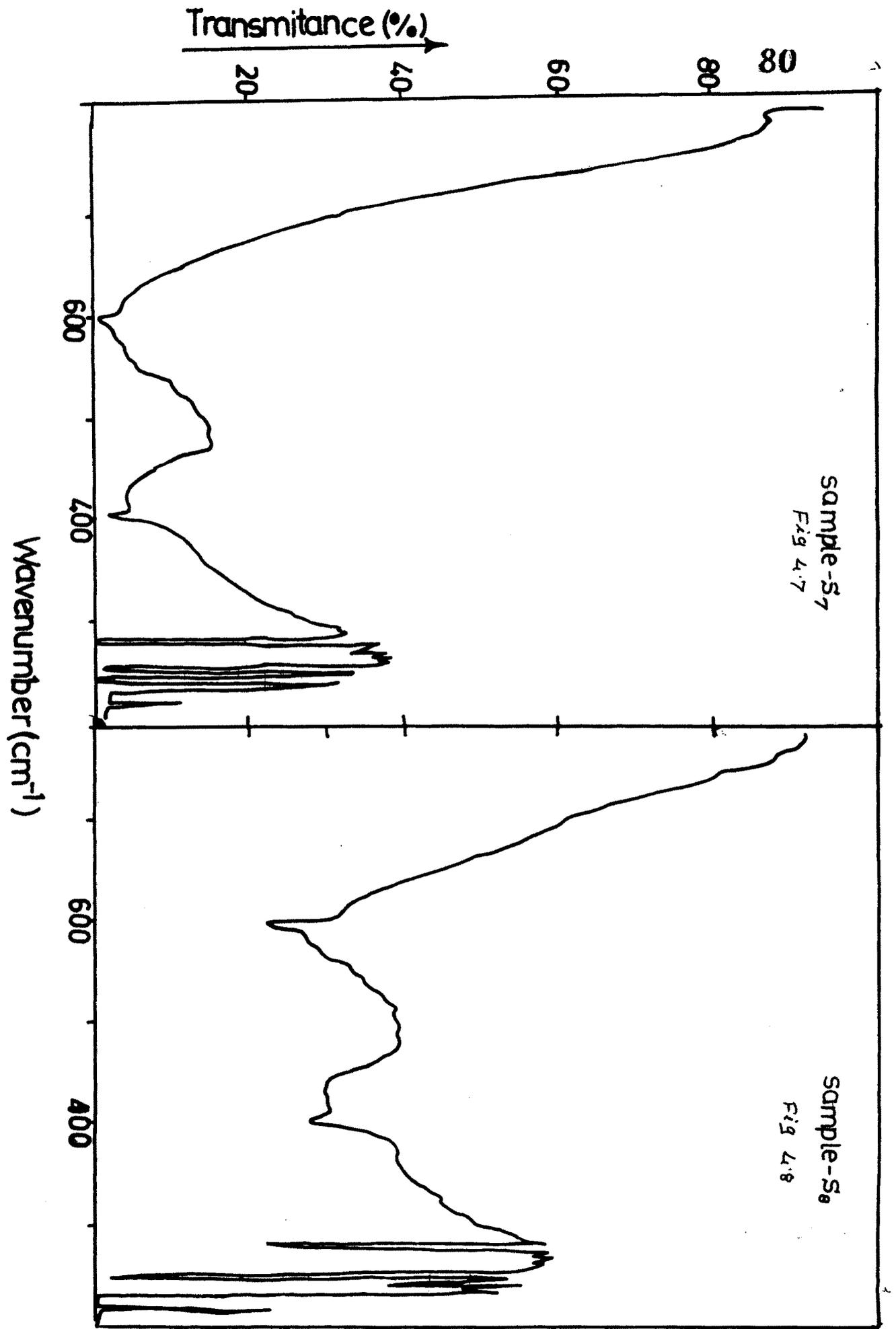






sample-Sa  
Fig 4.5

sample-Ss  
Fig 4.6



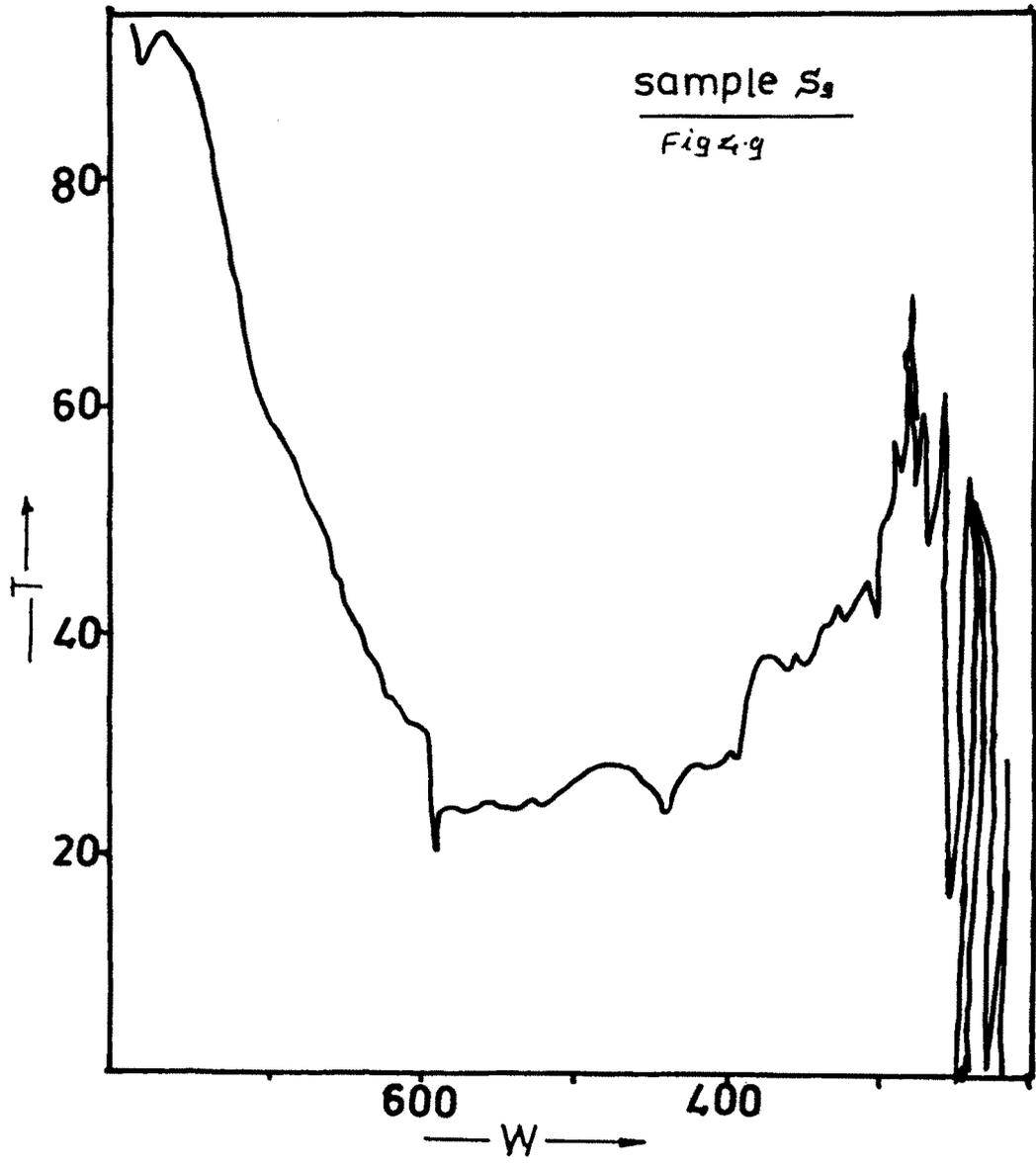


Table 4.1- IR Vibrational bands in  $\text{NiAl}_x\text{Fe}_{12-x}\text{O}_4$ 

Content	Band frequencies in /cm	
	1	2
2	600	400
3	595	400
4	595	432
5	598	402
6	600	420
7	595	402
8	600	405
9	598	400
10	592	445

observed. Waldron (3) studied IR spectra of some simple ferrites and gave analysis in detail.

## 4.2 EXPERIMENTAL

### 1. I.R. Spectra

The infrared spectra were recorded on Perkin - Elmer 783 IR Spectrometer. The pellets used for recording spectra were prepared with mixing of KBr in a small amount of ferrite powder. The range of frequencies selected is  $300\text{cm}^{-1}$  to  $800\text{ cm}^{-1}$ .

### 4.3 Results and discussions

IR spectra is shown in Fig. 4.1 to 4.9. The spectra has been used to locate band positions which are given in Table 4.1. IR spectral band observed are broad in nature.

Generally, there are four absorption bands observed in ferrites,  $\nu_1$  corresponding to stretching of tetrahedral metal and oxygen bond and  $\nu_2$  is caused by oxygen vibrations in the direction perpendicular to tetrahedral ion oxygen axis. The  $\nu_3$  and  $\nu_4$  are associated with vibrations of metal ions in the isotropic force field of their octahedral and tetrahedral environment. They are located in the far infra red region. Waldron (3) observed two broad bands for most of ferrites. He attributed  $\nu_1$  ( $600\text{ cm}^{-1}$ ) band to tetrahedral complexes and  $\nu_2$  ( $400\text{ cm}^{-1}$ ) to octahedral complexes. Most of the

workers (4,5,6,7) have observed the same band positions for ferrites. Our IR spectra shows two broad bands in the same region.

The splitting of tetrahedral band and observation of fine structure around the tetrahedral band and also in the far infra red region is clearly seen. This behaviour can be attributed to multivalence state of cations and their oxygen environment.

The present spectra shows the fine structure and the intensity of fine structure increases with increasing aluminium. Therefore observed spectra may be due to ion ordering.

## REFERENCES

1. Harrier L.  
J. of Opt. Soc. Amer. 45, 27 (1955)
2. Matossi F.  
J. Chem. Phys. 19, 1543 (1951)
3. Waldron R.D.  
Phys. Rev. 99, 16, 1727 (1955)
4. Patil S.A. et al.  
Solid State Commun. 78 (1), 639 (1991)
5. Bhise B.V. et al  
J. Mater. Sci. Letts. 10, 922 (1991)
6. Brabers V.A.M.  
Phys. Stat. Solidi A12, 629 (1972)
7. *ibid* 33, 563 (1969)